# DRAINAGE CALCULATIONS AND STORMWATER MANAGEMENT PLAN

*For:*

**COMPREHENSIVE PERMIT PLAN**
**RIVER MARSH VILLAGE**
**PEMBROKE, MA**

*Located:*

**0 WATER STREET**
**(ASSESSOR'S MAP E-17, LOT 0 & E-17A, LOT 274)**
**PEMBROKE, MASSACHUSETTS**

*Submitted to:*
**TOWN OF PEMBROKE**

*Prepared For:*
**RIVER MARSH, LLC**
**293R WASHINGTON STREET**
**NORWELL, MA 02061**

MCKENZIE ENGINEERING GROUP

**Professional Civil Engineering • Project Management • Land Planning**
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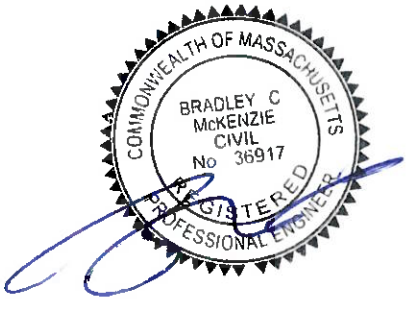
**November 27, 2018**
**Revised April 5, 2021**



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**Pembroke, Massachusetts**

## Project Summary

The project proponent River Marsh, LLC, proposes to develop an approximate 49.94-acre parcel of land located at 0 Water Street (Assessor's Map E-17, Lot 0 and E-17A, Lot 274) in Pembroke, Massachusetts. The development is being permitted under MGL Ch. 40B Comprehensive Permit and will consist of 56 condominium units comprised of 3, and 4-unit buildings. The proposed development will involve the construction of approximately 2,422 linear feet of bituminous roadways, residential buildings, driveways, stormwater management system, utilities and other related infrastructure.

The development will be comprised of two parcels which are shown on the Assessor's Map E-17, Lot 0 and E-17A, Lot 274. The site is located between the North River to the west and Water Street, at the intersection of Church Street (Route 139) to the east in Pembroke, Massachusetts. The entire site is located within the Residence "A" Zoning District and Business "B" Zoning District. Approximately 10,700 +/- square feet are in the Business "B" Zoning District. Access to the site will be provided by two (2) access points from Water Street. A double barrel entrance with 13-foot-wide travel lanes and an 8-foot-wide median and a 22-foot-wide roadway. Refer to Figure 1- USGS Locus Map for the location of the parcel.

The project will access utility infrastructure located on Water Street including electric, water, telephone and cable television. The lots will be served by a shared subsurface sewage disposal system with a pump chamber and connections to the municipal water system which will extend from Water Street throughout the proposed development. All stormwater management facilities will be designed provide renovation of stormwater and meet the requirements of the Department of Environment Protection's Stormwater Management Regulations. The existing and proposed site conditions are illustrated on the project *site plans* entitled "River March Village, Comprehensive Permit Plan, Water Street, Pembroke, Massachusetts", prepared by McKenzie Engineering Group, Inc. dated November 27, 2018, with a latest revision date of March 24, 2021.

This report contains stormwater runoff calculations for the pre-development and post-development conditions and includes the sizing of the drainage system and stormwater best management practices (BMPs).

## Pre-Development Condition

The site is located primarily within the Residence "A" Zoning District and is comprised of 22.53 acres of upland and 27.41 acres of wetland. The Massachusetts Department of Environmental Protection (DEP) has confirmed the wetland resource area by issuance of a Superseding Order of Resource Area Delineation (ORAD). The wetland complex that extends from the North River is tidal in nature. The project is exempt from Standard 2 of the Massachusetts DEP Stormwater Management Regulations for land subject to coastal storm flowage as defined in 310 CMR 10.04.

One single family home currently exists on parcel Map E-17A Lot 274, which is to be retained. The project site is partially wooded and partially cleared with grass cover and wetlands toward the west side of the site approaching the North River. No improvements have been made to the land. The topography of the site is varied with elevations ranging from 30 feet (NAVD88) along the eastern boundary of the parcel to 5 feet (NAVD88) at the natural riverbank of the North River. Slopes vary from gentle to somewhat steeper grades sloping toward the wetlands on the west side of the site.

Review of available environmental databases such as MassGIS reveals that the site is not located within a mapped Natural Heritage Area, a Zone II or Zone III Groundwater Recharge Area, an Interim Wellhead Protection Area (IWPA), or a Contributing Watershed to Outstanding Resource Water (ORW). Review of the Town of Pembroke's Zoning Map reveals that the site is not located within any other protection area.

The site is within Zone AE (Elevation 8-NAVD88) and Zone X of the Flood Insurance Rate Map, as shown on the current FEMA Flood Insurance Rate Map Panel Nos. 25023C0206J and 25023C0207J with an effective date of July 17, 2012. Refer to Figure 2 – FEMA Flood Map.

The Natural Resources Conservation Service (NRCS) has identified the soil on the site as Scarboro, Ipswich, Squamscott, Eldridge, Hinckley, Merrimac, Windsor and Deerfield soils. The soils range in hydrological soil group classifications from 'A' to 'D'. Soil testing conducted by McKenzie Engineering Group, Inc. (MEG) on March 16, 2021 identified the soils to be sandy loam. Refer to Figure 3 – Soil Map.

The existing watershed analyzed in this report is comprised of approximately 23.0 acres consisting of the subject parcel to be developed and offsite tributary areas. The watershed consists of three (3) sub-catchments. Refer to the Pre-Development Watershed Plan WS-1 in Appendix A for a delineation of drainage subcatchments for the pre-development design condition.

The SCS Technical Release 20 (TR-20) and Technical Release 55 (TR-55) method-based program "HydroCAD" was employed to develop pre- and post-development peak flows. Drainage calculations were prepared for the pre-development condition for the 2, 10, 25 and 100-year, Type III storm events. Refer to Appendix A for computer results, soil characteristics, cover descriptions and times of concentrations for all subareas.

## Post-Development Condition

The proposed development will consist of 56 condominium units comprised of 3, and 4-unit buildings with bituminous concrete access roadways, parking areas and associated infrastructure. Visitor parking will be dispersed throughout the site. Access to the site will be provided by a private 22 ft. wide roadway with two access points from Water Street.

Watershed areas were analyzed in the post-development condition to design stormwater management facilities to mitigate impacts resulting from developing the property. The objective in designing the proposed drainage facilities for the project was to maintain existing drainage patterns to the extent practicable and to ensure that the post-development rates of runoff are less than pre-development rates at the design points.

Refer to the Post-Development Watershed Plan WS-2 in Appendix B for a delineation of post-development drainage subareas. The design points for the post-development design conditions correspond to those analyzed for the pre-development design condition.

Drainage calculations were prepared by employing the SCS TR-20 Methods for the 2, 10, 25 and 100-year, type III storm events. Refer to Appendix B for computer results. The subsurface infiltration chambers were designed to accommodate peak flows generated by all storms up to and including the 100-year storm event. Refer to site plans for the drainage system design.

The project is exempt from Standard 2 of the Massachusetts DEP Stormwater Management Regulations for land subject to coastal storm flowage as defined in 310 CMR 10.04.

**Stormwater Best Management Practices (BMP's)**

The treatment stream shall consist of deep sump hooded catch basins, a sediment forebay and an infiltration basin to achieve the required removal of a least 80% of the total suspended solids (TSS) and mitigate the anticipated pollutant loading.

Refer to the TSS Removal Worksheets in Appendix D for TSS removal rates.

**Erosion and Sedimentation Controls**

Compost filter tube (Silt sock) erosion control barriers will be placed at the limit of work prior to the commencement of any construction activity. The integrity of the silt sock will be maintained by periodic inspection and replacement as necessary. The silt sock will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Refer to the Erosion Control details on the Site Development Plans and BMP Operation and Maintenance Plan for proposed erosion control measures to be employed for the project.

**Compliance with Stormwater Management Standards**

Standard 1 – No New Untreated Discharges

The proposed redevelopment will not introduce any new untreated discharges to a wetland area or waters of the Commonwealth of Massachusetts. All discharges from the site will be treated through proposed stormwater quality controls such as deep sump hooded catch basin, a sediment forebay and an infiltration basin including the establishment of proper maintenance procedures.

Standard 2 – Peak Rate Attenuation

In the pre-development and post-development stormwater analysis, the watershed area analyzed was approximately 23 acres consisting of the subject parcel to be developed and offsite tributary areas. Refer to Existing Watershed Delineation Plan WS-1 for a delineation of drainage subareas for the pre-development design condition and refer to Post-Development Watershed Delineation Plan WS-2 for a delineation of drainage subareas for the post-development design condition.

Drainage calculations were performed by employing SCS TR-20 methods for the 1, 2,

10, 25, and 100-year Type III storm events. Refer to Appendix A and B for computer results. All drainage structures will be designed employing the Rational Method and the Mass. DPW Design Manual to accommodate peak flows generated by a minimum of a 25-year storm event or a 100-year storm event where applicable. The stormwater management systems were designed to accommodate peak flows generated by a 100-year storm event.

The peak rates of runoff and elevations for this condition are as follows:

| **Table 1 – Pre-Development Results** | | | | |
|---|---|---|---|---|
| | Design Storm (flow in cfs) | | | |
| | 2-Year Storm | 10-Year Storm | 25-Year Storm | 100-Year Storm |
| Design Point | Flow (CFS) | Flow (CFS) | Flow (CFS) | Flow (CFS) |
| DP-1 | 1.89 | 12.26 | 22.15 | 38.33 |
| DP-2 | 0.00 | 0.03 | 0.15 | 0.66 |
| DP-3 | 0.19 | 0.40 | 0.55 | 0.81 |

| | Design Storm (volume in ac-ft) | | | |
|---|---|---|---|---|
| | 2-Year Storm | 10-Year Storm | 25-Year Storm | 100-Year Storm |
| Design Point | Volume (AC-FT) | Volume (AC-FT) | Volume (AC-FT) | Volume (AC-FT) |
| DP-1 | 0.762 | 1.984 | 3.032 | 4.932 |
| DP-2 | 0.000 | 0.020 | 0.051 | 0.121 |
| DP-3 | 0.015 | 0.029 | 0.040 | 0.059 |

The peak rates of runoff and elevations for this condition are as follows:

| **Table 2 – Post-Development Results** | | | | |
|---|---|---|---|---|
| | Design Storm (flow in cfs) | | | |
| | 2-Year Storm | 10-Year Storm | 25-Year Storm | 100-Year Storm |
| Design Point | Flow (CFS) | Flow (CFS) | Flow (CFS) | Flow (CFS) |
| DP-1 | 1.33 | 7.81 | 16.04 | 28.68 |
| DP-2 | 0.00 | 0.00 | 0.00 | 0.00 |
| DP-3 | 0.00 | 0.00 | 0.00 | 0.00 |

| | Design Storm (volume in ac-ft) | | | |
|---|---|---|---|---|
| | 2-Year Storm | 10-Year Storm | 25-Year Storm | 100-Year Storm |
| Design Point | Volume (AC-FT) | Volume (AC-FT) | Volume (AC-FT) | Volume (AC-FT) |
| DP-1 | 0.608 | 2.392 | 3.742 | 6.089 |
| DP-2 | 0.000 | 0.000 | 0.000 | 0.000 |
| DP-3 | 0.000 | 0.000 | 0.000 | 0.000 |

Although the project is exempt from Standard 2 of the Massachusetts DEP Stormwater Management Regulations for land subject to coastal storm flowage as defined in 310 CMR 10.04, a comparison of the pre-development and post-development peak rates of runoff indicate that the peak rates of runoff for the post-development condition at all Design Points will be less than the pre-development condition for all storm events.

***Pre-Development vs. Post-Development Peak Surface Elevations***

| Design Point | 2 Year Storm | | 10 Year Storm | | 25 Year Storm | | 100 Year Storm | |
|---|---|---|---|---|---|---|---|---|
| | **Exist. (Ft)** | **Prop. (Ft)** | **Exist. (Ft)** | **Prop. (Ft)** | **Exist. (Ft)** | **Prop. (Ft)** | **Exist. (Ft)** | **Prop. (Ft)** |
| E-P1 | *18.04* | 18.04 | *18.06* | 18.06 | *18.07* | 18.07 | *18.09* | 18.09 |
| E-P2 | *13.03* | 13.02 | *13.21* | 13.29 | *13.30* | 13.46 | *13.38* | 13.69 |

Standard 3 – Groundwater Recharge

Runoff will be infiltrated by the infiltration basin, which will meet the Stormwater Guidelines for infiltration:

- The infiltration basin will be a minimum of two (2) feet above seasonal high groundwater.
- Utilize the "Simple Dynamic" method for sizing the storage volume, which takes into account the fact that stormwater is exfiltrating from the infiltration basin at the same time that the basin is filling.
- Hydraulic conductivity is based on soil data from the test pits and values developed from Rawls, Brakensiek and Saxton, 1982, Estimation of Soil Water Properties, *Transactions of the American Society of Agricultural Engineers*, vol.25, no. 5.
- Refer to Appendix D for infiltration and drawdown calculations and Appendix E for soil data.

***Groundwater Recharge Volume***

| **Infiltration Basin** | **Soil Type** | **Target Depth Factor (F) (in)** | **Total Impervious Area (sf)** | **Required Recharge Volume (cf)[1]** | **Provided Recharge Volume (cf)[2]** |
|---|---|---|---|---|---|
| | A | 0.60 | 104,145 | 5,207 | |
| | C | 0.25 | 126,517 | 2,636 | |
| 1P | | | | | |
| | | | | **7,843 (8,290 ADJ.)** | **27,882** |

[Simple dynamic method]

1. Required Recharge Volume = Target Depth Factor x Impervious Area / (d+Kt)
   (Refer to supplemental calculations in Appendix D)
2. Provided Recharge Volume = Volume provided below lowest invert elevation.

.

Per Standard 3, if stormwater runoff from less than 100% of the site's impervious cover is

directed to the BMP intended to infiltrate the Required Recharge Volume, then the storage capacity of the infiltration BMP needs to be increased so that the BMP can capture more of the runoff from the impervious surfaces located with the contributing drainage area. The impervious cover directed towards the infiltration system is 94.61%; therefore, a capture area adjustment was made. Refer to Appendix D for Capture Area Adjustment calculations.

The infiltration basin will provide both water quality treatment and recharge. Per Standard 4, Water Quality, the BMP must be sized to treat or hold the Target Volume, the larger of the Required Water Quality Volume and the Required Recharge Volume. The Required Water Quality Volume is based on one inch of runoff and the Required Recharge Volume is based on 0.60-inches (Soil Type A) and 0.25-inches (Soil Type C); 1.0 inches is greater than 0.60 and 0.25 inches, therefore the Target Volume is the Required Water Quality Volume of 18,186 cubic feet. Refer to Appendix D supplemental calculations.

The proposed infiltration basin has been designed to completely drain within 72 hours. The drawdown analysis is based on the required recharge volume exfiltrating at the Rawls Rates based on the soil textural analysis conducted at the proposed exfiltration location. Refer to Appendix D for calculations.

Standard 4 – Water Quality

The total required water quality treatment volume was calculated to be 18,186 cubic feet. The one-inch rule has been applied to the water quality volume calculations. The water quality treatment volume will be provided within the storm water management facilities as follows:

*Water Quality Treatment Volume*

| Basin | Required WQ Volume (cf) | Proposed WQ Volume (cf) | |
|---|---|---|---|
| 1P | 18,186 | 27,882 | Infiltration basin with sediment forebay |
| | | | |
| | | | |
| | **5,173** | **19,810** | |

The Long-Term Pollution Prevention Plan has been incorporated into the Post-Development Operation and Maintenance Plan. Refer to Appendix F for BMP Operation and Maintenance Plans.

The stormwater management system design calls for the installation of 4-foot-deep sump catch basins with hooded outlets to collect runoff from the proposed roadway. Stormwater runoff from the roadway will be routed to a sediment forebay followed by the infiltration basin. Removal rates for all paved surfaces are:

| | |
|---|---|
| Deep Sump Catch Basins | 25% |
| Infiltration Basin w/ Sediment Forebay | 80% |

***Sediment Forebay Sizing Requirements***

| Infiltration Basin | Contributing Impervious Area ($ft^2$) | Required Volume[1] ($ft^3$) | Provided Volume ($ft^3$) |
|---|---|---|---|
| 1P | 218,233 | 1,819 | 2,001 |
| | | | |

1. Required Volume = Contributing Impervious Area (sq.ft.) x (1 ft./12 in.) x (0.1 in./acre)

The drainage system is designed to comply with the Standards of the DEP Stormwater Management Policy. A treatment stream consisting of deep sump catch basins with hooded outlets and a sediment forebay will ensure that the 44% TSS removal (total suspended solids) is removed prior to discharge to the infiltration basin and to ensure that 80% TSS removal is accomplished. The proposed treatment stream will renovate the stormwater and improve the water quality by promoting the settlement of sediments and pollutants before runoff is released into the existing drainage system. Refer to Appendix D for TSS Removal Calculation Worksheets.

Standard 5 – Land Use with Higher Potential Pollutant Loads (LUHPPL)

The proposed project does not include land uses with higher potential pollutant loads. Not Applicable.

Standard 6 – Critical Areas

The proposed project does not discharge to any critical areas. Not Applicable.

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

The proposed project is not a redevelopment project. Not Applicable.

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

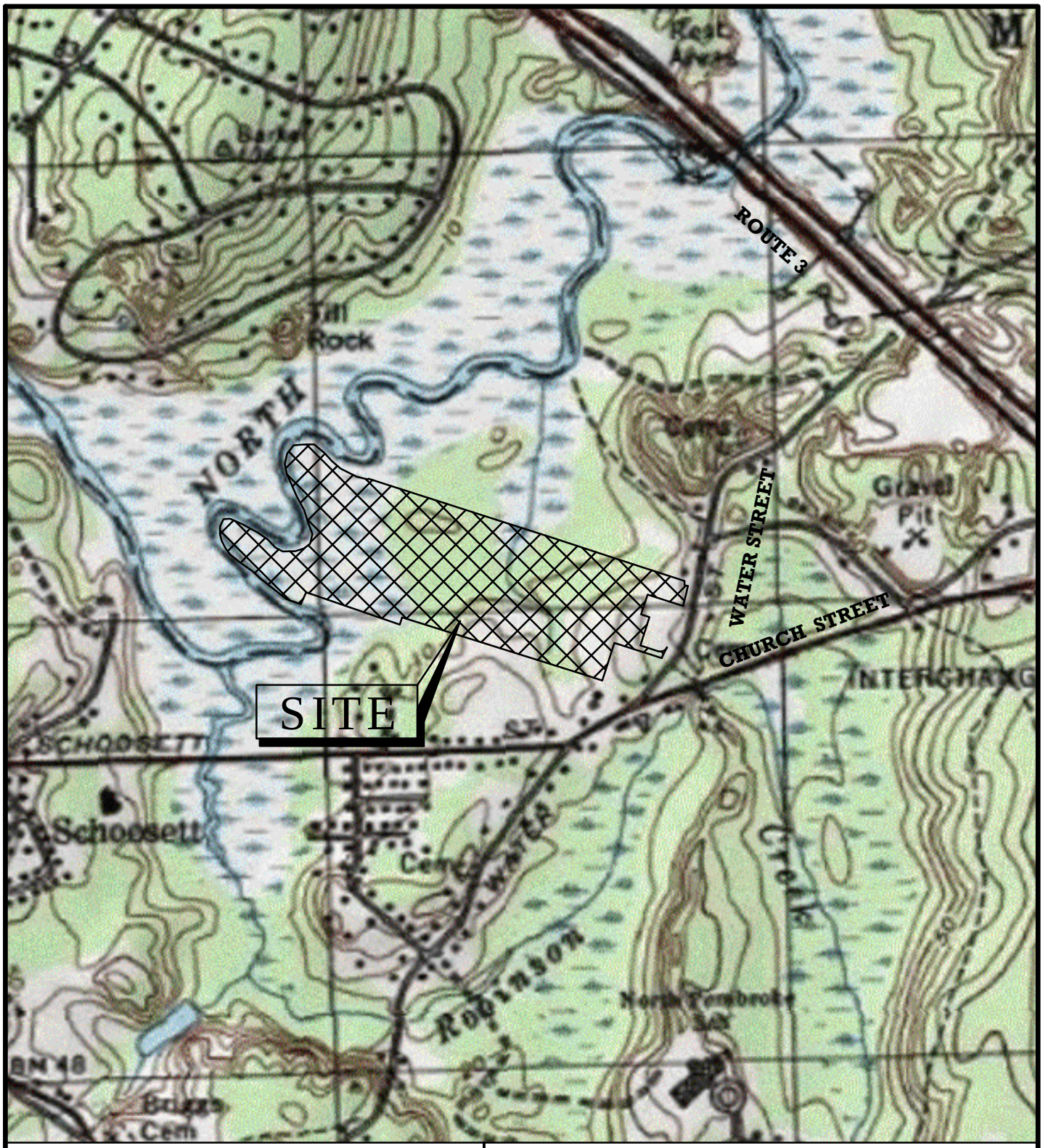
The project will require a NPDES Construction General Permit, but the Stormwater Pollution Prevention Plan (SWPPP) has not been submitted. The SWPPP will be submitted prior to any proposed construction. A Construction Phase BMP Operation and Maintenance Plan will be provided as a basis for the SWPPP during final design.

Standard 9 – Operation and Maintenance Plan

The Long-Term Pollution Prevention Plan has been incorporated into the Post-Development Operation and Maintenance Plan. Refer to Appendix F for BMP Operation and Maintenance Plans.

Standard 10 – Prohibition of Illicit Discharges

No illicit discharges are anticipated on site. An Illicit Discharge Compliance Statement will be submitted prior to the discharge of any stormwater to the post-construction best management practices. Measures to prevent illicit discharges will be included in the Long-Term Pollution Prevention Plan.




# FIGURE - 1

0 1000' 2000' 2500'

U.S. GEOLOGICAL SURVEY
7.5 X 15 MINUTE SERIES



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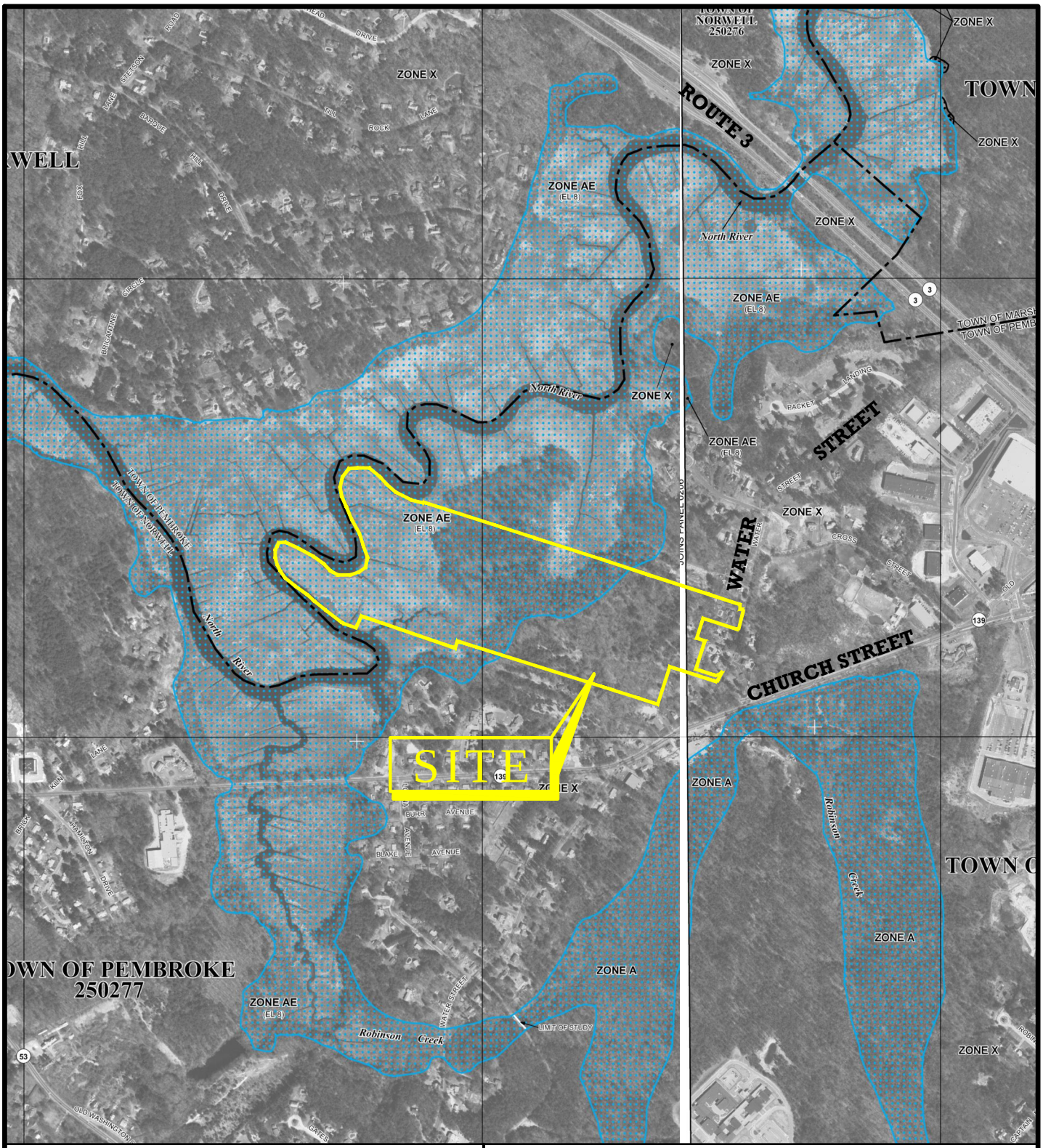
## USGS LOCUS MAP

WATER STREET
PEMBROKE, MASSACHUSETTS




# FIGURE - 2

0 1000' 2000' 2500'

COMMUNITY PANELS NO: 25023C0206J, 25023C0207J

EFFECTIVE DATE: JULY 17, 2012



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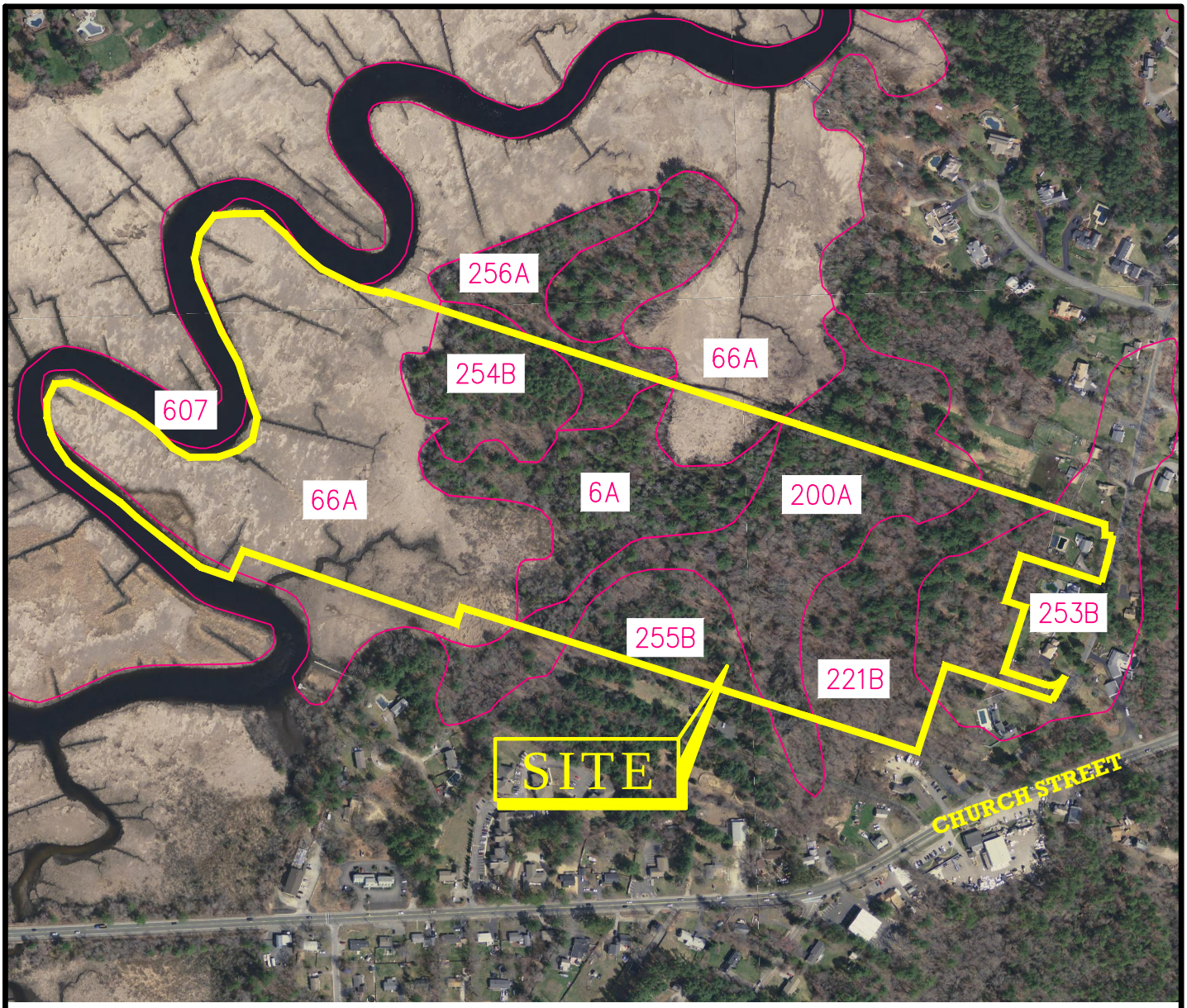
## FEMA FLOOD MAP

WATER STREET

PEMBROKE, MASSACHUSETTS




| LEGEND | NAME | HSG HYDROLOGIC |
|---|---|---|
| 6A | SCARBORO MUCK, COASTAL LOWLAND | D |
| 66A | IPSWICH–PAWCATUCK–MATUNUCK COMPLEX | D |
| 200A | SQUAMSCOTT FINE SANDY LOAM | A/D |
| 221B | ELDRIDGE FINE SANDY LOAM | C/D |
| 253B | HINCKLEY LOAMY SAND | A |
| 254B | MERRIMAC FINE SANDY LOAM | A |
| 255B | WINDSOR LOAMY SAND | A |
| 256A | DEERFIELD FINE SAND | B |
| 607 | WATER, SALINE | |

# FIGURE - 3

0 500' 1000' 1500'

PLYMOUTH COUNTY, MASSACHUSETTS
SOIL SURVEY



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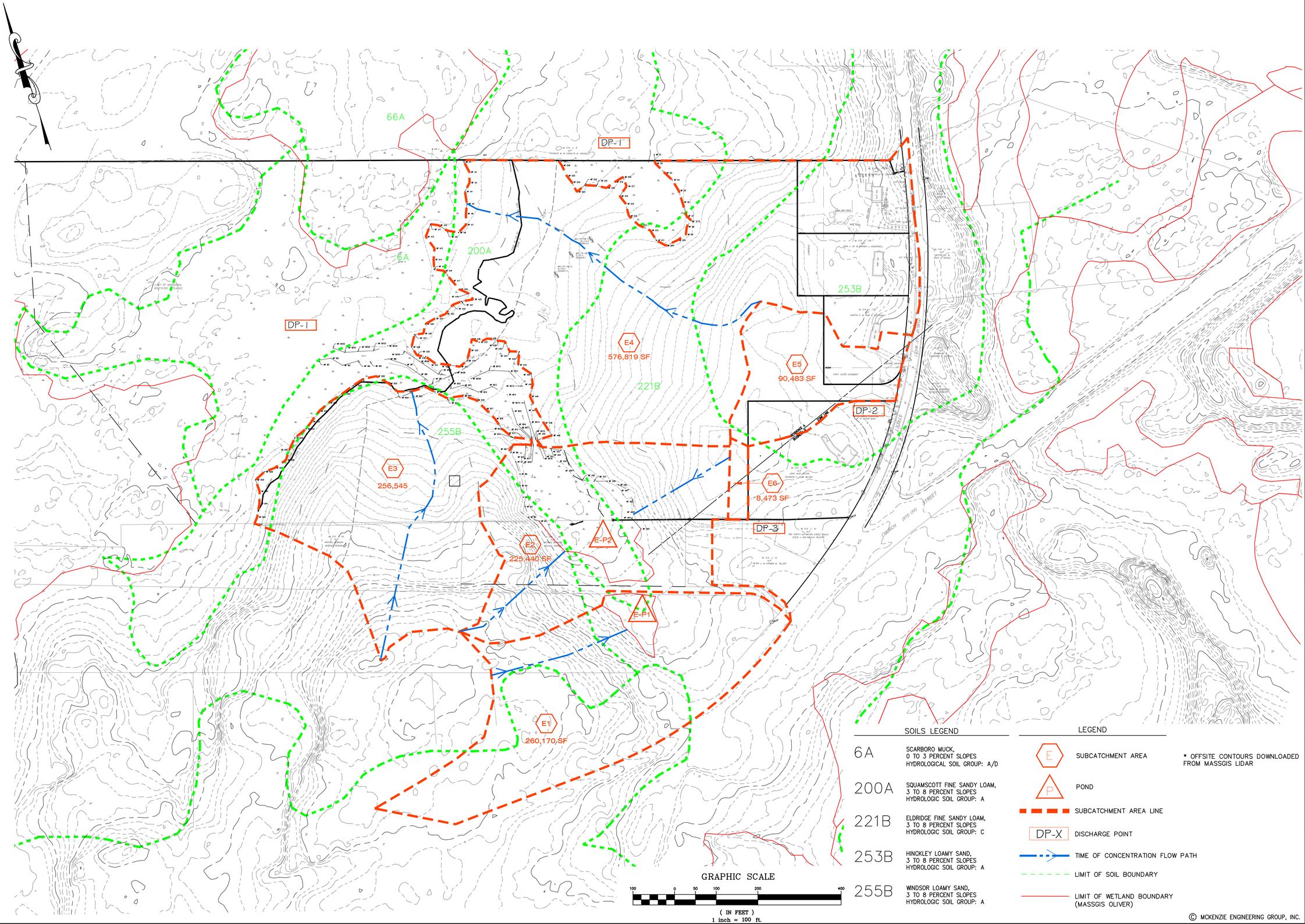
## SOIL MAP

WATER STREET
PEMBROKE, MASSACHUSETTS

# A P P E N D I X A

## Pre-Development Condition





| REV | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|
| 1 | 4/5/2021 | MERRILL ENGINEERS PEER REVIEW COMMENTS | SBS | BCM |

PREPARED BY:
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# RIVER MARSH VILLAGE
# COMPREHENSIVE PERMIT PLAN

(ASSESSOR'S MAP E-17, LOT 0 AND E-17A, LOT 274)
WATER STREET
PEMBROKE, MASSACHUSETTS

PROFESSIONAL ENGINEER:

OWNER/APPLICANT:
RIVER MARSH, LLC
293R WASHINGTON STREET
NORWELL, MA 02061

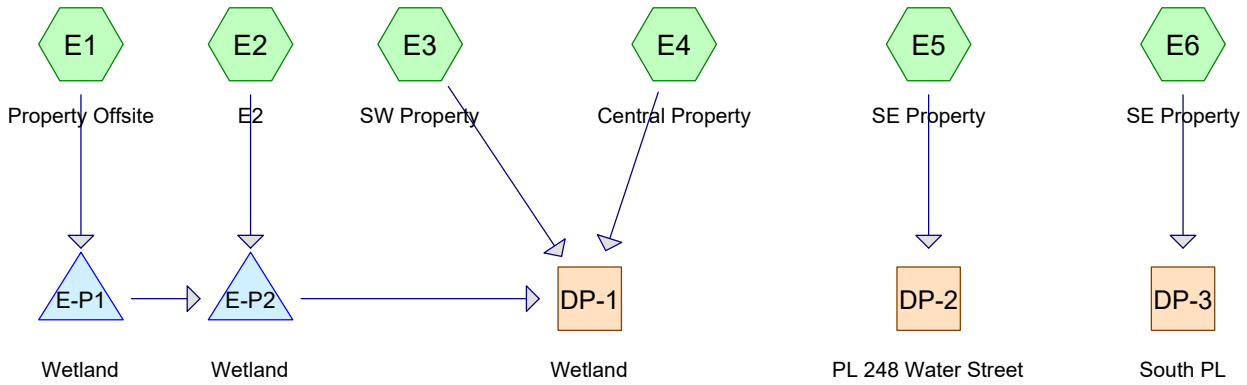
PERMITTING

| | |
|---|---|
| DRAWN BY: | AJC |
| DESIGNED BY: | SBS |
| CHECKED BY: | SBS |
| APPROVED BY: | BCM |
| DATE: | AUGUST 1, 2018 |
| SCALE: | 1"=100' |
| PROJECT NO.: | 215-181 |

DWG. TITLE:
PRE-DEVELOPMENT WATERSHED PLAN

DWG. NO:
WS-1

M:\MEG\2015 PROJECTS\215-181\DWGS\CUT SHEETS\ZBA APPLICATION\SUBMISSION (R2)\215-181 WATERSHED (R2).DWG




Subcat Reach Pond Link

**Routing Diagram for 215-181 PRE-DEV (R2)**
Prepared by McKenzie Engineering Group, Inc., Printed 4/7/2021

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-yr | Type III 24-hr | | Default | 24.00 | 1 | 3.40 | 2 |
| 2 | 10-yr | Type III 24-hr | | Default | 24.00 | 1 | 4.70 | 2 |
| 3 | 25-yr | Type III 24-hr | | Default | 24.00 | 1 | 5.60 | 2 |
| 4 | 100-yr | Type III 24-hr | | Default | 24.00 | 1 | 7.00 | 2 |

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.270 | 49 | 50-75% Grass cover, Fair, HSG A (E5) |
| 1.383 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) (E4, E5) |
| 0.295 | 98 | Impervious, HSG A (OFFSITE) (E3, E4) |
| 0.018 | 98 | Paved parking, HSG A (E5) |
| 0.273 | 98 | Paved parking, HSG A (OFFSITE) (E2, E5) |
| 0.106 | 98 | Paved parking, HSG C (OFFSITE) (E2) |
| 0.086 | 98 | Pavement, HSG A (OFFSITE) (E4) |
| 3.277 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) (E1) |
| 1.124 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) (E1) |
| 1.314 | 78 | Wetlands/woods, HSG A (E2, E4) |
| 0.199 | 78 | Wetlands/woods, HSG A (OFFSITE) (E1) |
| 0.272 | 78 | Wetlands/woods, HSG C (E2, E4) |
| 0.133 | 78 | Wetlands/woods, HSG C (OFFSITE) (E1, E2) |
| 0.463 | 78 | Wetlands/woods. HSG A (OFFSITE) (E2) |
| 2.175 | 30 | Woods, Fair, HSG A (OFFSITE) (E3) |
| 12.163 | 30 | Woods, Good, HSG A (E2, E3, E4, E5) |
| 2.648 | 30 | Woods, Good, HSG A (OFFSITE) (E1, E2, E4, E5) |
| 5.665 | 70 | Woods, Good, HSG C (E2, E4, E5, E6) |
| 1.390 | 70 | Woods, Good, HSG C (OFFSITE) (E1, E2, E5) |
| **33.252** | **52** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 24.563 | HSG A | E1, E2, E3, E4, E5 |
| 0.000 | HSG B | |
| 8.690 | HSG C | E1, E2, E4, E5, E6 |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **33.252** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.270 | 0.000 | 0.000 | 0.000 | 0.000 | 0.270 | 50-75% Grass cover, Fair | E5 |
| 1.383 | 0.000 | 0.000 | 0.000 | 0.000 | 1.383 | >75% Grass cover, Good | E4, E5 |
| 0.295 | 0.000 | 0.000 | 0.000 | 0.000 | 0.295 | Impervious | E3, E4 |
| 0.291 | 0.000 | 0.106 | 0.000 | 0.000 | 0.397 | Paved parking | E2, E5 |
| 0.086 | 0.000 | 0.000 | 0.000 | 0.000 | 0.086 | Pavement | E4 |
| 3.277 | 0.000 | 1.124 | 0.000 | 0.000 | 4.401 | Urban commercial, 85% imp | E1 |
| 1.513 | 0.000 | 0.405 | 0.000 | 0.000 | 1.918 | Wetlands/woods | E1, E2, E4 |
| 0.463 | 0.000 | 0.000 | 0.000 | 0.000 | 0.463 | Wetlands/woods. | E2 |
| 2.175 | 0.000 | 0.000 | 0.000 | 0.000 | 2.175 | Woods, Fair | E3 |
| 14.811 | 0.000 | 7.055 | 0.000 | 0.000 | 21.866 | Woods, Good | E1, E2, E3, E4, E5, E6 |
| **24.563** | **0.000** | **8.690** | **0.000** | **0.000** | **33.252** | **TOTAL AREA** | |

Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 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 E1: Property Offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=1.56"
Flow Length=343' Tc=31.4 min CN=80 Runoff=5.98 cfs 0.775 af

**Subcatchment E2: E2** Runoff Area=255,440 sf 5.35% Impervious Runoff Depth=0.61"
Flow Length=319' Tc=21.2 min CN=63 Runoff=2.12 cfs 0.299 af

**Subcatchment E3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.00 cfs 0.000 af

**Subcatchment E4: Central Property** Runoff Area=576,819 sf 2.06% Impervious Runoff Depth=0.09"
Flow Length=808' Tc=17.9 min CN=46 Runoff=0.15 cfs 0.096 af

**Subcatchment E5: SE Property** Runoff Area=91,029 sf 3.99% Impervious Runoff Depth=0.00"
Flow Length=290' Tc=13.3 min CN=38 Runoff=0.00 cfs 0.000 af

**Subcatchment E6: SE Property** Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=0.95"
Tc=6.0 min CN=70 Runoff=0.20 cfs 0.015 af

**Reach DP-1: Wetland** Inflow=1.89 cfs 0.762 af
Outflow=1.89 cfs 0.762 af

**Reach DP-2: PL 248 Water Street** Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

**Reach DP-3: South PL** Inflow=0.20 cfs 0.015 af
Outflow=0.20 cfs 0.015 af

**Pond E-P1: Wetland** Peak Elev=18.04' Storage=7,800 cf Inflow=5.98 cfs 0.775 af
Outflow=5.93 cfs 0.607 af

**Pond E-P2: Wetland** Peak Elev=13.03' Storage=15,356 cf Inflow=7.90 cfs 0.906 af
Outflow=1.76 cfs 0.667 af

**Total Runoff Area = 33.252 ac Runoff Volume = 1.185 af Average Runoff Depth = 0.43"**
**86.41% Pervious = 28.734 ac 13.59% Impervious = 4.518 ac**

## Summary for Subcatchment E1: Property Offsite

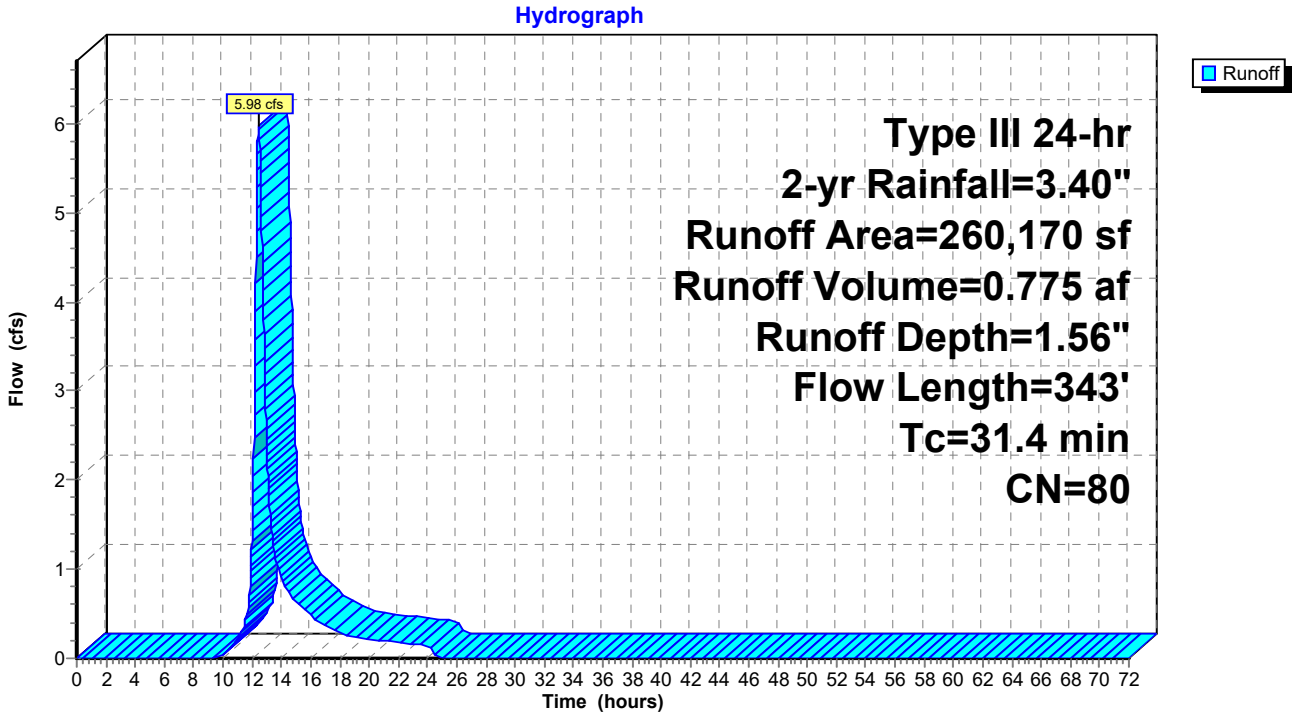
Runoff = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment E1: Property Offsite



## Summary for Subcatchment E2: E2

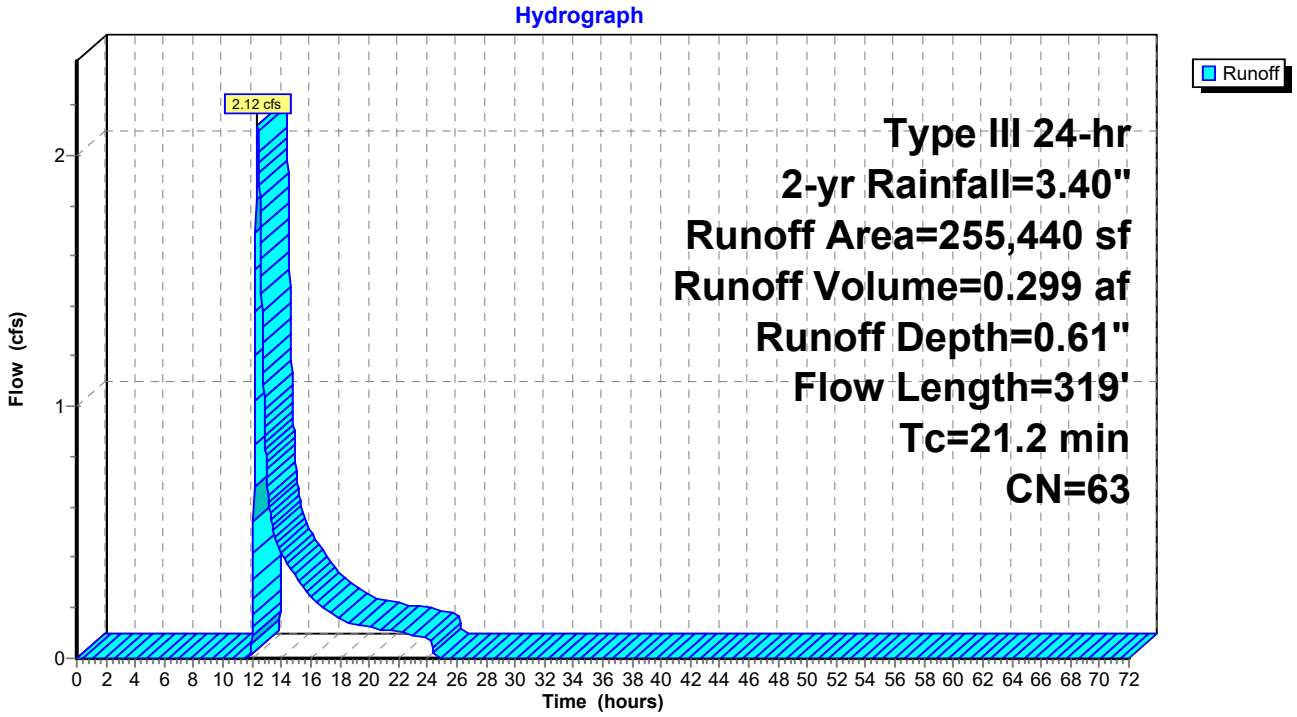
Runoff = 2.12 cfs @ 12.37 hrs, Volume= 0.299 af, Depth= 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 83,652 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| | 255,440 | 63 | Weighted Average |
| | 241,786 | | 94.65% Pervious Area |
| | 13,654 | | 5.35% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.2 | 95 | 0.0100 | 0.50 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.2 | 174 | 0.0710 | 1.33 | | **Shallow Concentrated Flow, c-WETLAND**<br>Woodland Kv= 5.0 fps |
| 21.2 | 319 | Total | | | |

## Subcatchment E2: E2



## Summary for Subcatchment E3: SW Property

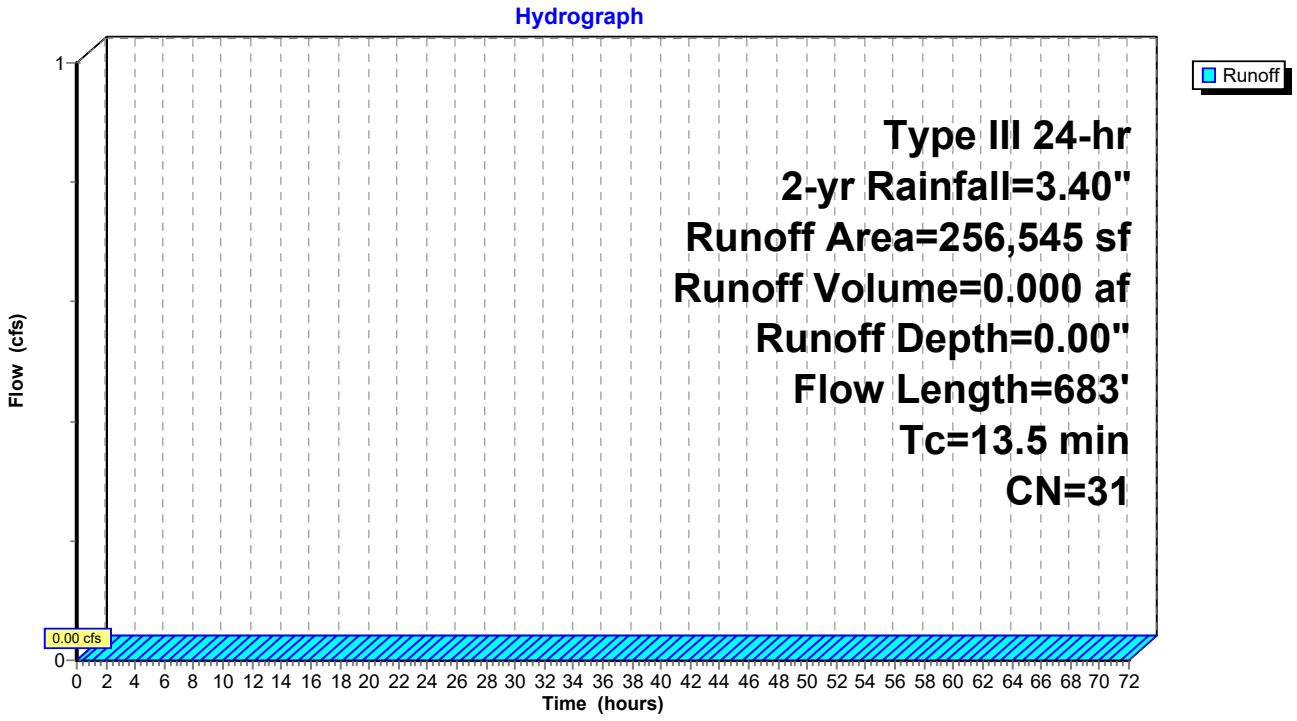
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 157,110 | 30 | Woods, Good, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 31 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.3 | 633 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 13.5 | 683 | Total | | | |

## Subcatchment E3: SW Property



## Summary for Subcatchment E4: Central Property

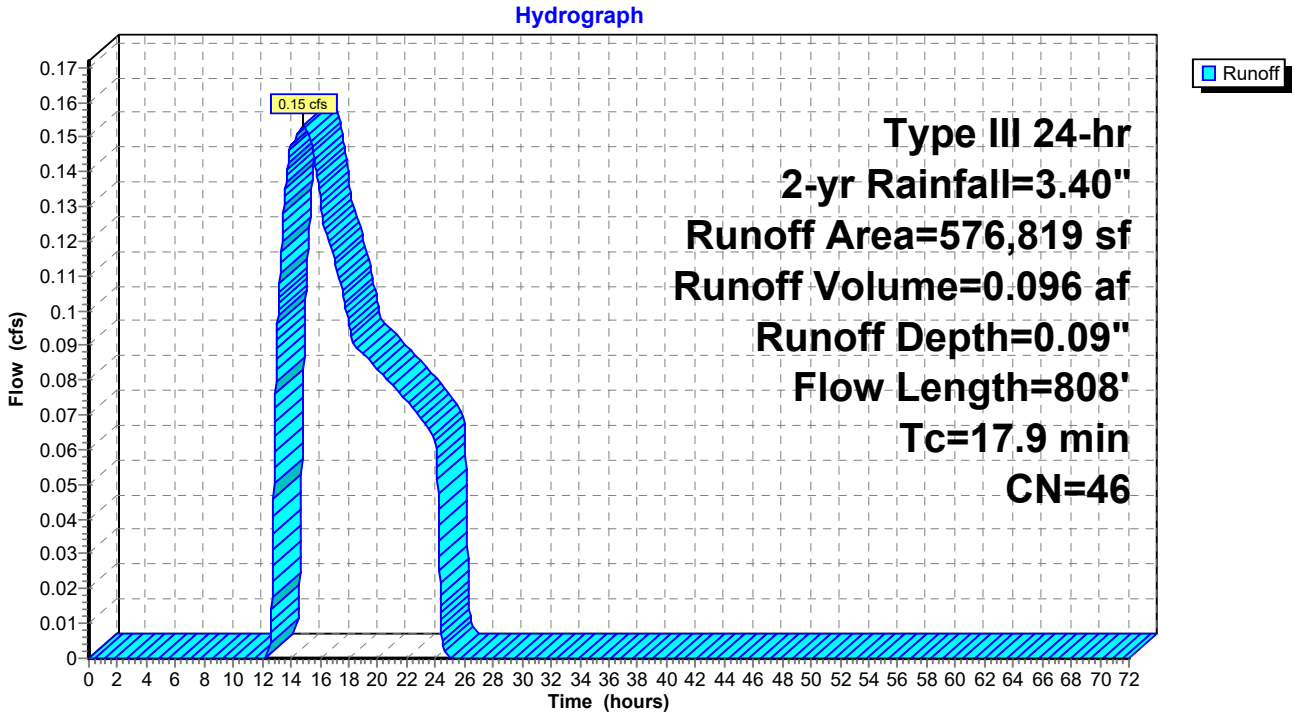
Runoff = 0.15 cfs @ 14.86 hrs, Volume= 0.096 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 317,356 | 30 | Woods, Good, HSG A |
| | 153,440 | 70 | Woods, Good, HSG C |
| * | 3,765 | 98 | Pavement, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| * | 17,970 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 41,632 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 576,819 | 46 | Weighted Average |
| | 564,933 | | 97.94% Pervious Area |
| | 11,886 | | 2.06% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.4 | 50 | 0.0150 | 0.06 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 4.5 | 758 | 0.0310 | 2.83 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 17.9 | 808 | Total | | | |

## Subcatchment E4: Central Property



## Summary for Subcatchment E5: SE Property

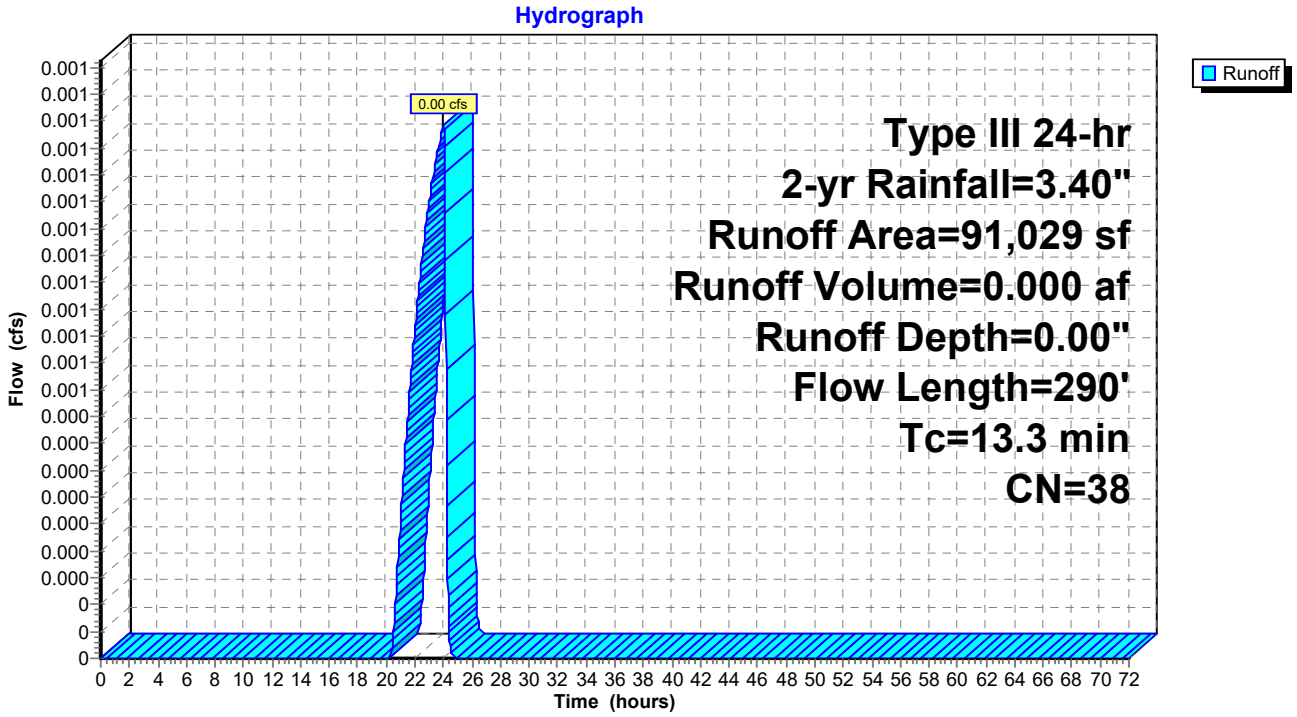
Runoff = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 39,519 | 30 | Woods, Good, HSG A |
| | 1,209 | 70 | Woods, Good, HSG C |
| | 11,750 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 770 | 98 | Paved parking, HSG A |
| * | 15,917 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 18,600 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 2,858 | 98 | Paved parking, HSG A (OFFSITE) |
| | 91,029 | 38 | Weighted Average |
| | 87,401 | | 96.01% Pervious Area |
| | 3,628 | | 3.99% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.5 | 50 | 0.0220 | 0.07 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 240 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 13.3 | 290 | Total | | | |

## Subcatchment E5: SE Property



## Summary for Subcatchment E6: SE Property

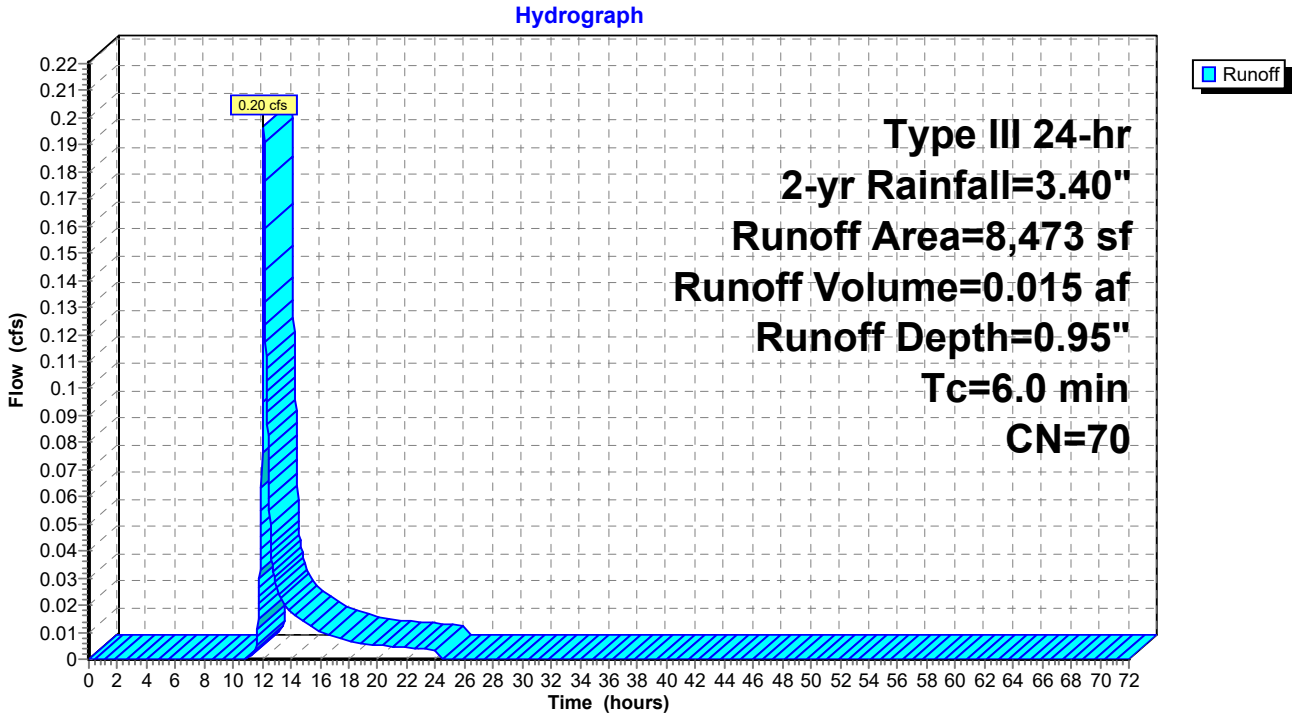
Runoff = 0.20 cfs @ 12.10 hrs, Volume= 0.015 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| Area (sf) | CN | Description |
|---|---|---|
| 8,473 | 70 | Woods, Good, HSG C |
| 8,473 | | 100.00% Pervious Area |

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

## Subcatchment E6: SE Property

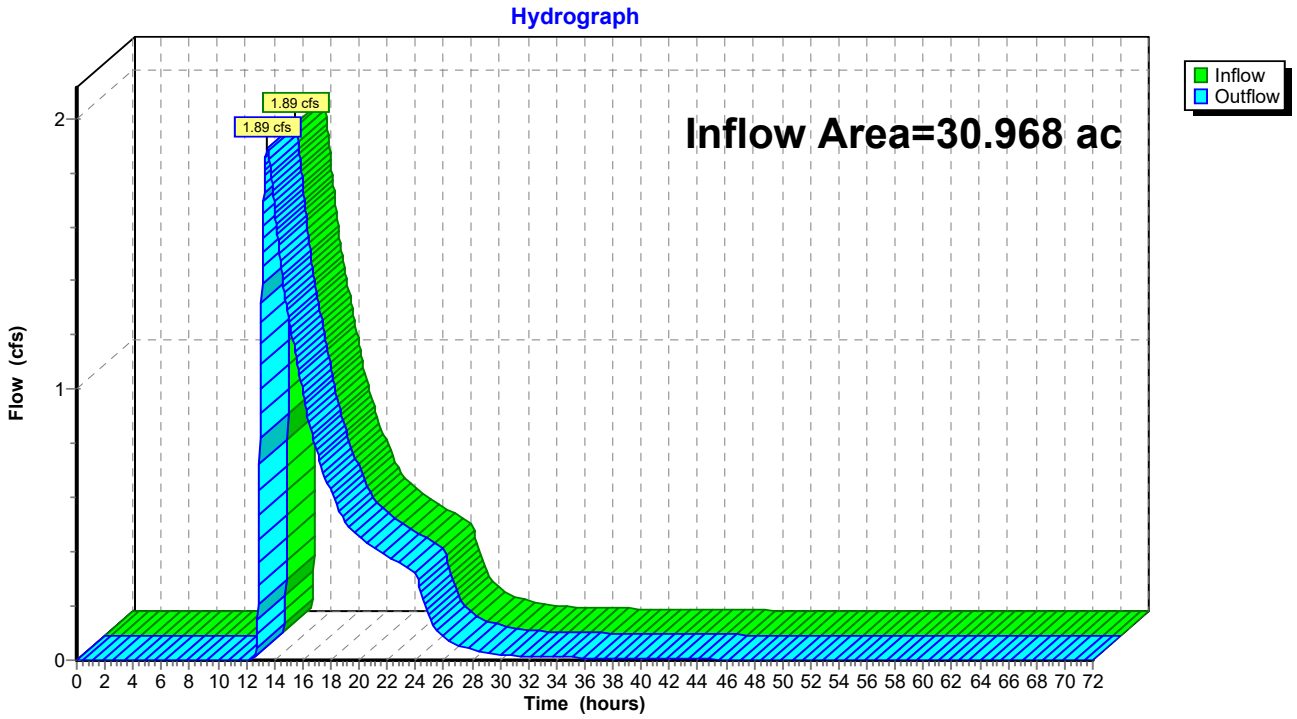


## Summary for Reach DP-1: Wetland

Inflow Area = 30.968 ac, 14.32% Impervious, Inflow Depth > 0.30" for 2-yr event
Inflow = 1.89 cfs @ 13.49 hrs, Volume= 0.762 af
Outflow = 1.89 cfs @ 13.49 hrs, Volume= 0.762 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

### Reach DP-1: Wetland

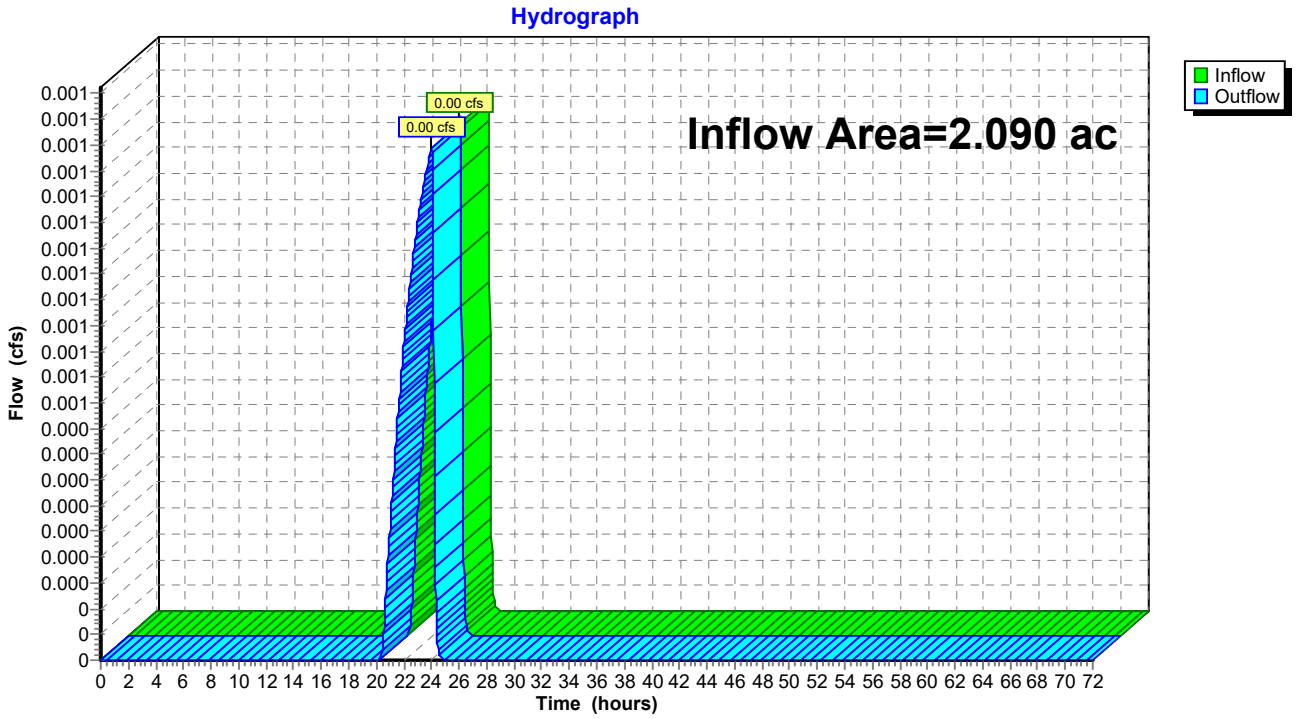


## Summary for Reach DP-2: PL 248 Water Street

Inflow Area = 2.090 ac, 3.99% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.02 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-2: PL 248 Water Street

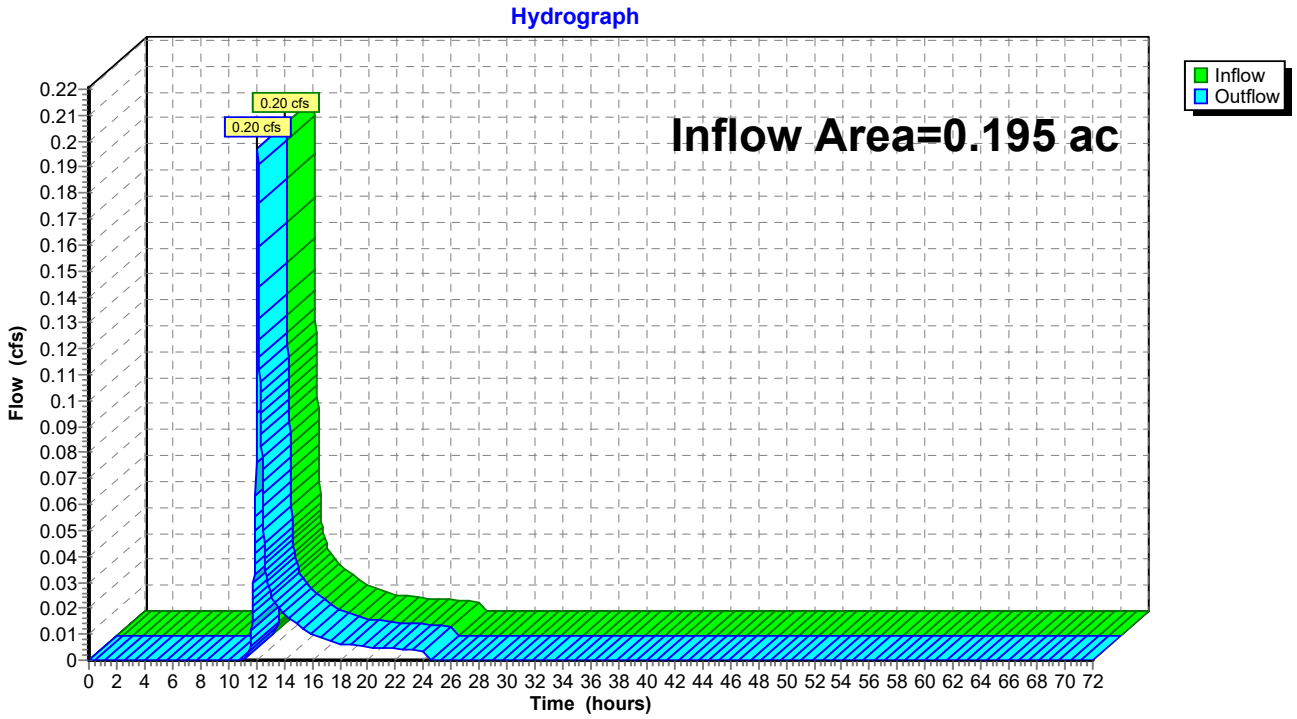


## Summary for Reach DP-3: South PL

Inflow Area = 0.195 ac, 0.00% Impervious, Inflow Depth = 0.95" for 2-yr event
Inflow = 0.20 cfs @ 12.10 hrs, Volume= 0.015 af
Outflow = 0.20 cfs @ 12.10 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-3: South PL



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 1.56" for 2-yr event
Inflow = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af
Outflow = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af, Atten= 1%, Lag= 2.0 min
Primary = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.04' @ 12.49 hrs Surf.Area= 12,886 sf Storage= 7,800 cf

Plug-Flow detention time= 125.2 min calculated for 0.607 af (78% of inflow)
Center-of-Mass det. time= 41.8 min ( 905.0 - 863.2 )

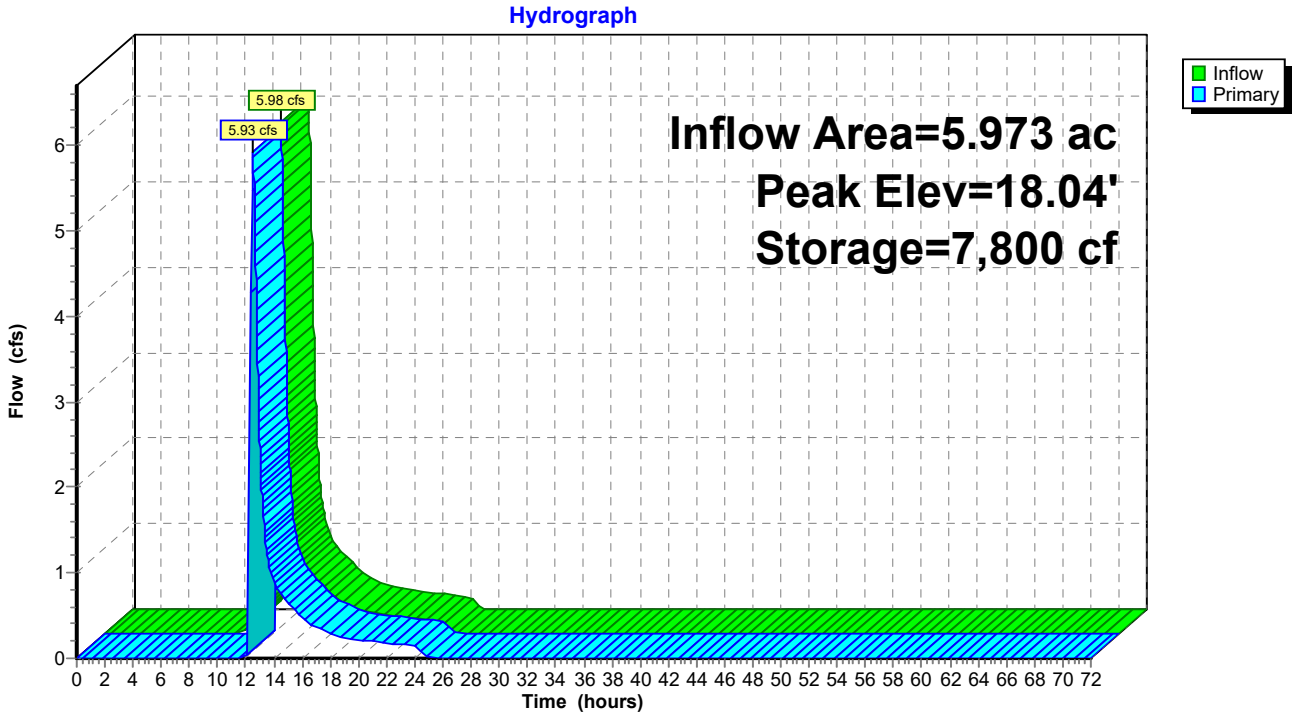
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=4.98 cfs @ 12.49 hrs HW=18.04' (Free Discharge)
↑**1=Asymmetrical Weir** (Weir Controls 4.98 cfs @ 0.63 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 11.837 ac, 34.25% Impervious, Inflow Depth = 0.92" for 2-yr event
Inflow = 7.90 cfs @ 12.48 hrs, Volume= 0.906 af
Outflow = 1.76 cfs @ 13.47 hrs, Volume= 0.667 af, Atten= 78%, Lag= 59.7 min
Primary = 1.76 cfs @ 13.47 hrs, Volume= 0.667 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.03' @ 13.47 hrs Surf.Area= 27,541 sf Storage= 15,356 cf

Plug-Flow detention time= 250.7 min calculated for 0.667 af (74% of inflow)
Center-of-Mass det. time= 151.7 min ( 1,059.0 - 907.3 )

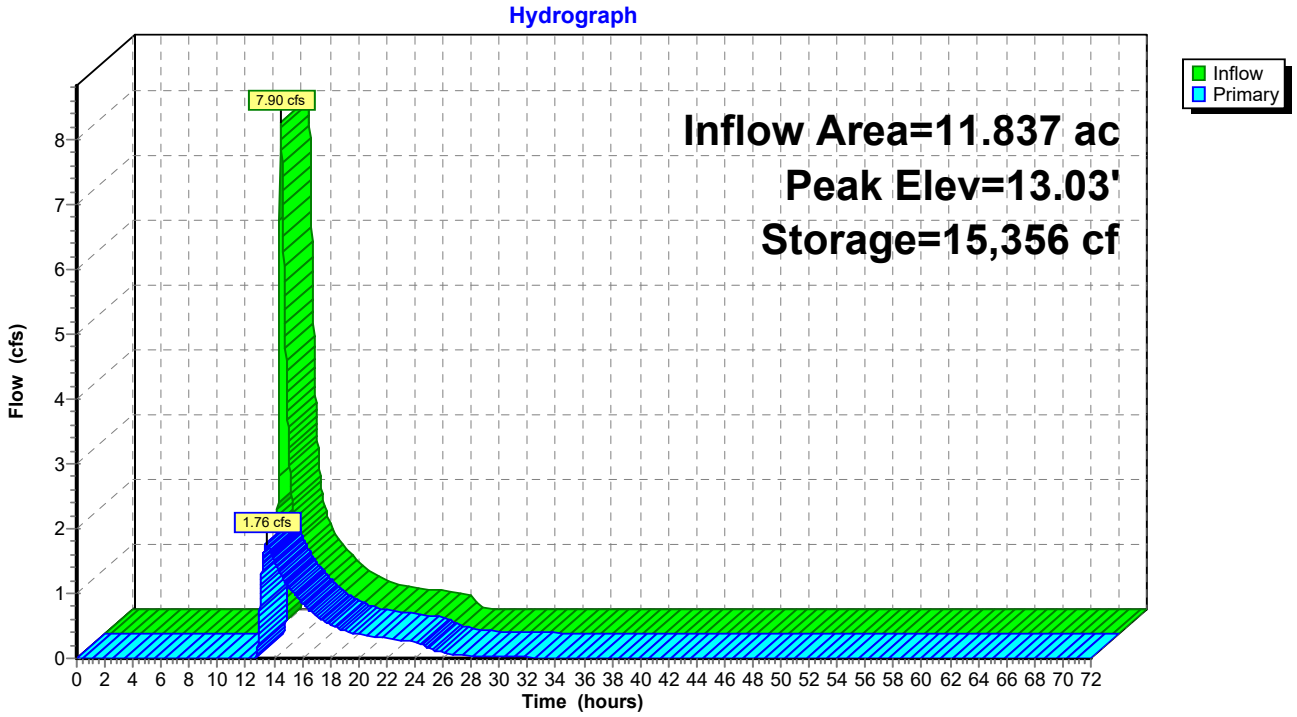
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31<br>Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00 |

**Primary OutFlow** Max=1.75 cfs @ 13.47 hrs HW=13.03' (Free Discharge)
↑**1=Asymmetrical Weir** (Weir Controls 1.75 cfs @ 0.59 fps)

## Pond E-P2: Wetland



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 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 E1: Property Offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=2.63"
Flow Length=343' Tc=31.4 min CN=80 Runoff=10.20 cfs 1.310 af

**Subcatchment E2: E2** Runoff Area=255,440 sf 5.35% Impervious Runoff Depth=1.32"
Flow Length=319' Tc=21.2 min CN=63 Runoff=5.45 cfs 0.646 af

**Subcatchment E3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.01 cfs 0.001 af

**Subcatchment E4: Central Property** Runoff Area=576,819 sf 2.06% Impervious Runoff Depth=0.39"
Flow Length=808' Tc=17.9 min CN=46 Runoff=1.96 cfs 0.433 af

**Subcatchment E5: SE Property** Runoff Area=91,029 sf 3.99% Impervious Runoff Depth=0.12"
Flow Length=290' Tc=13.3 min CN=38 Runoff=0.03 cfs 0.020 af

**Subcatchment E6: SE Property** Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=70 Runoff=0.40 cfs 0.029 af

**Reach DP-1: Wetland** Inflow=12.26 cfs 1.984 af
Outflow=12.26 cfs 1.984 af

**Reach DP-2: PL 248 Water Street** Inflow=0.03 cfs 0.020 af
Outflow=0.03 cfs 0.020 af

**Reach DP-3: South PL** Inflow=0.40 cfs 0.029 af
Outflow=0.40 cfs 0.029 af

**Pond E-P1: Wetland** Peak Elev=18.06' Storage=8,052 cf Inflow=10.20 cfs 1.310 af
Outflow=10.18 cfs 1.143 af

**Pond E-P2: Wetland** Peak Elev=13.21' Storage=20,577 cf Inflow=15.17 cfs 1.789 af
Outflow=10.70 cfs 1.550 af

**Total Runoff Area = 33.252 ac Runoff Volume = 2.441 af Average Runoff Depth = 0.88"**
**86.41% Pervious = 28.734 ac 13.59% Impervious = 4.518 ac**

## Summary for Subcatchment E1: Property Offsite

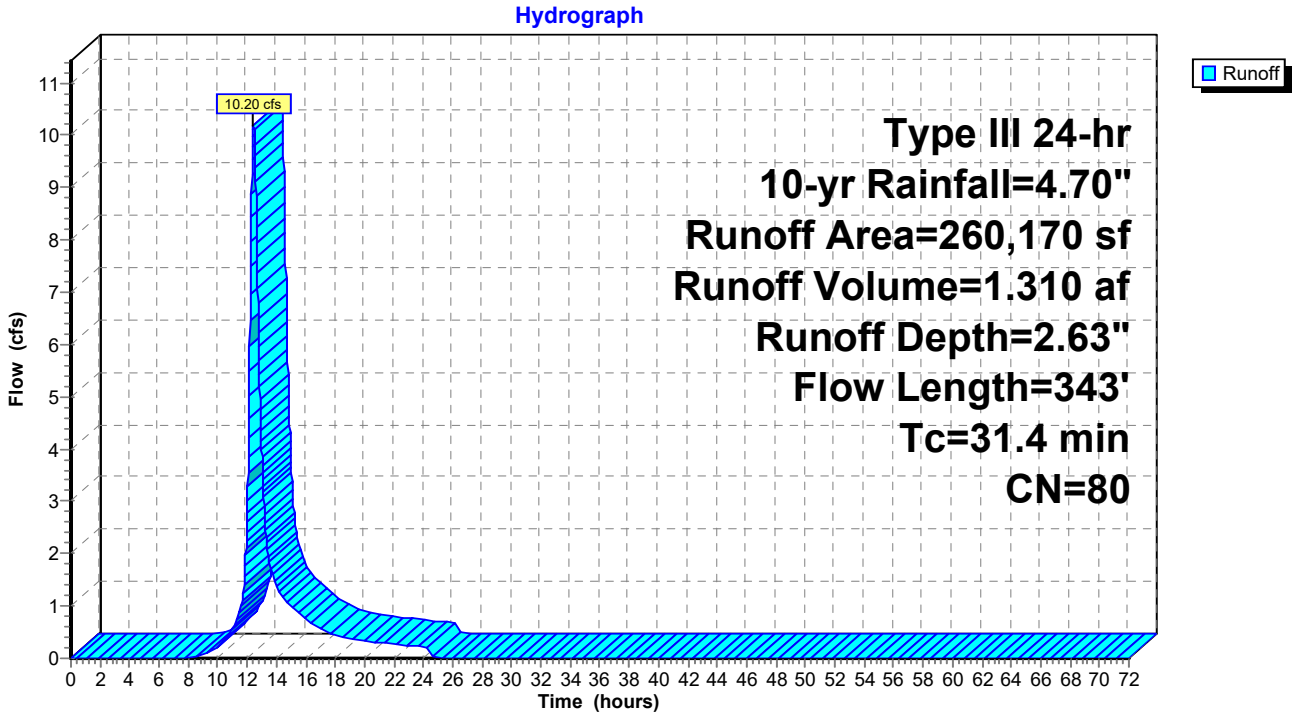
Runoff = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment E1: Property Offsite



## Summary for Subcatchment E2: E2

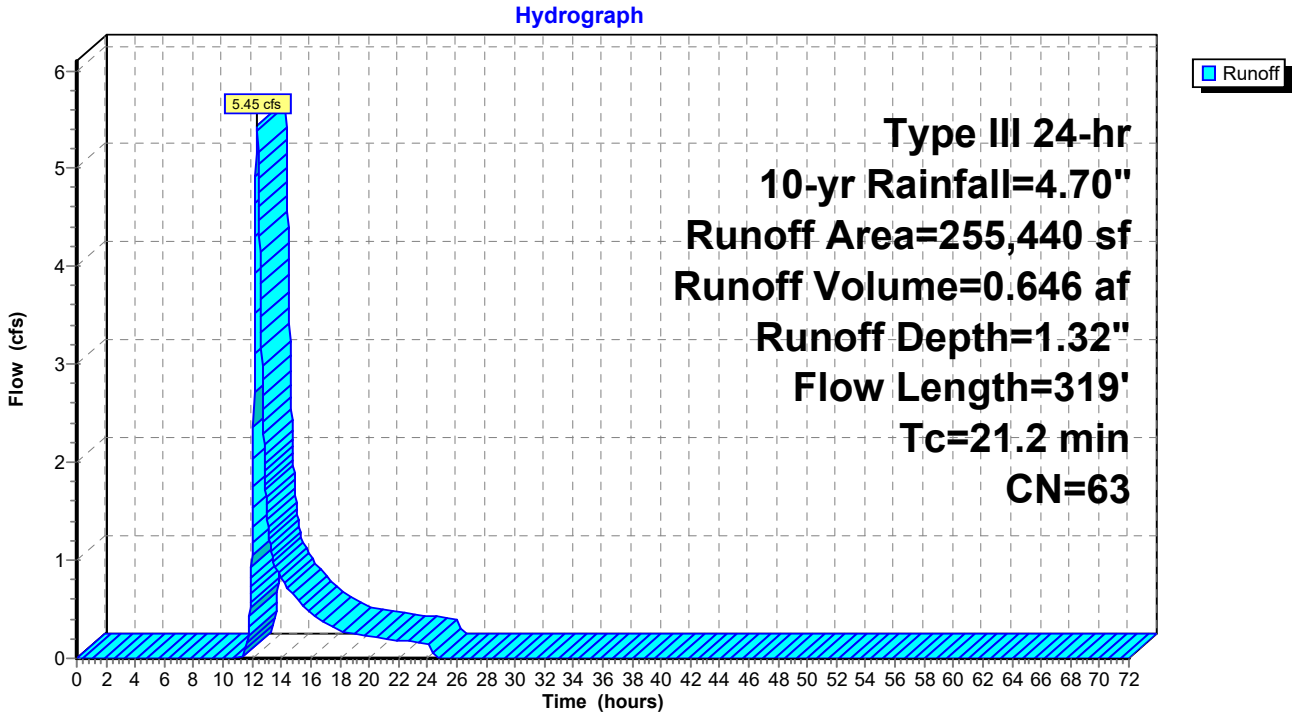
Runoff = 5.45 cfs @ 12.33 hrs, Volume= 0.646 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 83,652 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| | 255,440 | 63 | Weighted Average |
| | 241,786 | | 94.65% Pervious Area |
| | 13,654 | | 5.35% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.2 | 95 | 0.0100 | 0.50 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.2 | 174 | 0.0710 | 1.33 | | **Shallow Concentrated Flow, c-WETLAND**<br>Woodland Kv= 5.0 fps |
| 21.2 | 319 | Total | | | |

## Subcatchment E2: E2



## Summary for Subcatchment E3: SW Property

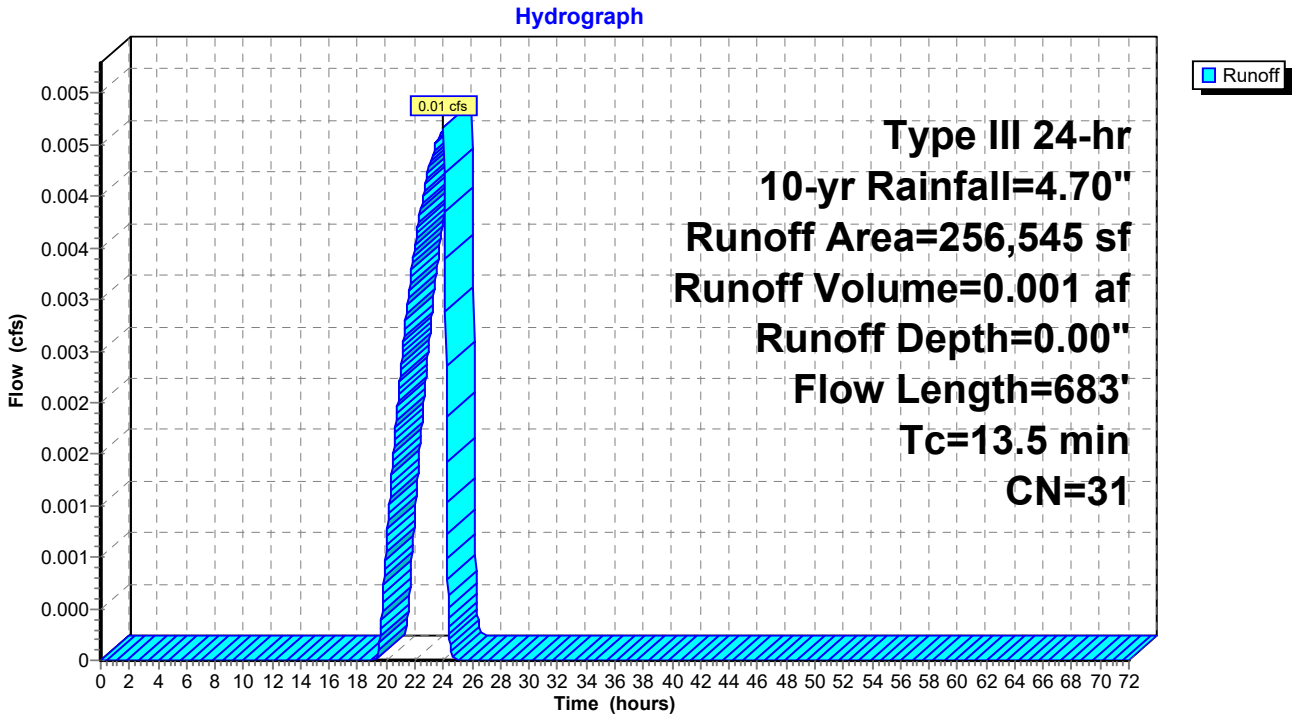
Runoff = 0.01 cfs @ 24.02 hrs, Volume= 0.001 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 157,110 | 30 | Woods, Good, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 31 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.3 | 633 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 13.5 | 683 | Total | | | |

## Subcatchment E3: SW Property



## Summary for Subcatchment E4: Central Property

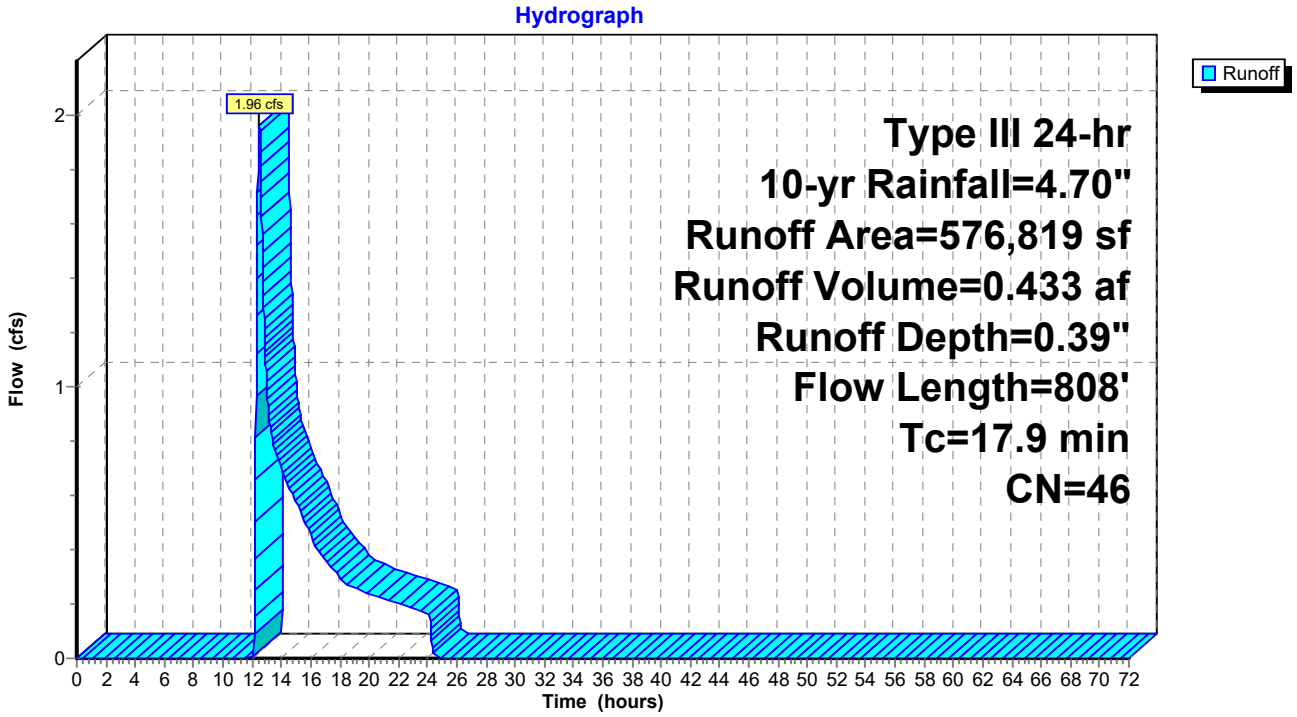
Runoff = 1.96 cfs @ 12.50 hrs, Volume= 0.433 af, Depth= 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 317,356 | 30 | Woods, Good, HSG A |
| | 153,440 | 70 | Woods, Good, HSG C |
| * | 3,765 | 98 | Pavement, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| * | 17,970 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 41,632 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 576,819 | 46 | Weighted Average |
| | 564,933 | | 97.94% Pervious Area |
| | 11,886 | | 2.06% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.4 | 50 | 0.0150 | 0.06 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 4.5 | 758 | 0.0310 | 2.83 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 17.9 | 808 | Total | | | |

## Subcatchment E4: Central Property



## Summary for Subcatchment E5: SE Property

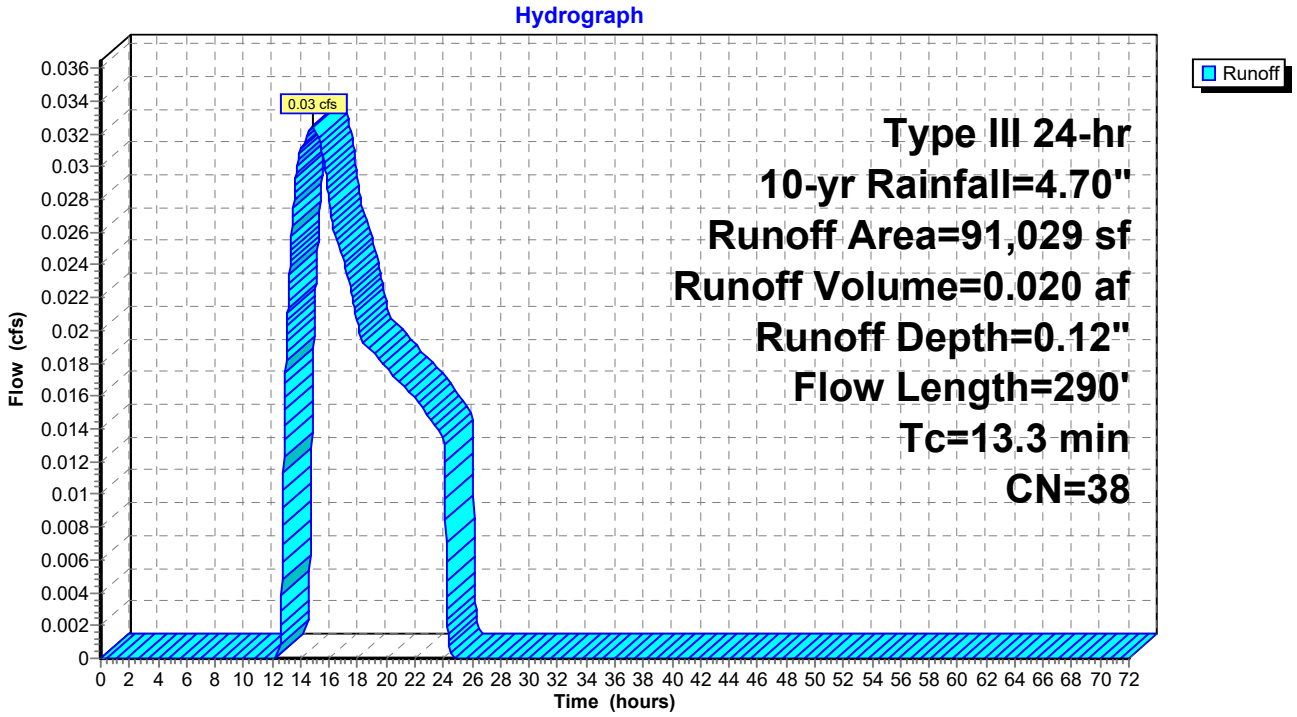
Runoff = 0.03 cfs @ 14.82 hrs, Volume= 0.020 af, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 39,519 | 30 | Woods, Good, HSG A |
| | 1,209 | 70 | Woods, Good, HSG C |
| | 11,750 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 770 | 98 | Paved parking, HSG A |
| * | 15,917 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 18,600 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 2,858 | 98 | Paved parking, HSG A (OFFSITE) |
| | 91,029 | 38 | Weighted Average |
| | 87,401 | | 96.01% Pervious Area |
| | 3,628 | | 3.99% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.5 | 50 | 0.0220 | 0.07 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 240 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 13.3 | 290 | Total | | | |

## Subcatchment E5: SE Property



## Summary for Subcatchment E6: SE Property

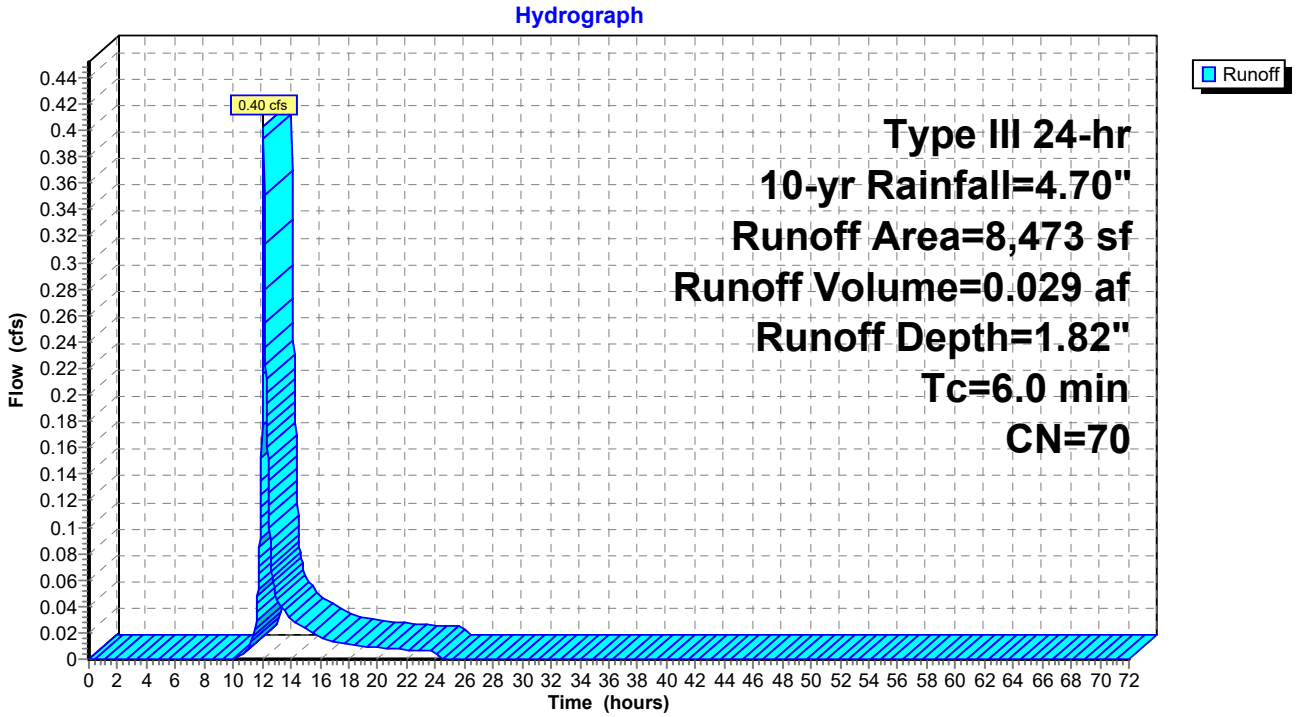
Runoff = 0.40 cfs @ 12.09 hrs, Volume= 0.029 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| Area (sf) | CN | Description |
|---|---|---|
| 8,473 | 70 | Woods, Good, HSG C |
| 8,473 | | 100.00% Pervious Area |

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

## Subcatchment E6: SE Property

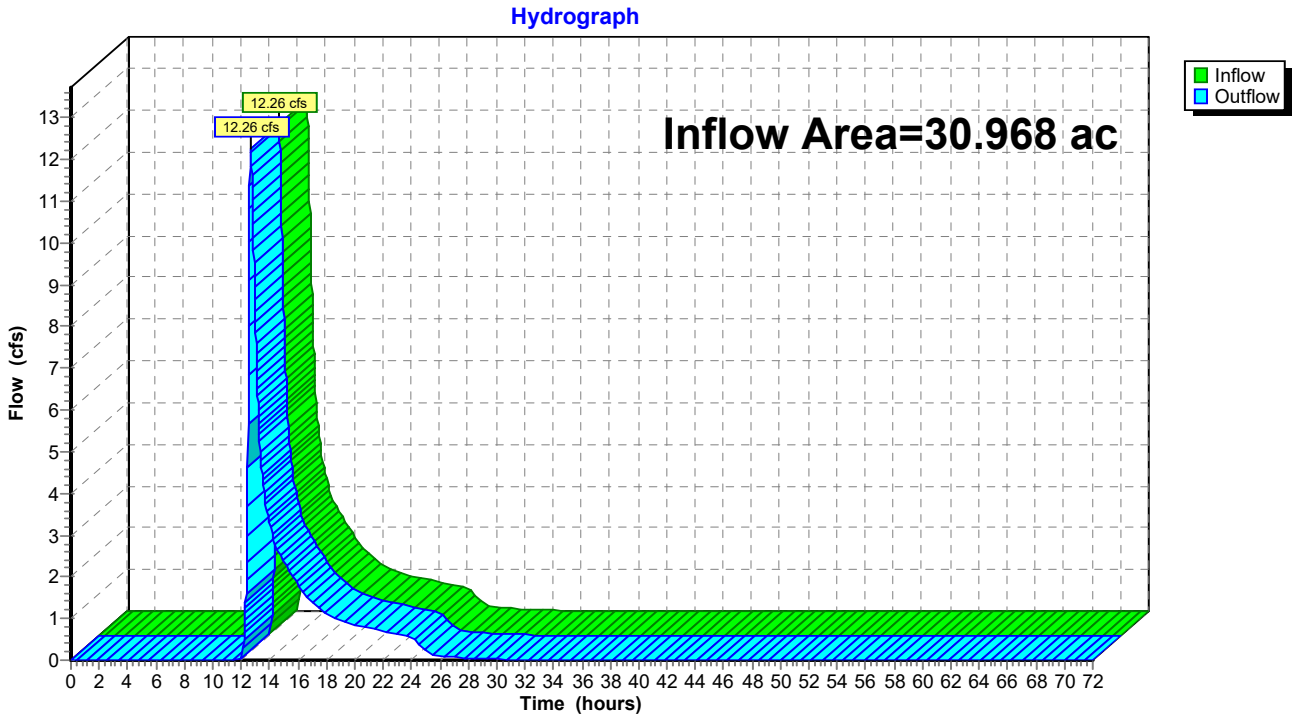


## Summary for Reach DP-1: Wetland

Inflow Area = 30.968 ac, 14.32% Impervious, Inflow Depth = 0.77" for 10-yr event
Inflow = 12.26 cfs @ 12.68 hrs, Volume= 1.984 af
Outflow = 12.26 cfs @ 12.68 hrs, Volume= 1.984 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-1: Wetland

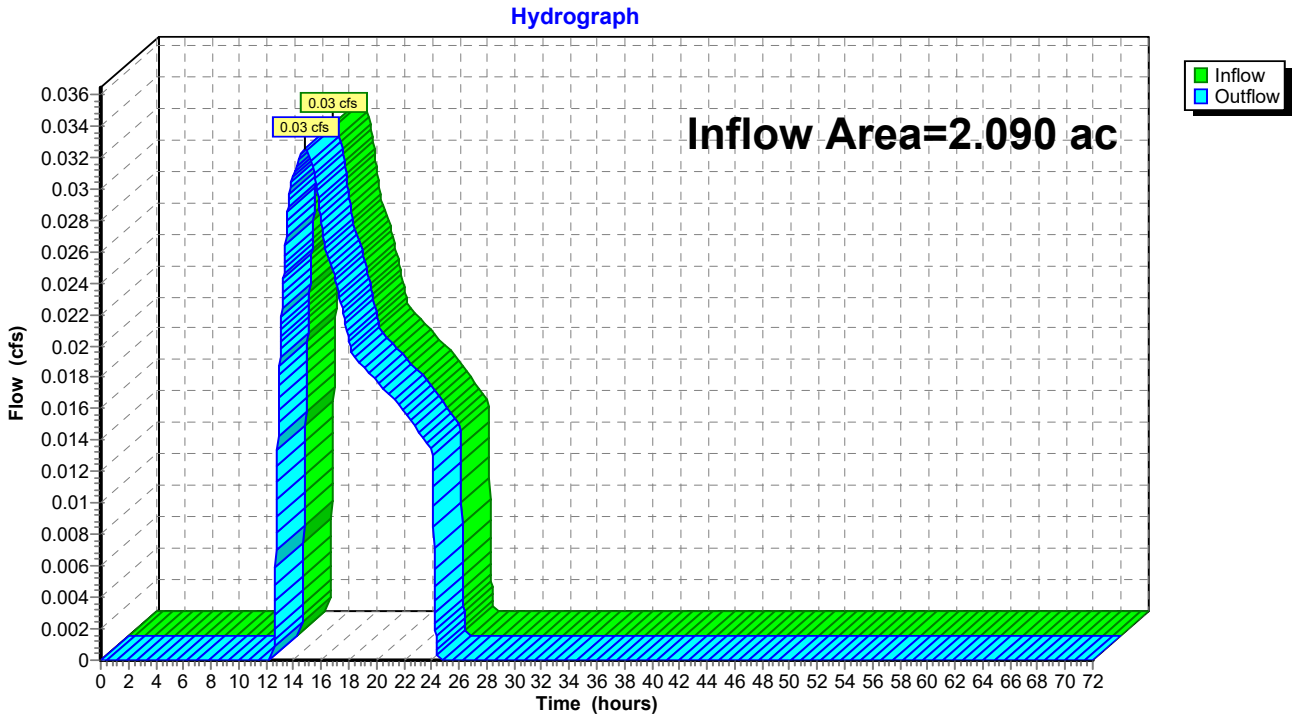


## Summary for Reach DP-2: PL 248 Water Street

Inflow Area = 2.090 ac, 3.99% Impervious, Inflow Depth = 0.12" for 10-yr event
Inflow = 0.03 cfs @ 14.82 hrs, Volume= 0.020 af
Outflow = 0.03 cfs @ 14.82 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-2: PL 248 Water Street

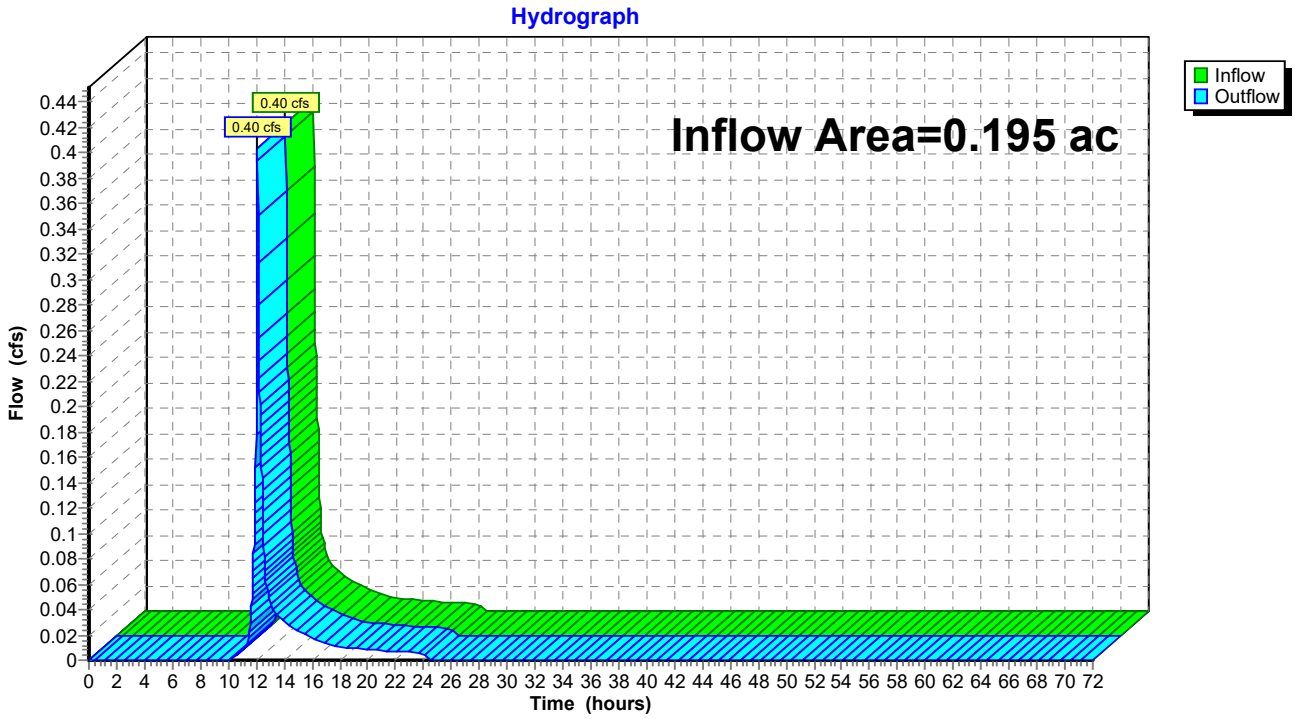


## Summary for Reach DP-3: South PL

Inflow Area = 0.195 ac, 0.00% Impervious, Inflow Depth = 1.82" for 10-yr event
Inflow = 0.40 cfs @ 12.09 hrs, Volume= 0.029 af
Outflow = 0.40 cfs @ 12.09 hrs, Volume= 0.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-3: South PL



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 2.63" for 10-yr event
Inflow = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af
Outflow = 10.18 cfs @ 12.46 hrs, Volume= 1.143 af, Atten= 0%, Lag= 0.9 min
Primary = 10.18 cfs @ 12.46 hrs, Volume= 1.143 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.06' @ 12.46 hrs Surf.Area= 13,190 sf Storage= 8,052 cf

Plug-Flow detention time= 84.8 min calculated for 1.143 af (87% of inflow)
Center-of-Mass det. time= 26.5 min ( 874.5 - 848.0 )

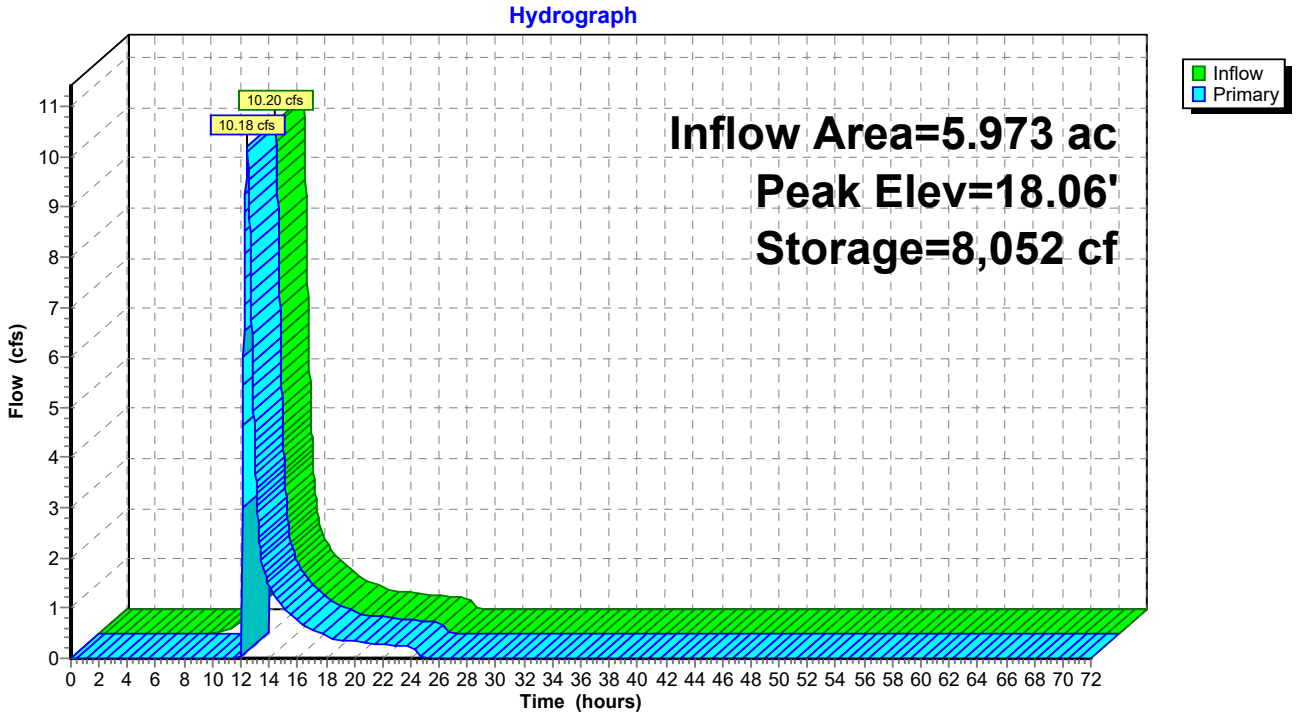
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=9.21 cfs @ 12.46 hrs HW=18.06' (Free Discharge)
**1=Asymmetrical Weir** (Weir Controls 9.21 cfs @ 0.77 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 11.837 ac, 34.25% Impervious, Inflow Depth = 1.81" for 10-yr event
Inflow = 15.17 cfs @ 12.41 hrs, Volume= 1.789 af
Outflow = 10.70 cfs @ 12.69 hrs, Volume= 1.550 af, Atten= 29%, Lag= 17.0 min
Primary = 10.70 cfs @ 12.69 hrs, Volume= 1.550 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.21' @ 12.69 hrs Surf.Area= 29,713 sf Storage= 20,577 cf

Plug-Flow detention time= 136.7 min calculated for 1.549 af (87% of inflow)
Center-of-Mass det. time= 76.8 min ( 955.0 - 878.2 )

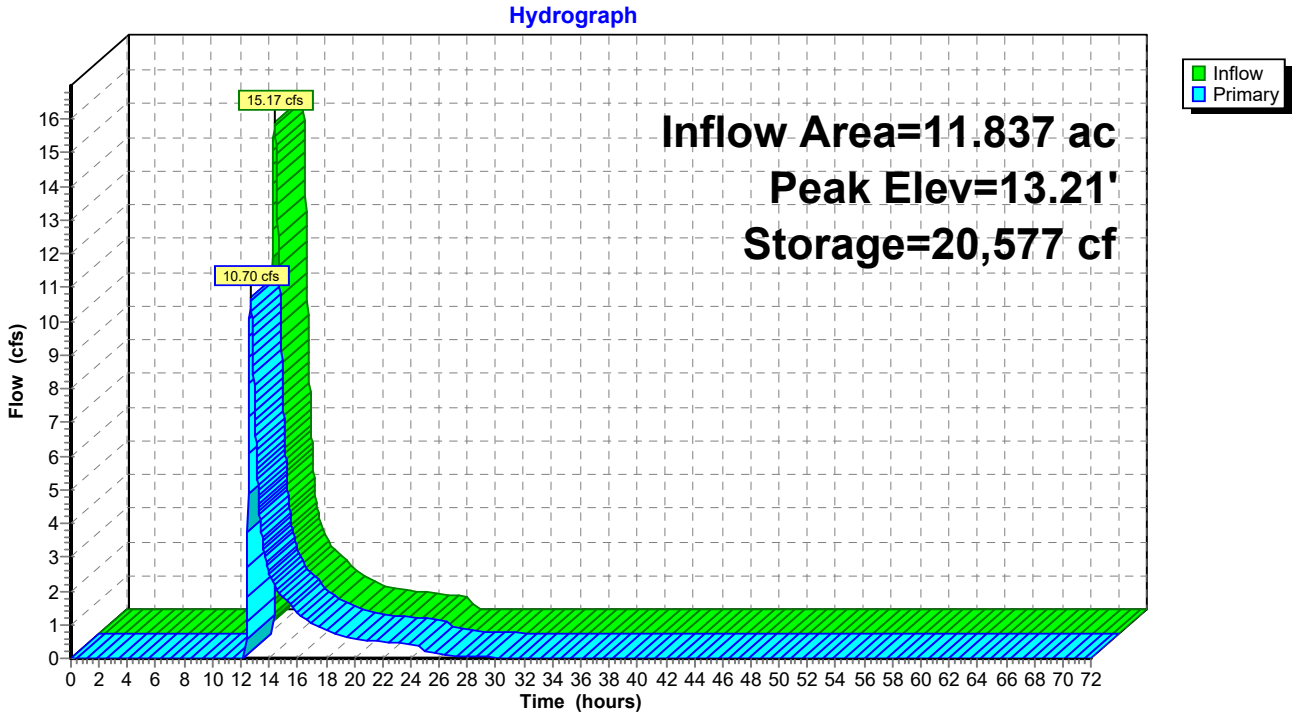
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31<br>Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00 |

**Primary OutFlow** Max=10.68 cfs @ 12.69 hrs HW=13.21' (Free Discharge)
↑—**1=Asymmetrical Weir** (Weir Controls 10.68 cfs @ 1.06 fps)

## Pond E-P2: Wetland



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 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 E1: Property Offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=3.42"
Flow Length=343' Tc=31.4 min CN=80 Runoff=13.24 cfs 1.703 af

**Subcatchment E2: E2** Runoff Area=255,440 sf 5.35% Impervious Runoff Depth=1.90"
Flow Length=319' Tc=21.2 min CN=63 Runoff=8.17 cfs 0.929 af

**Subcatchment E3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.06"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.04 cfs 0.028 af

**Subcatchment E4: Central Property** Runoff Area=576,819 sf 2.06% Impervious Runoff Depth=0.71"
Flow Length=808' Tc=17.9 min CN=46 Runoff=4.68 cfs 0.779 af

**Subcatchment E5: SE Property** Runoff Area=91,029 sf 3.99% Impervious Runoff Depth=0.29"
Flow Length=290' Tc=13.3 min CN=38 Runoff=0.16 cfs 0.051 af

**Subcatchment E6: SE Property** Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=2.49"
Tc=6.0 min CN=70 Runoff=0.56 cfs 0.040 af

**Reach DP-1: Wetland** Inflow=22.14 cfs 3.031 af
Outflow=22.14 cfs 3.031 af

**Reach DP-2: PL 248 Water Street** Inflow=0.16 cfs 0.051 af
Outflow=0.16 cfs 0.051 af

**Reach DP-3: South PL** Inflow=0.56 cfs 0.040 af
Outflow=0.56 cfs 0.040 af

**Pond E-P1: Wetland** Peak Elev=18.07' Storage=8,236 cf Inflow=13.24 cfs 1.703 af
Outflow=13.22 cfs 1.535 af

**Pond E-P2: Wetland** Peak Elev=13.30' Storage=23,036 cf Inflow=20.65 cfs 2.465 af
Outflow=18.02 cfs 2.225 af

**Total Runoff Area = 33.252 ac Runoff Volume = 3.530 af Average Runoff Depth = 1.27"**
**86.41% Pervious = 28.734 ac 13.59% Impervious = 4.518 ac**

## Summary for Subcatchment E1: Property Offsite

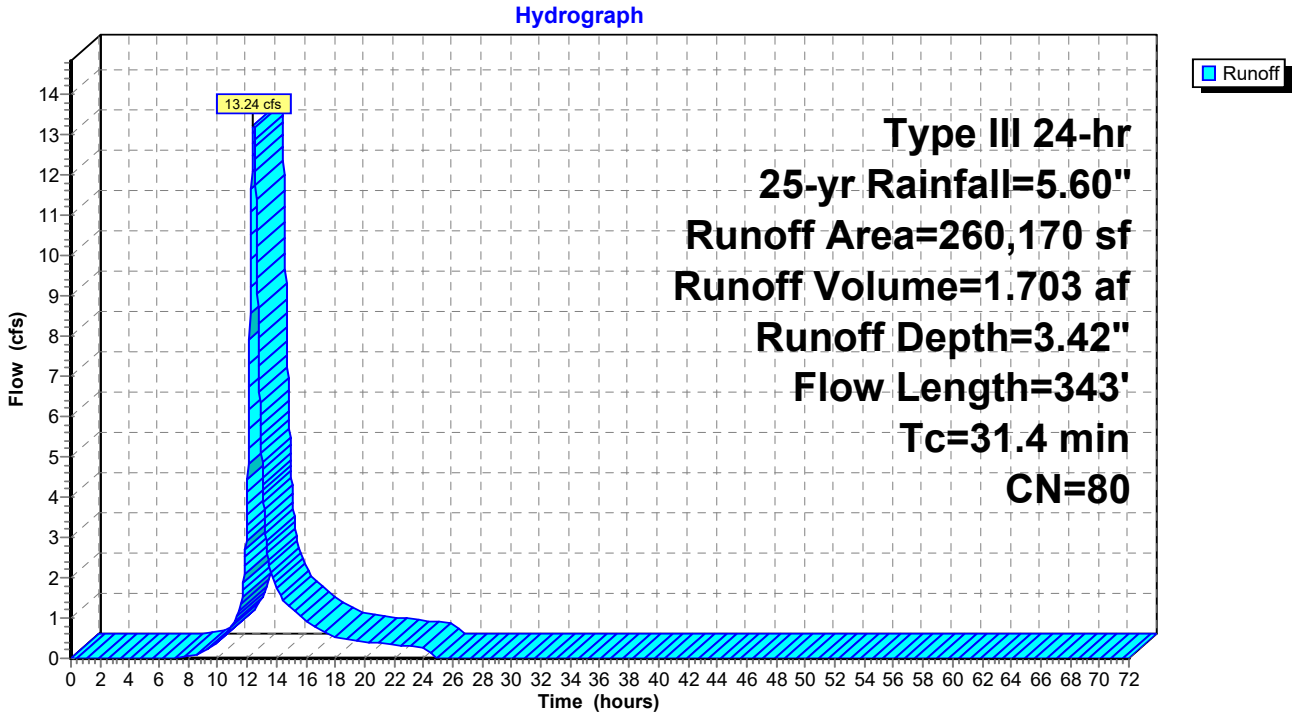
Runoff = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment E1: Property Offsite



## Summary for Subcatchment E2: E2

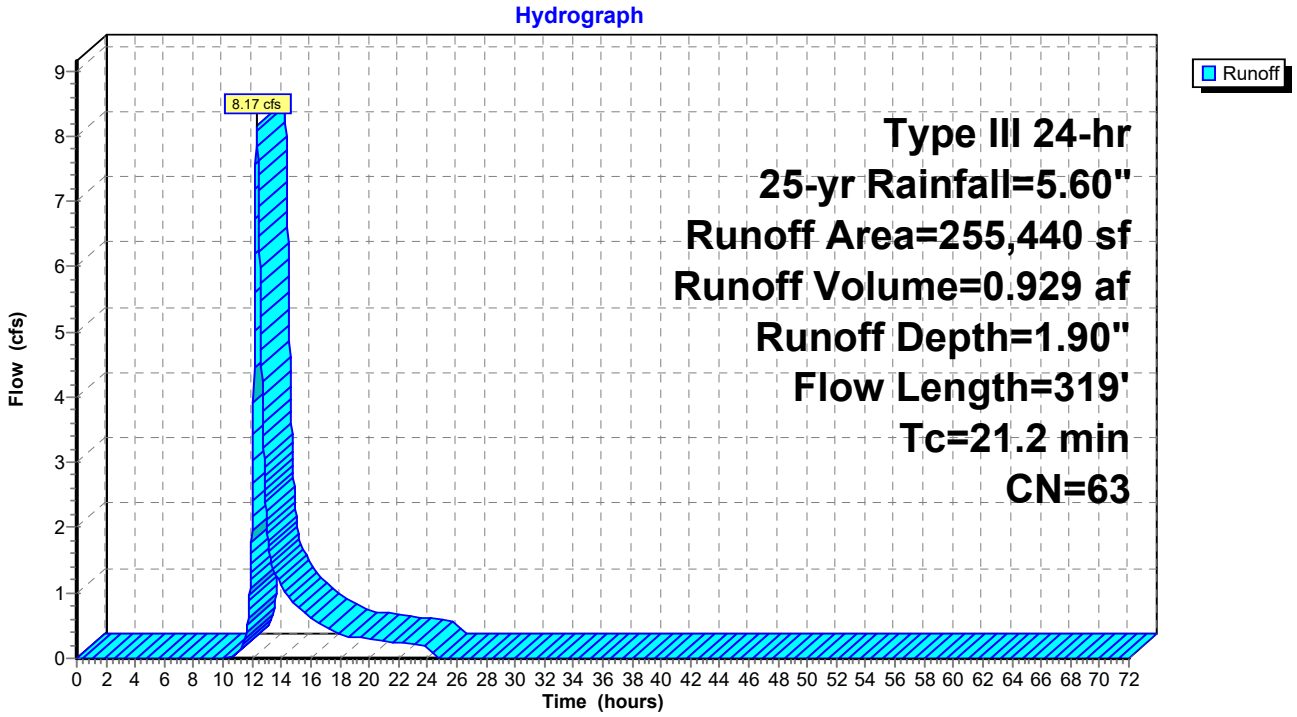
Runoff = 8.17 cfs @ 12.32 hrs, Volume= 0.929 af, Depth= 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 83,652 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| | 255,440 | 63 | Weighted Average |
| | 241,786 | | 94.65% Pervious Area |
| | 13,654 | | 5.35% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.2 | 95 | 0.0100 | 0.50 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.2 | 174 | 0.0710 | 1.33 | | **Shallow Concentrated Flow, c-WETLAND**<br>Woodland Kv= 5.0 fps |
| 21.2 | 319 | Total | | | |

## Subcatchment E2: E2



## Summary for Subcatchment E3: SW Property

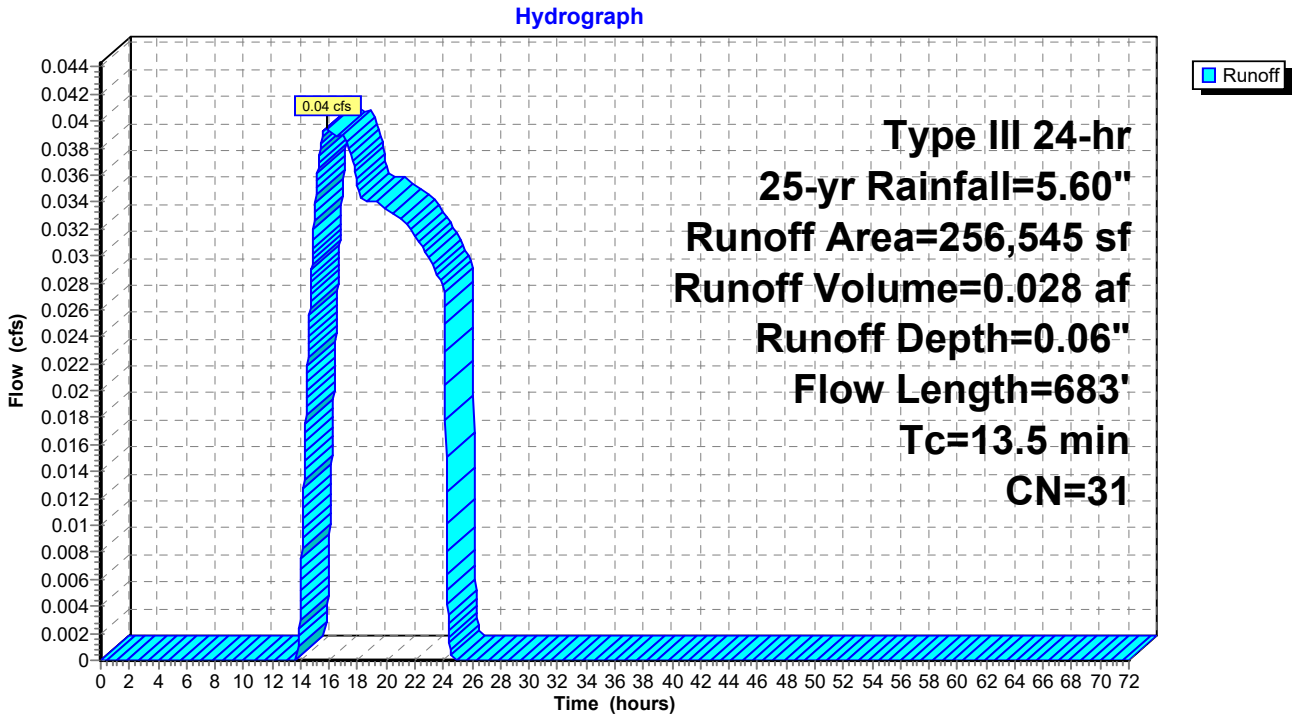
Runoff = 0.04 cfs @ 15.81 hrs, Volume= 0.028 af, Depth= 0.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 157,110 | 30 | Woods, Good, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 31 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.3 | 633 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 13.5 | 683 | Total | | | |

## Subcatchment E3: SW Property



## Summary for Subcatchment E4: Central Property

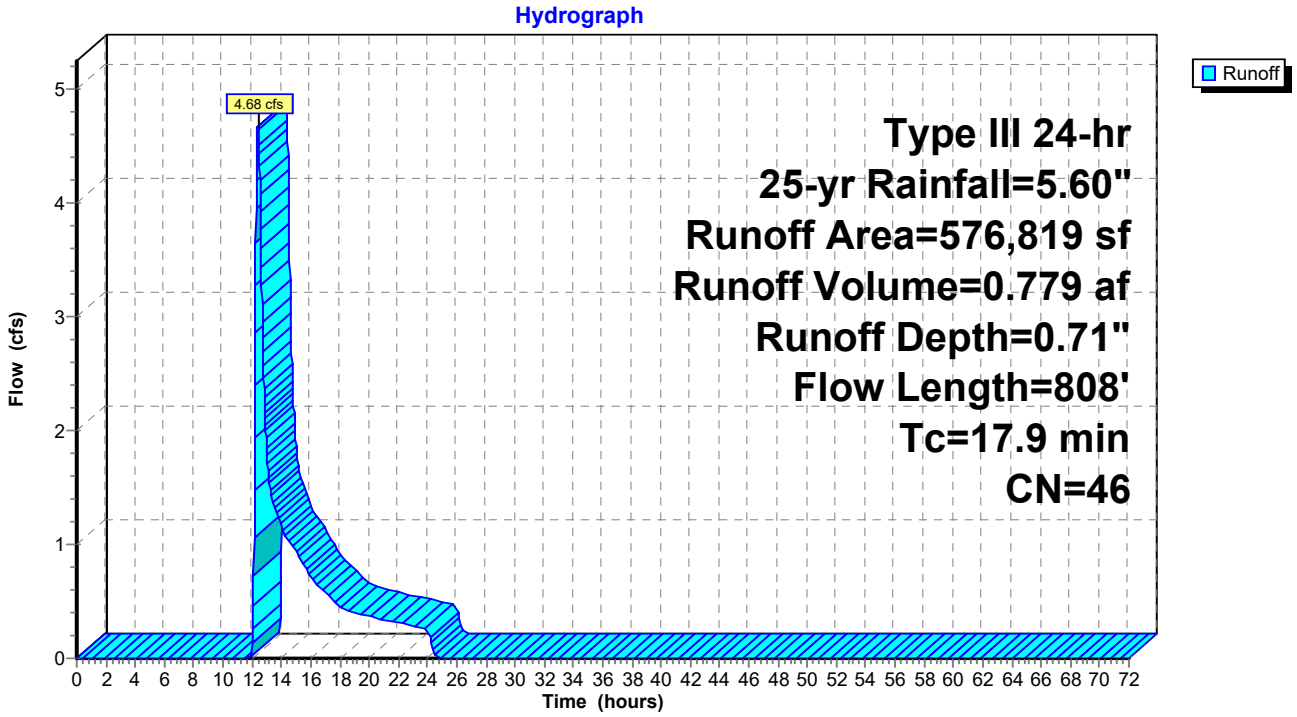
Runoff = 4.68 cfs @ 12.39 hrs, Volume= 0.779 af, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 317,356 | 30 | Woods, Good, HSG A |
| | 153,440 | 70 | Woods, Good, HSG C |
| * | 3,765 | 98 | Pavement, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| * | 17,970 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 41,632 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 576,819 | 46 | Weighted Average |
| | 564,933 | | 97.94% Pervious Area |
| | 11,886 | | 2.06% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.4 | 50 | 0.0150 | 0.06 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 4.5 | 758 | 0.0310 | 2.83 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 17.9 | 808 | Total | | | |

## Subcatchment E4: Central Property



## Summary for Subcatchment E5: SE Property

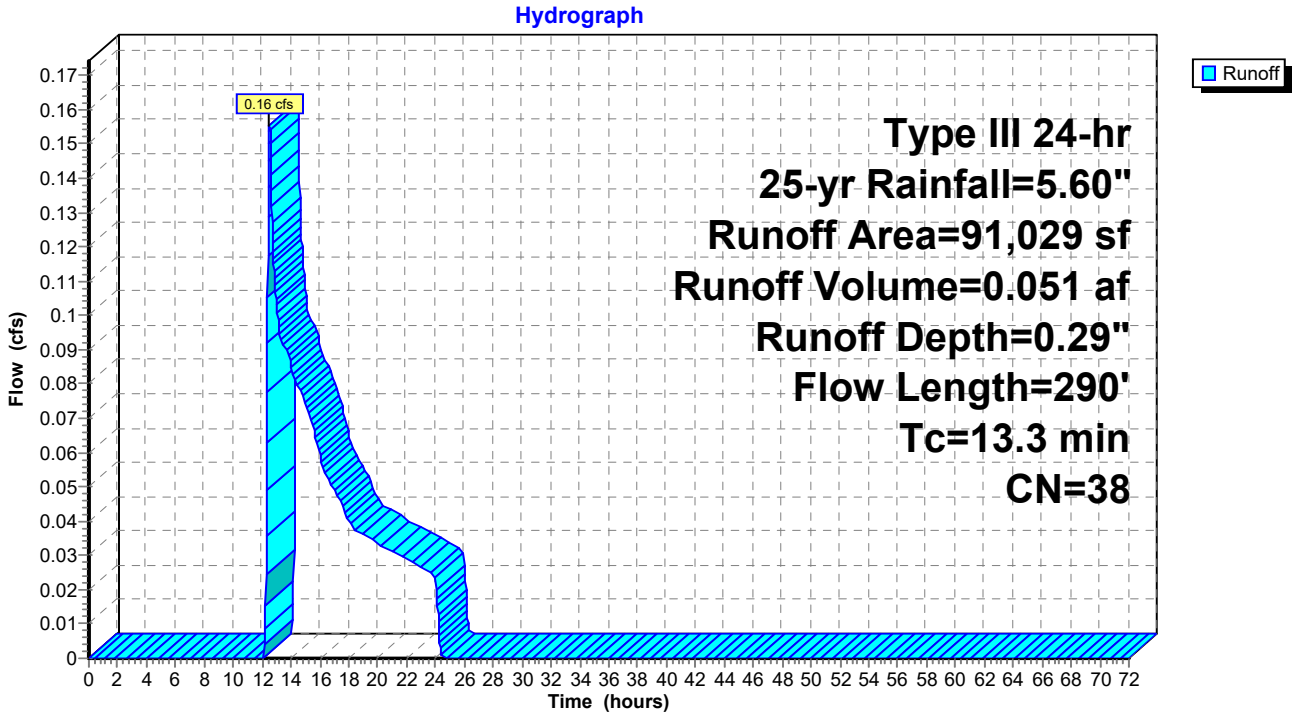
Runoff = 0.16 cfs @ 12.53 hrs, Volume= 0.051 af, Depth= 0.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 39,519 | 30 | Woods, Good, HSG A |
| | 1,209 | 70 | Woods, Good, HSG C |
| | 11,750 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 770 | 98 | Paved parking, HSG A |
| * | 15,917 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 18,600 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 2,858 | 98 | Paved parking, HSG A (OFFSITE) |
| | 91,029 | 38 | Weighted Average |
| | 87,401 | | 96.01% Pervious Area |
| | 3,628 | | 3.99% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.5 | 50 | 0.0220 | 0.07 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 240 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 13.3 | 290 | Total | | | |

## Subcatchment E5: SE Property



## Summary for Subcatchment E6: SE Property

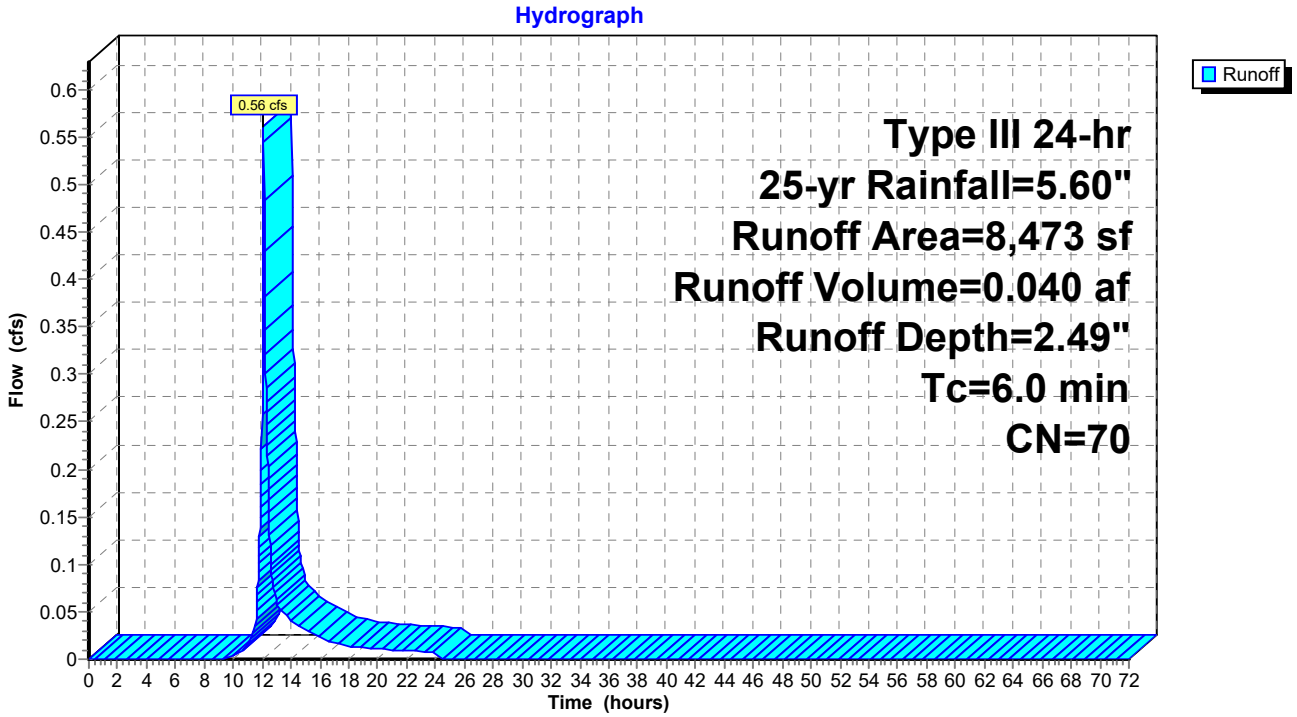
Runoff = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| Area (sf) | CN | Description |
|---|---|---|
| 8,473 | 70 | Woods, Good, HSG C |
| 8,473 | | 100.00% Pervious Area |

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

## Subcatchment E6: SE Property

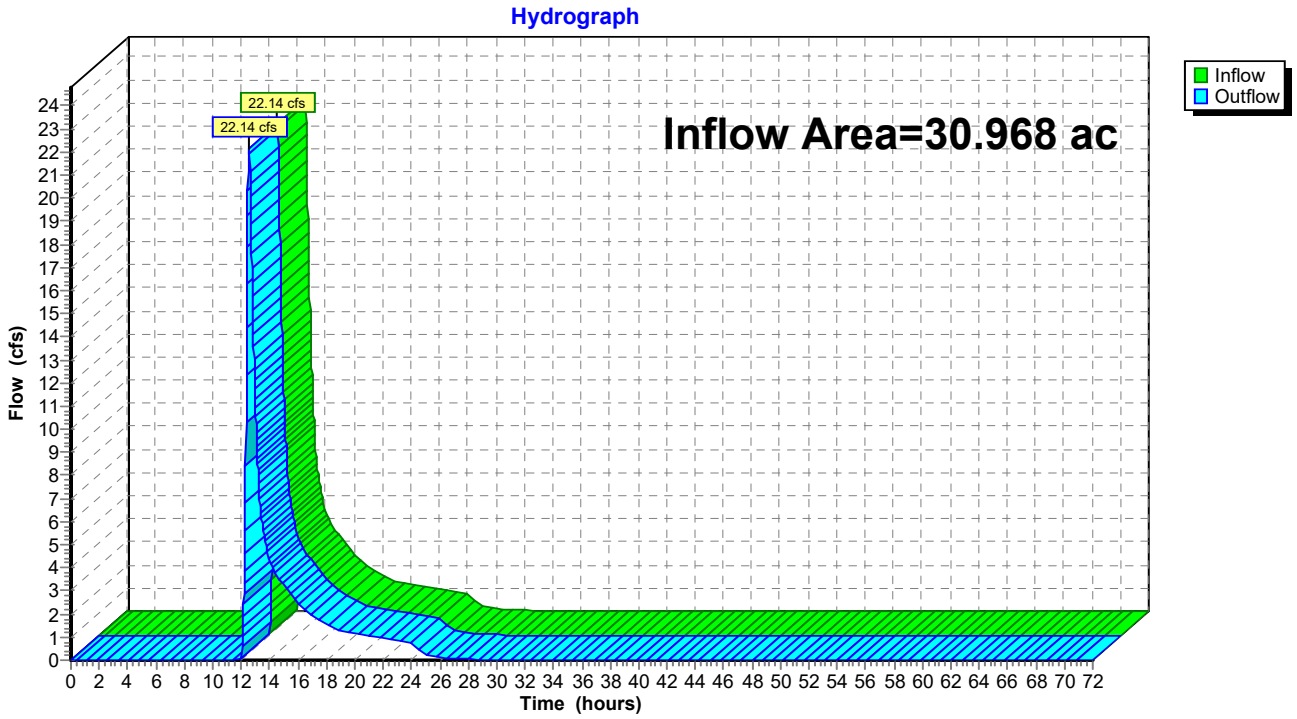


## Summary for Reach DP-1: Wetland

Inflow Area = 30.968 ac, 14.32% Impervious, Inflow Depth = 1.17" for 25-yr event
Inflow = 22.14 cfs @ 12.54 hrs, Volume= 3.031 af
Outflow = 22.14 cfs @ 12.54 hrs, Volume= 3.031 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-1: Wetland

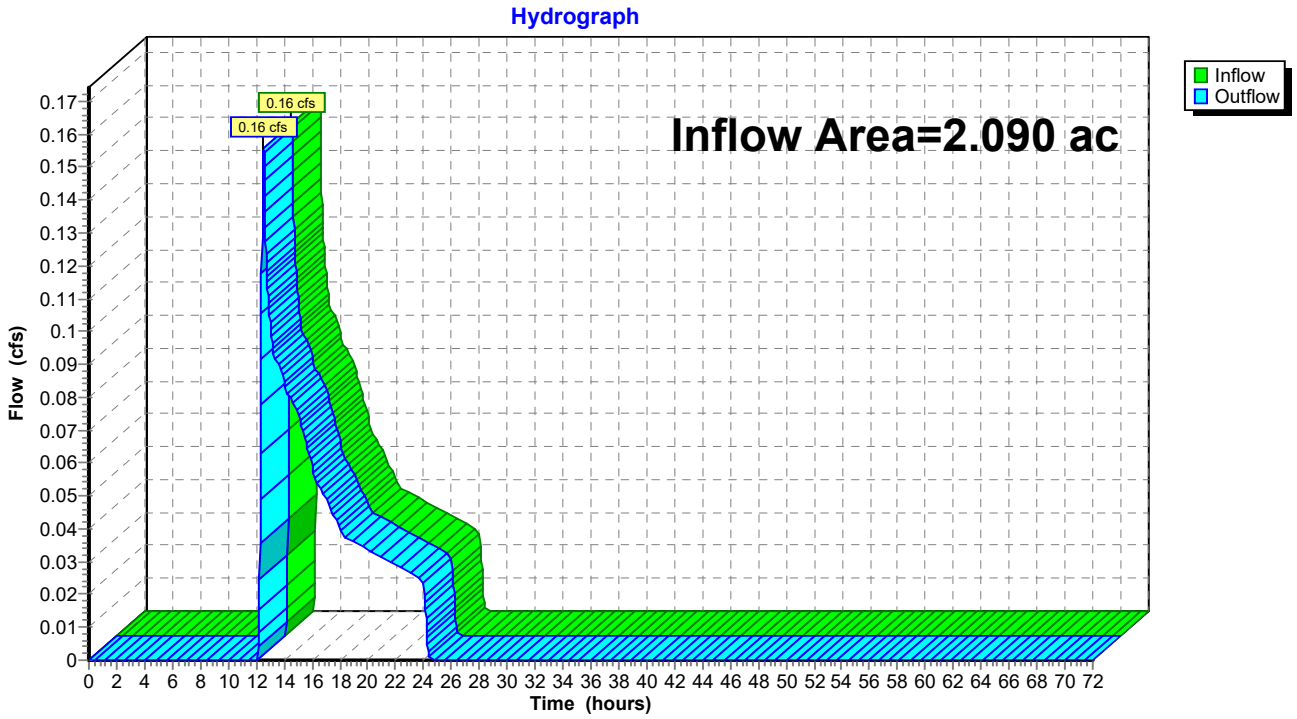


## Summary for Reach DP-2: PL 248 Water Street

Inflow Area = 2.090 ac, 3.99% Impervious, Inflow Depth = 0.29" for 25-yr event
Inflow = 0.16 cfs @ 12.53 hrs, Volume= 0.051 af
Outflow = 0.16 cfs @ 12.53 hrs, Volume= 0.051 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

### Reach DP-2: PL 248 Water Street

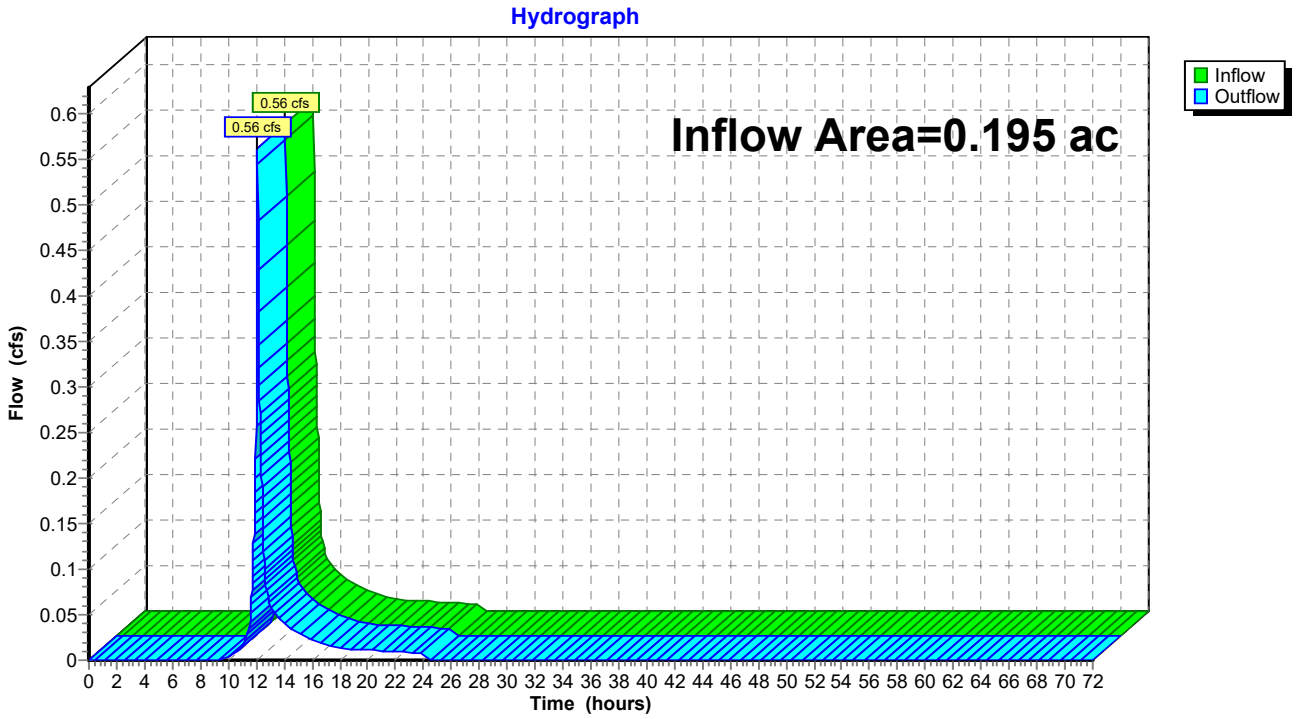


## Summary for Reach DP-3: South PL

Inflow Area = 0.195 ac, 0.00% Impervious, Inflow Depth = 2.49" for 25-yr event
Inflow = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af
Outflow = 0.56 cfs @ 12.09 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-3: South PL



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 3.42" for 25-yr event
Inflow = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af
Outflow = 13.22 cfs @ 12.45 hrs, Volume= 1.535 af, Atten= 0%, Lag= 1.0 min
Primary = 13.22 cfs @ 12.45 hrs, Volume= 1.535 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.07' @ 12.45 hrs Surf.Area= 13,407 sf Storage= 8,236 cf

Plug-Flow detention time= 71.2 min calculated for 1.535 af (90% of inflow)
Center-of-Mass det. time= 22.8 min ( 863.4 - 840.5 )

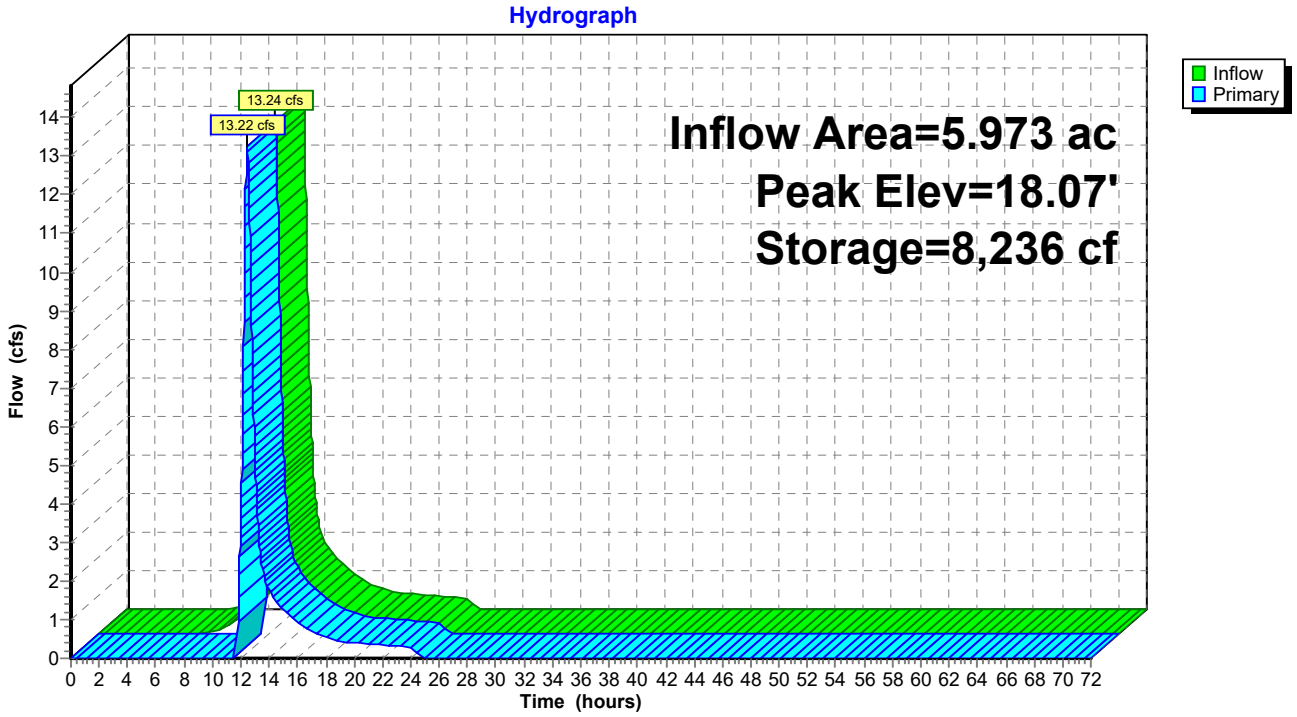
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=12.74 cfs @ 12.45 hrs HW=18.07' (Free Discharge)
↑**1=Asymmetrical Weir** (Weir Controls 12.74 cfs @ 0.86 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 11.837 ac, 34.25% Impervious, Inflow Depth = 2.50" for 25-yr event
Inflow = 20.65 cfs @ 12.39 hrs, Volume= 2.465 af
Outflow = 18.02 cfs @ 12.56 hrs, Volume= 2.225 af, Atten= 13%, Lag= 10.2 min
Primary = 18.02 cfs @ 12.56 hrs, Volume= 2.225 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.30' @ 12.56 hrs Surf.Area= 30,682 sf Storage= 23,036 cf

Plug-Flow detention time= 104.7 min calculated for 2.225 af (90% of inflow)
Center-of-Mass det. time= 58.2 min ( 925.3 - 867.1 )

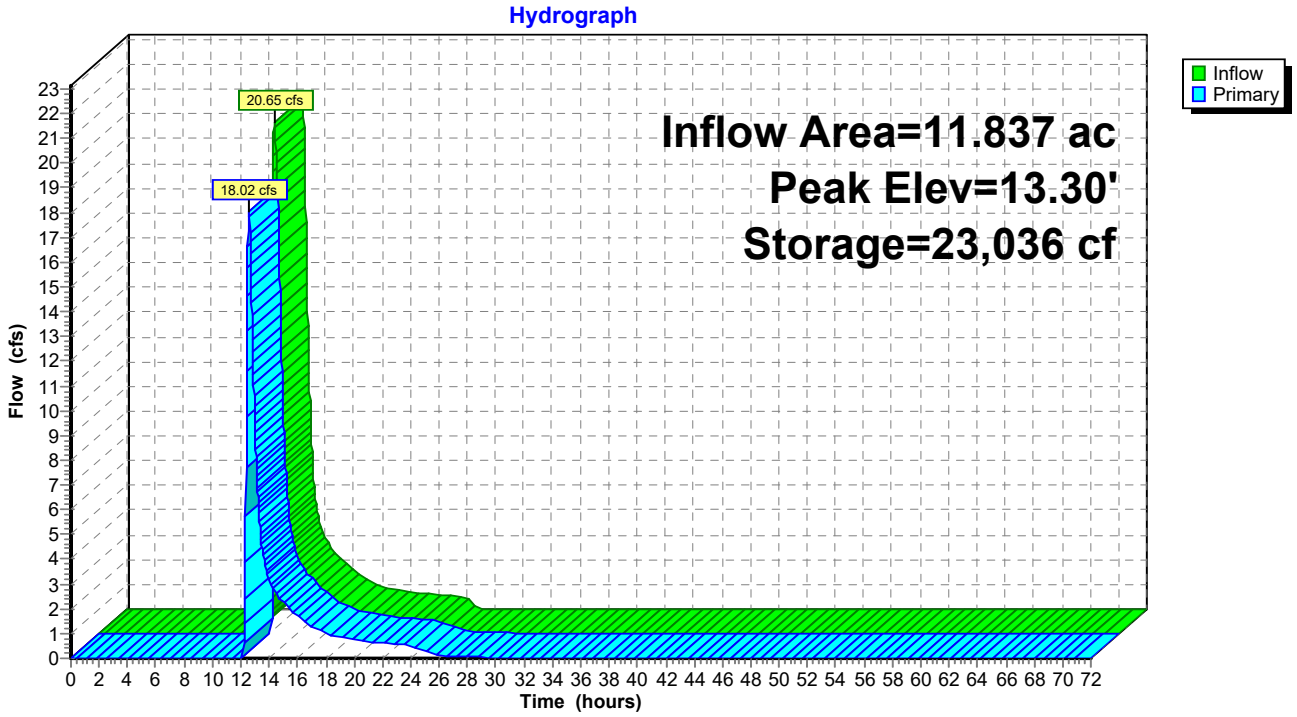
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31<br>Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00 |

**Primary OutFlow** Max=18.00 cfs @ 12.56 hrs HW=13.30' (Free Discharge)
↑—**1=Asymmetrical Weir** (Weir Controls 18.00 cfs @ 1.25 fps)

## Pond E-P2: Wetland



Time span=0.00-72.00 hrs, dt=0.02 hrs, 3601 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 E1: Property Offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=4.69"
Flow Length=343' Tc=31.4 min CN=80 Runoff=18.06 cfs 2.337 af

**Subcatchment E2: E2** Runoff Area=255,440 sf 5.35% Impervious Runoff Depth=2.90"
Flow Length=319' Tc=21.2 min CN=63 Runoff=12.84 cfs 1.418 af

**Subcatchment E3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.26"
Flow Length=683' Tc=13.5 min CN=31 Runoff=0.22 cfs 0.128 af

**Subcatchment E4: Central Property** Runoff Area=576,819 sf 2.06% Impervious Runoff Depth=1.32"
Flow Length=808' Tc=17.9 min CN=46 Runoff=11.24 cfs 1.457 af

**Subcatchment E5: SE Property** Runoff Area=91,029 sf 3.99% Impervious Runoff Depth=0.70"
Flow Length=290' Tc=13.3 min CN=38 Runoff=0.66 cfs 0.121 af

**Subcatchment E6: SE Property** Runoff Area=8,473 sf 0.00% Impervious Runoff Depth=3.62"
Tc=6.0 min CN=70 Runoff=0.82 cfs 0.059 af

**Reach DP-1: Wetland** Inflow=38.34 cfs 4.932 af
Outflow=38.34 cfs 4.932 af

**Reach DP-2: PL 248 Water Street** Inflow=0.66 cfs 0.121 af
Outflow=0.66 cfs 0.121 af

**Reach DP-3: South PL** Inflow=0.82 cfs 0.059 af
Outflow=0.82 cfs 0.059 af

**Pond E-P1: Wetland** Peak Elev=18.09' Storage=8,469 cf Inflow=18.06 cfs 2.337 af
Outflow=18.05 cfs 2.169 af

**Pond E-P2: Wetland** Peak Elev=13.38' Storage=25,818 cf Inflow=29.79 cfs 3.586 af
Outflow=28.42 cfs 3.347 af

**Total Runoff Area = 33.252 ac Runoff Volume = 5.520 af Average Runoff Depth = 1.99"**
**86.41% Pervious = 28.734 ac 13.59% Impervious = 4.518 ac**

## Summary for Subcatchment E1: Property Offsite

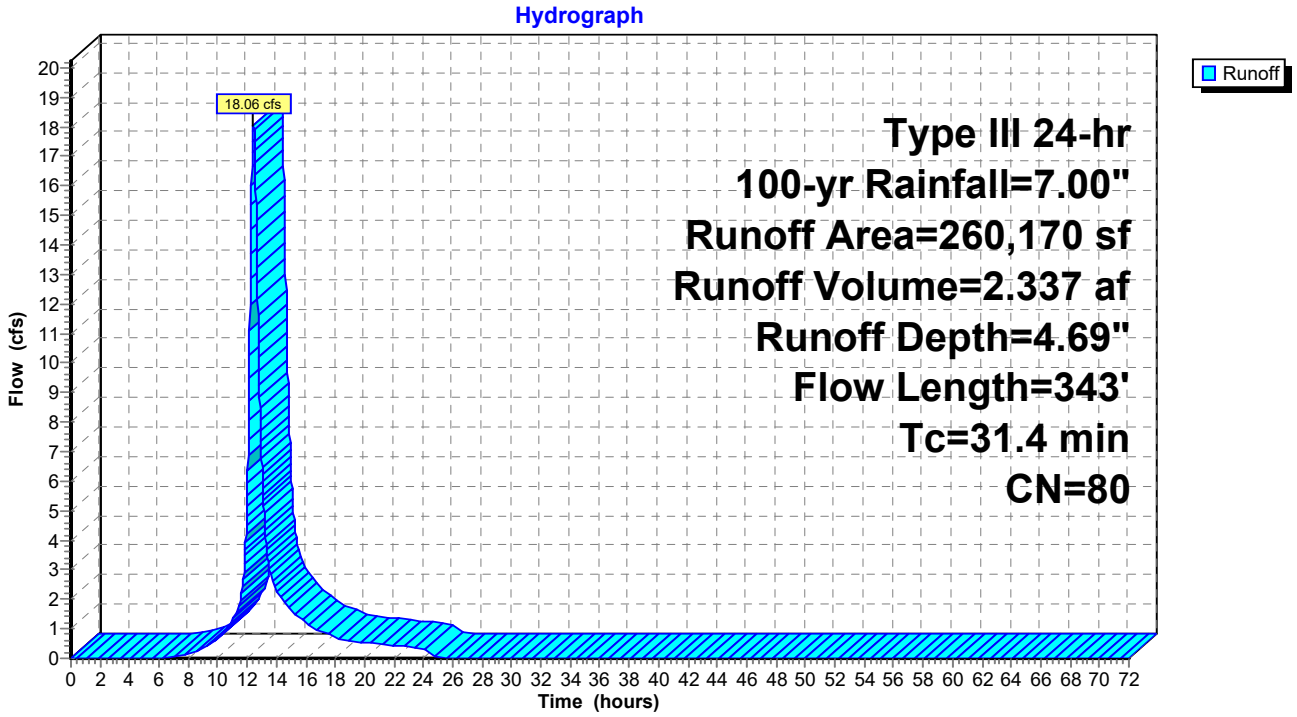
Runoff = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment E1: Property Offsite



## Summary for Subcatchment E2: E2

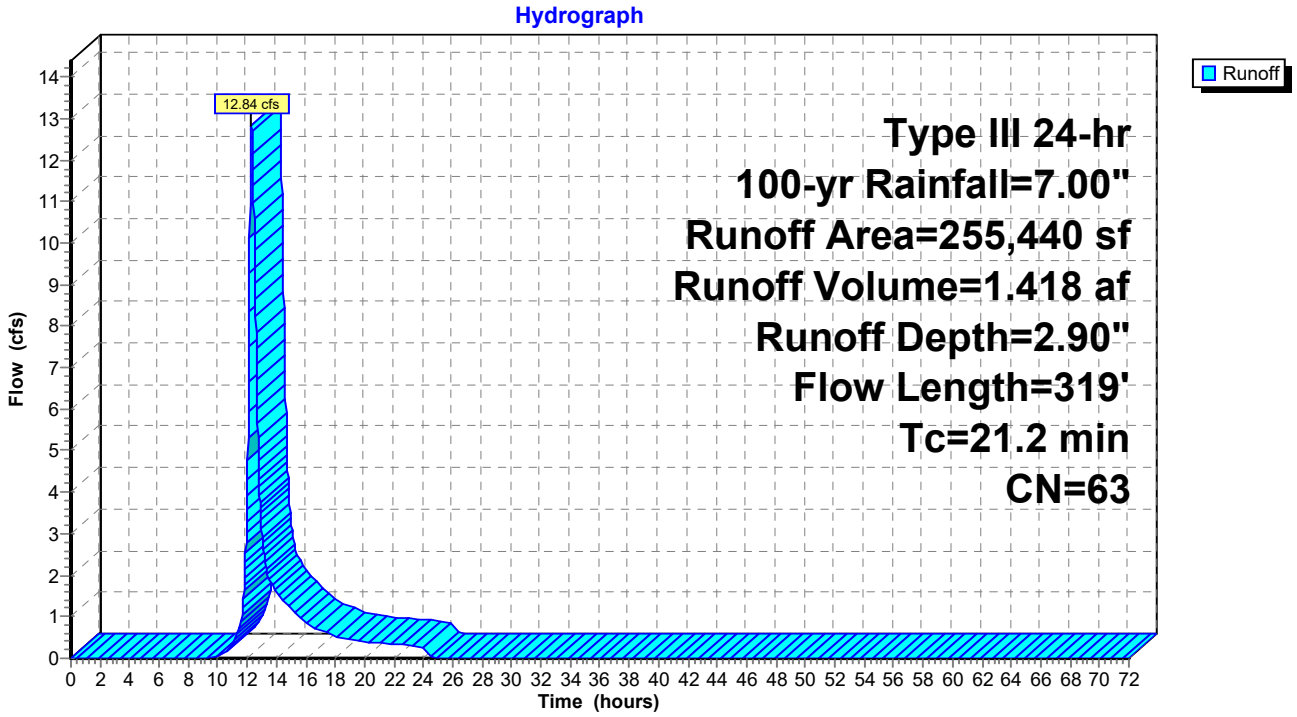
Runoff = 12.84 cfs @ 12.31 hrs, Volume= 1.418 af, Depth= 2.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 83,652 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| | 255,440 | 63 | Weighted Average |
| | 241,786 | | 94.65% Pervious Area |
| | 13,654 | | 5.35% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.2 | 95 | 0.0100 | 0.50 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.2 | 174 | 0.0710 | 1.33 | | **Shallow Concentrated Flow, c-WETLAND**<br>Woodland Kv= 5.0 fps |
| 21.2 | 319 | Total | | | |

## Subcatchment E2: E2



## Summary for Subcatchment E3: SW Property

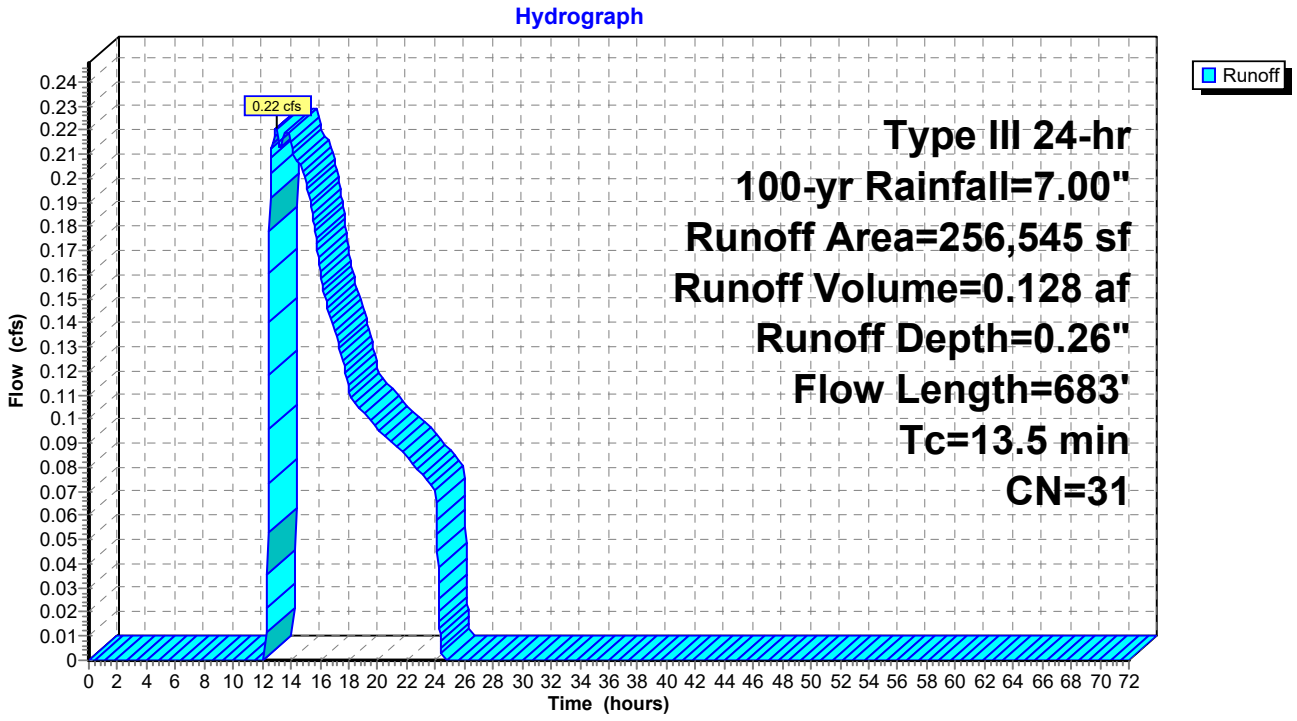
Runoff = 0.22 cfs @ 12.95 hrs, Volume= 0.128 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 157,110 | 30 | Woods, Good, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 31 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, Start Off Property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 3.3 | 633 | 0.0400 | 3.22 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 13.5 | 683 | Total | | | |

## Subcatchment E3: SW Property



## Summary for Subcatchment E4: Central Property

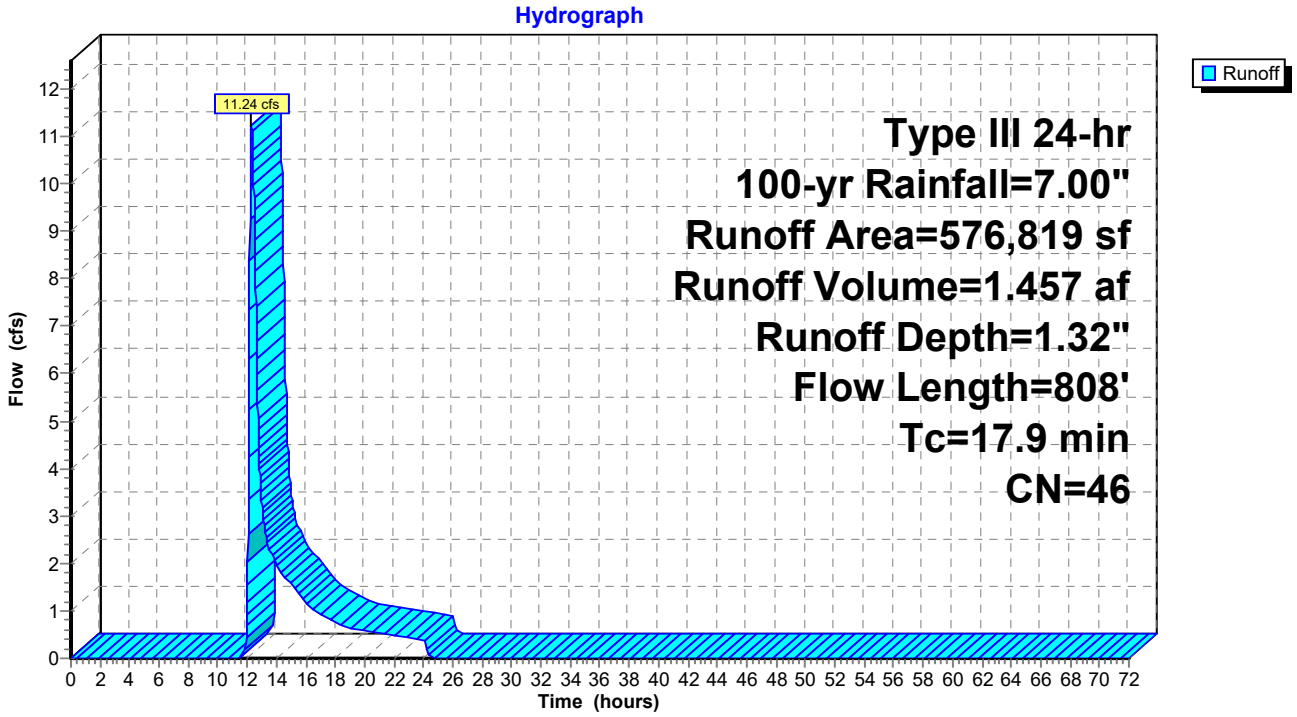
Runoff = 11.24 cfs @ 12.31 hrs, Volume= 1.457 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 317,356 | 30 | Woods, Good, HSG A |
| | 153,440 | 70 | Woods, Good, HSG C |
| * | 3,765 | 98 | Pavement, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| * | 17,970 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 41,632 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 576,819 | 46 | Weighted Average |
| | 564,933 | | 97.94% Pervious Area |
| | 11,886 | | 2.06% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 13.4 | 50 | 0.0150 | 0.06 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 4.5 | 758 | 0.0310 | 2.83 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 17.9 | 808 | Total | | | |

## Subcatchment E4: Central Property



## Summary for Subcatchment E5: SE Property

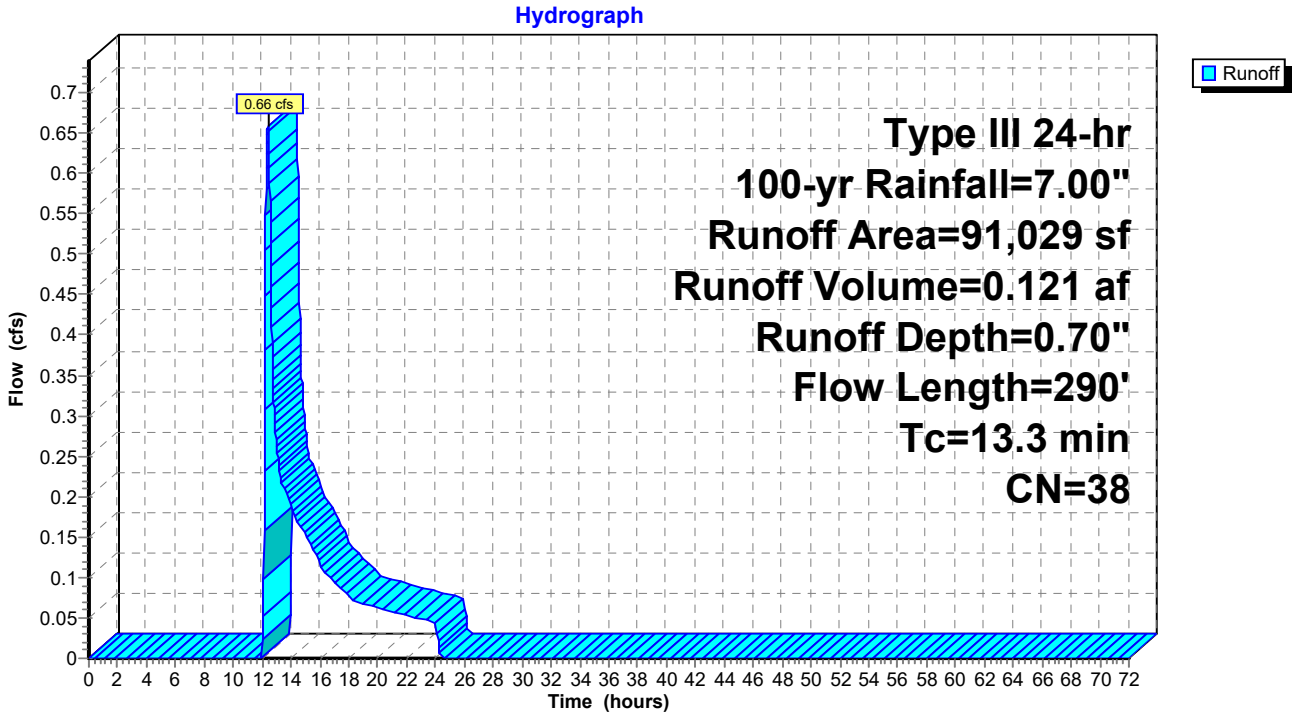
Runoff = 0.66 cfs @ 12.39 hrs, Volume= 0.121 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 39,519 | 30 | Woods, Good, HSG A |
| | 1,209 | 70 | Woods, Good, HSG C |
| | 11,750 | 49 | 50-75% Grass cover, Fair, HSG A |
| | 770 | 98 | Paved parking, HSG A |
| * | 15,917 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 18,600 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 2,858 | 98 | Paved parking, HSG A (OFFSITE) |
| | 91,029 | 38 | Weighted Average |
| | 87,401 | | 96.01% Pervious Area |
| | 3,628 | | 3.99% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 11.5 | 50 | 0.0220 | 0.07 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 240 | 0.0200 | 2.28 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 13.3 | 290 | Total | | | |

## Subcatchment E5: SE Property



## Summary for Subcatchment E6: SE Property

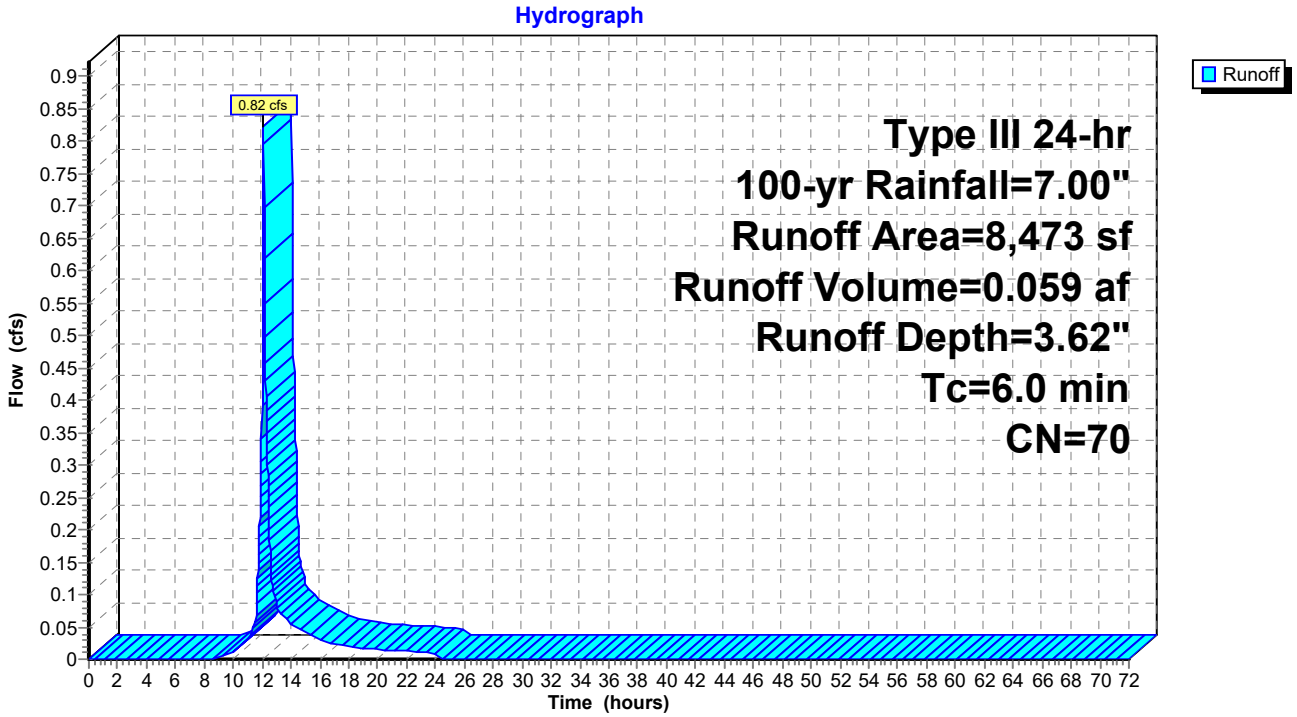
Runoff = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 8,473 | 70 | Woods, Good, HSG C |
| 8,473 | | 100.00% Pervious Area |

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

## Subcatchment E6: SE Property

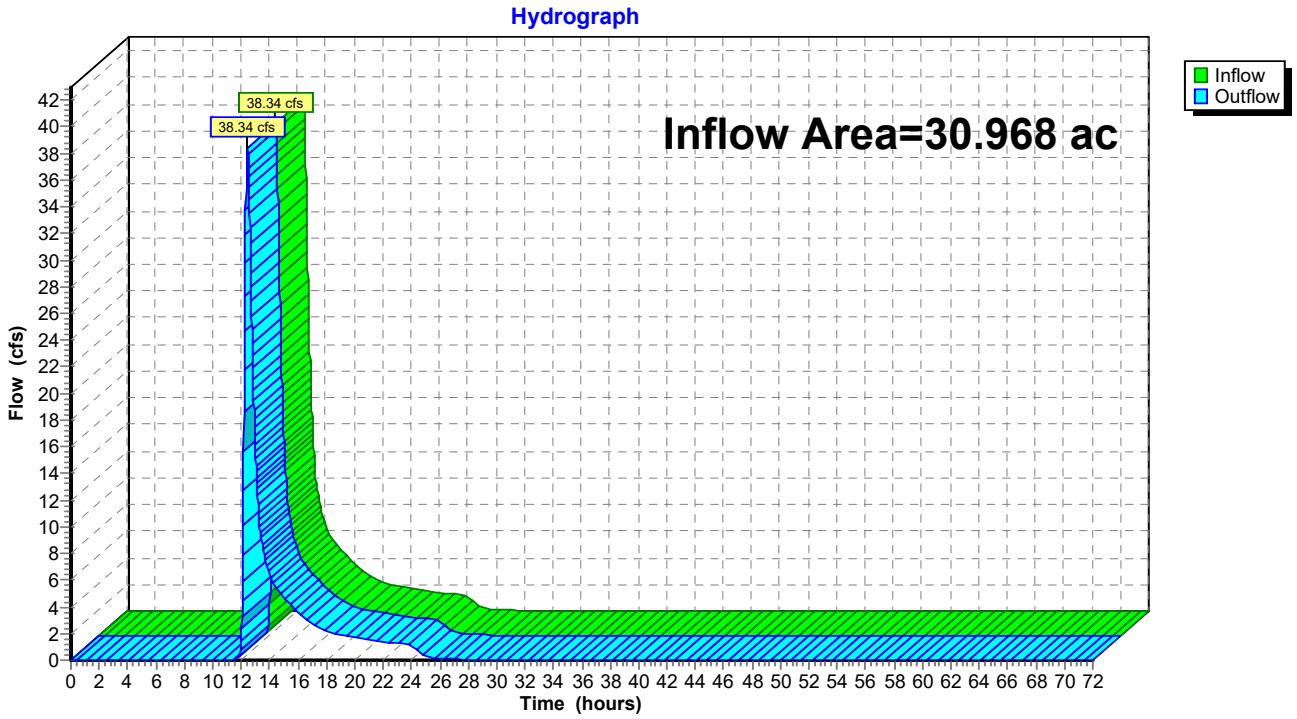


## Summary for Reach DP-1: Wetland

Inflow Area = 30.968 ac, 14.32% Impervious, Inflow Depth = 1.91" for 100-yr event
Inflow = 38.34 cfs @ 12.44 hrs, Volume= 4.932 af
Outflow = 38.34 cfs @ 12.44 hrs, Volume= 4.932 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-1: Wetland

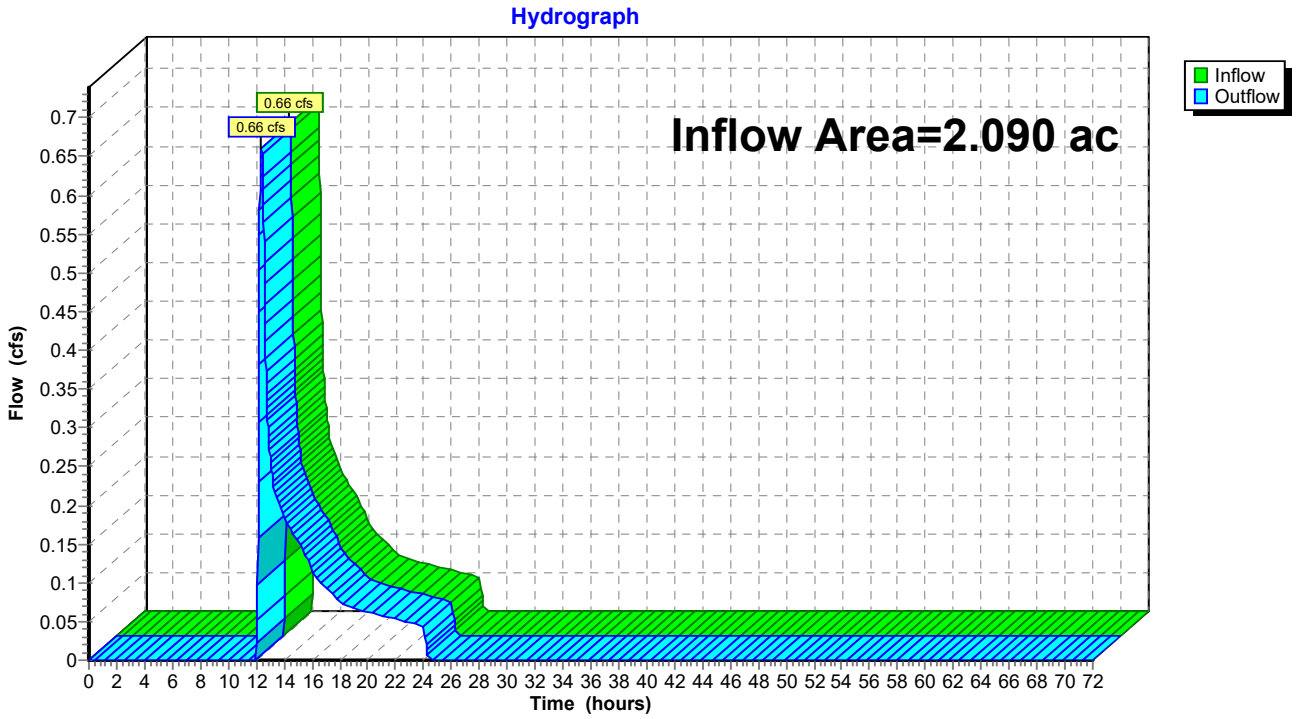


## Summary for Reach DP-2: PL 248 Water Street

Inflow Area = 2.090 ac, 3.99% Impervious, Inflow Depth = 0.70" for 100-yr event
Inflow = 0.66 cfs @ 12.39 hrs, Volume= 0.121 af
Outflow = 0.66 cfs @ 12.39 hrs, Volume= 0.121 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-2: PL 248 Water Street

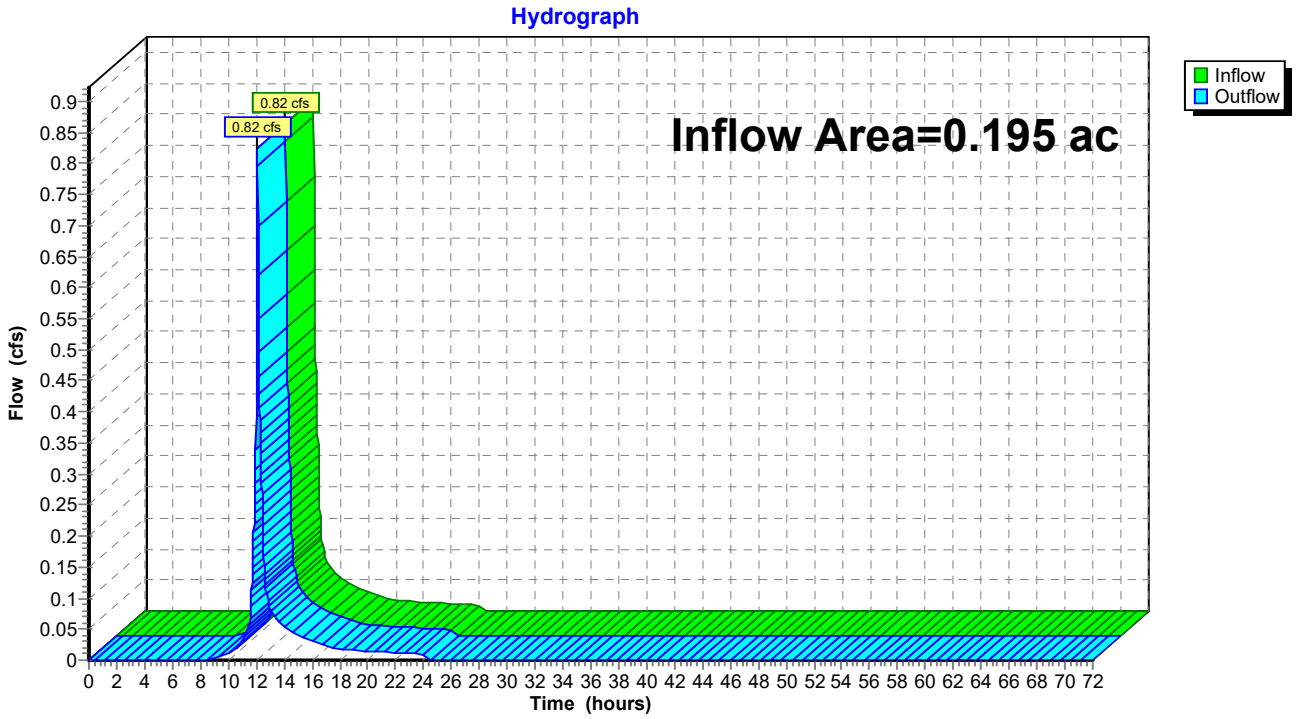


## Summary for Reach DP-3: South PL

Inflow Area = 0.195 ac, 0.00% Impervious, Inflow Depth = 3.62" for 100-yr event
Inflow = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af
Outflow = 0.82 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

## Reach DP-3: South PL



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 4.69" for 100-yr event
Inflow = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af
Outflow = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af, Atten= 0%, Lag= 0.7 min
Primary = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.09' @ 12.44 hrs Surf.Area= 13,677 sf Storage= 8,469 cf

Plug-Flow detention time= 57.4 min calculated for 2.169 af (93% of inflow)
Center-of-Mass det. time= 19.7 min ( 851.2 - 831.5 )

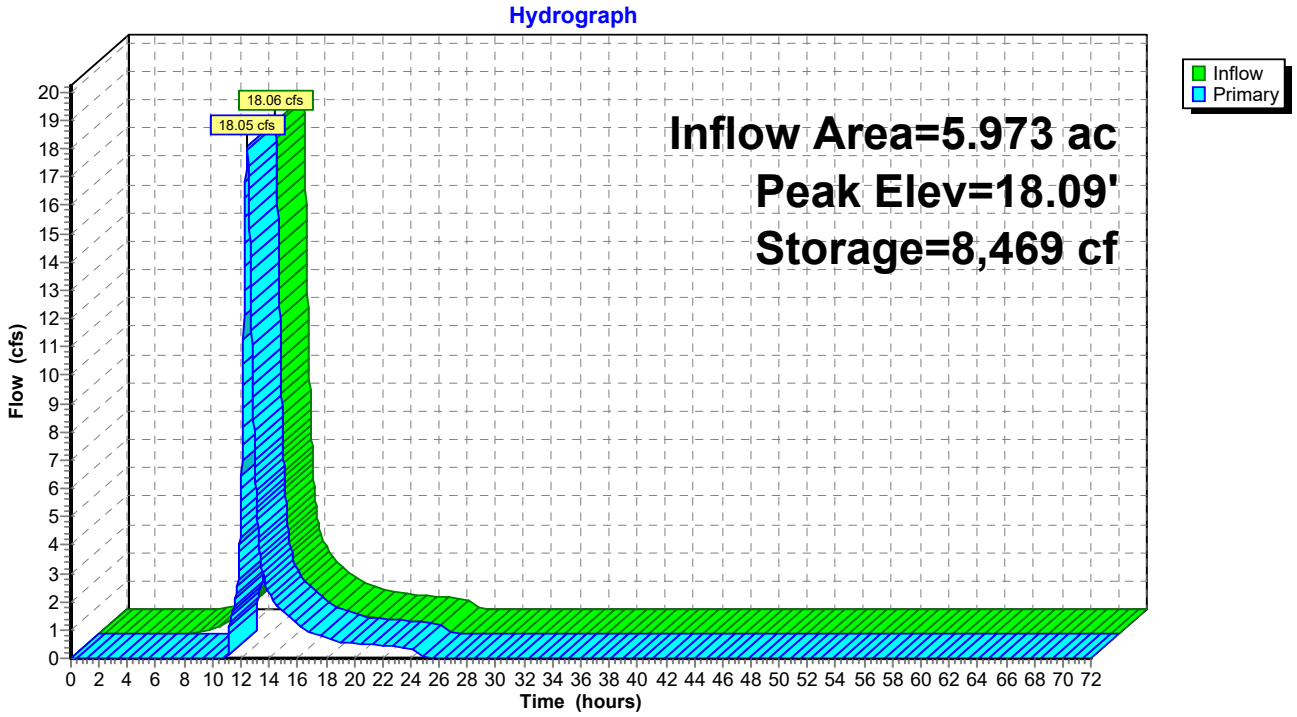
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=17.66 cfs @ 12.44 hrs HW=18.09' (Free Discharge)
**1=Asymmetrical Weir** (Weir Controls 17.66 cfs @ 0.95 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 11.837 ac, 34.25% Impervious, Inflow Depth = 3.64" for 100-yr event
Inflow = 29.79 cfs @ 12.38 hrs, Volume= 3.586 af
Outflow = 28.42 cfs @ 12.47 hrs, Volume= 3.347 af, Atten= 5%, Lag= 5.5 min
Primary = 28.42 cfs @ 12.47 hrs, Volume= 3.347 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 13.38' @ 12.47 hrs Surf.Area= 31,743 sf Storage= 25,818 cf

Plug-Flow detention time= 78.8 min calculated for 3.347 af (93% of inflow)
Center-of-Mass det. time= 44.0 min ( 898.9 - 854.9 )

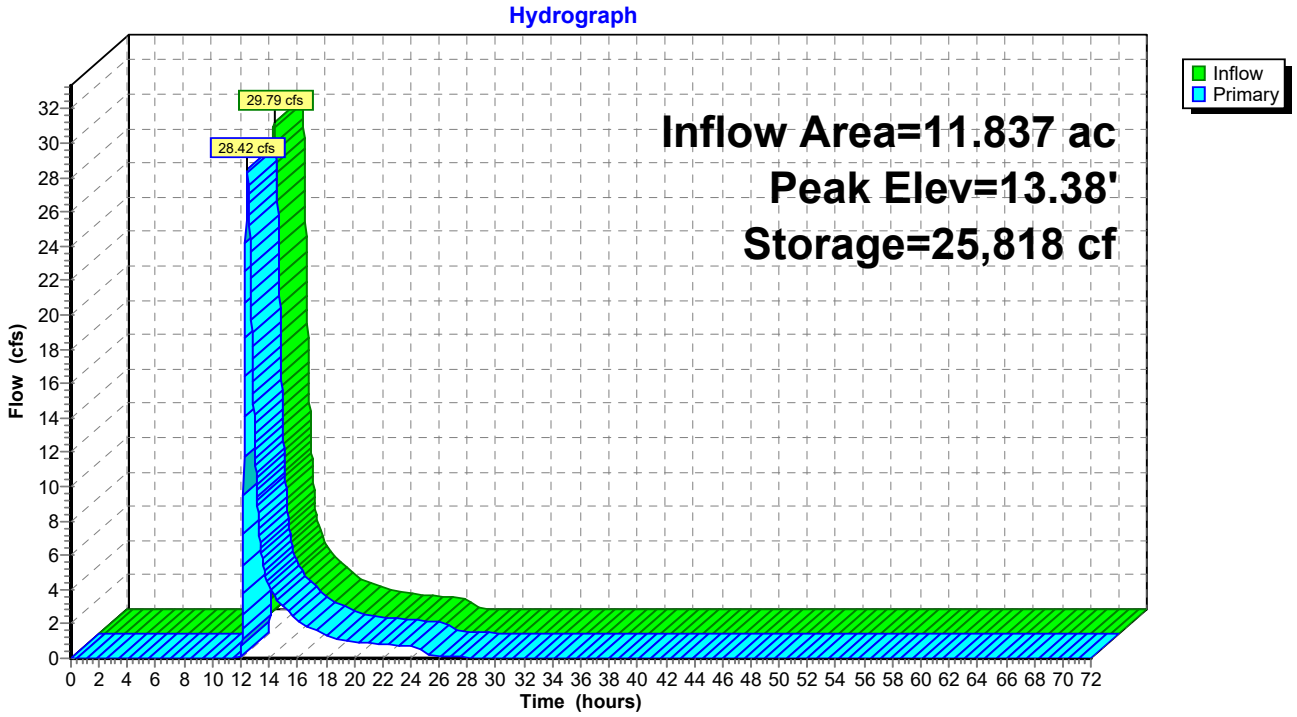
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 13.92 43.45 57.57 61.89 74.87 84.88 105.86 131.31<br>Elev. (feet) 14.00 13.56 13.12 13.03 12.83 13.08 13.85 13.88 14.00 |

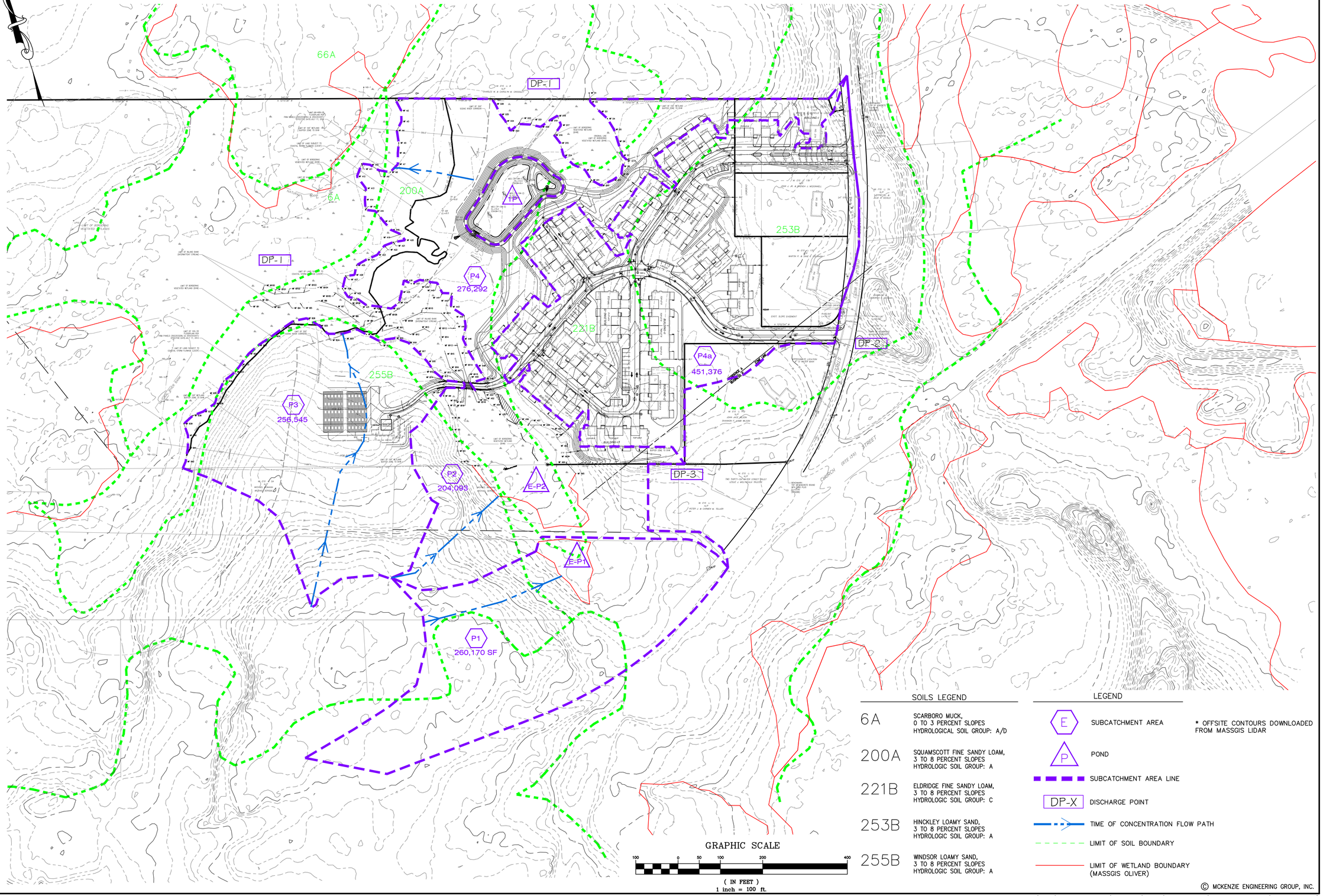
**Primary OutFlow** Max=28.39 cfs @ 12.47 hrs HW=13.38' (Free Discharge)
**1=Asymmetrical Weir** (Weir Controls 28.39 cfs @ 1.39 fps)

## Pond E-P2: Wetland



# A P P E N D I X B

## Post-Development Condition




SOILS LEGEND

| | |
|---|---|
| 6A | SCARBORO MUCK, 0 TO 3 PERCENT SLOPES HYDROLOGICAL SOIL GROUP: A/D |
| 200A | SQUAMSCOTT FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES HYDROLOGIC SOIL GROUP: A |
| 221B | ELDRIDGE FINE SANDY LOAM, 3 TO 8 PERCENT SLOPES HYDROLOGIC SOIL GROUP: C |
| 253B | HINCKLEY LOAMY SAND, 3 TO 8 PERCENT SLOPES HYDROLOGIC SOIL GROUP: A |
| 255B | WINDSOR LOAMY SAND, 3 TO 8 PERCENT SLOPES HYDROLOGIC SOIL GROUP: A |

LEGEND

- E — SUBCATCHMENT AREA
- P — POND
- SUBCATCHMENT AREA LINE
- DP-X — DISCHARGE POINT
- TIME OF CONCENTRATION FLOW PATH
- LIMIT OF SOIL BOUNDARY
- LIMIT OF WETLAND BOUNDARY (MASSGIS OLIVER)

* OFFSITE CONTOURS DOWNLOADED FROM MASSGIS LIDAR



| REV | DATE | DESCRIPTION | BY | APP |
|---|---|---|---|---|
| 1 | 4/5/2021 | MERRILL ENGINEERS PEER REVIEW COMMENTS | SBS | BCM |

PREPARED BY:
MCKENZIE ENGINEERING GROUP
Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061
P: 781.792.3900
F: 781.792.0333
www.mckeng.com

# RIVER MARSH VILLAGE
# COMPREHENSIVE PERMIT PLAN

(ASSESSOR'S MAP E-17, LOT 0 AND E-17A, LOT 274)

WATER STREET
PEMBROKE, MASSACHUSETTS

PROFESSIONAL ENGINEER:

OWNER/APPLICANT:
RIVER MARSH, LLC
293R WASHINGTON STREET
NORWELL, MA 02061

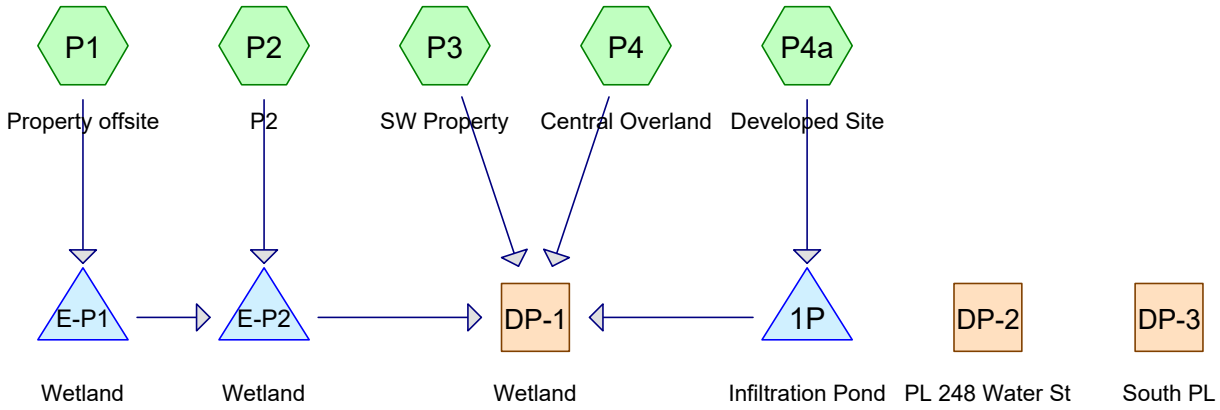
PERMITTING

| | |
|---|---|
| DRAWN BY: | AJC |
| DESIGNED BY: | SBS |
| CHECKED BY: | SBS |
| APPROVED BY: | BCM |
| DATE: | AUGUST 1, 2018 |
| SCALE: | 1"=100' |
| PROJECT NO.: | 215-181 |

DWG. TITLE:
POST-DEVELOPMENT WATERSHED PLAN

DWG. NO:
WS-2

M:\MEG\2015 PROJECTS\215-181\DWGS\CUT SHEETS\ZBA APPLICATION\SUBMISSION (R2)\215-181 WATERSHED (R2).DWG




Subcat Reach Pond Link

**Routing Diagram for 215-181 Post-DEV (R2)**
Prepared by McKenzie Engineering Group, Inc., Printed 4/7/2021

## Rainfall Events Listing

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 2-yr | Type III 24-hr | | Default | 24.00 | 1 | 3.40 | 2 |
| 2 | 10-yr | Type III 24-hr | | Default | 24.00 | 1 | 4.70 | 2 |
| 3 | 25-yr | Type III 24-hr | | Default | 24.00 | 1 | 5.60 | 2 |
| 4 | 100-yr | Type III 24-hr | | Default | 24.00 | 1 | 7.00 | 2 |

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 3.779 | 39 | >75% Grass cover, Good, HSG A (P3, P4, P4a) |
| 1.403 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) (P4, P4a) |
| 2.108 | 74 | >75% Grass cover, Good, HSG C (P2, P4, P4a) |
| 0.077 | 98 | Decks, HSG A (P4, P4a) |
| 0.194 | 98 | Decks, HSG C (P2, P4, P4a) |
| 0.142 | 76 | Gravel roads, HSG A (P3, P4) |
| 0.295 | 98 | Impervious, HSG A (OFFSITE) (P3, P4a) |
| 0.601 | 39 | Infiltration basin, HSG A (P4a) |
| 1.091 | 98 | Paved parking, HSG A (P4a) |
| 0.261 | 98 | Paved parking, HSG A (OFFSITE) (P2, P4a) |
| 1.088 | 98 | Paved parking, HSG C (P4a) |
| 0.106 | 98 | Paved parking, HSG C (OFFSITE) (P2) |
| 0.086 | 98 | Pavement, HSG A (OFFSITE) (P4, P4a) |
| 0.043 | 98 | Roof, HSG A (P4) |
| 0.746 | 98 | Roofs, HSG A (P4a) |
| 1.657 | 98 | Roofs, HSG C (P4a) |
| 3.277 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) (P1) |
| 1.124 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) (P1) |
| 0.657 | 78 | Wetlands/woods, HSG A (P2) |
| 0.199 | 78 | Wetlands/woods, HSG A (OFFSITE) (P1) |
| 0.136 | 78 | Wetlands/woods, HSG C (P2) |
| 0.133 | 78 | Wetlands/woods, HSG C (OFFSITE) (P1, P2) |
| 0.463 | 78 | Wetlands/woods. HSG A (OFFSITE) (P2) |
| 2.175 | 30 | Woods, Fair, HSG A (OFFSITE) (P3) |
| 6.620 | 30 | Woods, Good, HSG A (P2, P3, P4) |
| 2.648 | 30 | Woods, Good, HSG A (OFFSITE) (P1, P2, P4a) |
| 0.755 | 70 | Woods, Good, HSG C (P2, P4) |
| 1.390 | 70 | Woods, Good, HSG C (OFFSITE) (P1, P2, P4a) |
| **33.252** | **59** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 24.563 | HSG A | P1, P2, P3, P4, P4a |
| 0.000 | HSG B | |
| 8.690 | HSG C | P1, P2, P4, P4a |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **33.252** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 5.183 | 0.000 | 2.108 | 0.000 | 0.000 | 7.290 | >75% Grass cover, Good | P2, P3, P4, P4a |
| 0.077 | 0.000 | 0.194 | 0.000 | 0.000 | 0.271 | Decks | P2, P4, P4a |
| 0.142 | 0.000 | 0.000 | 0.000 | 0.000 | 0.142 | Gravel roads | P3, P4 |
| 0.295 | 0.000 | 0.000 | 0.000 | 0.000 | 0.295 | Impervious | P3, P4a |
| 0.601 | 0.000 | 0.000 | 0.000 | 0.000 | 0.601 | Infiltration basin | P4a |
| 1.352 | 0.000 | 1.194 | 0.000 | 0.000 | 2.546 | Paved parking | P2, P4a |
| 0.086 | 0.000 | 0.000 | 0.000 | 0.000 | 0.086 | Pavement | P4, P4a |
| 0.043 | 0.000 | 0.000 | 0.000 | 0.000 | 0.043 | Roof | P4 |
| 0.746 | 0.000 | 1.657 | 0.000 | 0.000 | 2.403 | Roofs | P4a |
| 3.277 | 0.000 | 1.124 | 0.000 | 0.000 | 4.401 | Urban commercial, 85% imp | P1 |
| 0.856 | 0.000 | 0.269 | 0.000 | 0.000 | 1.126 | Wetlands/woods | P1, P2 |
| 0.463 | 0.000 | 0.000 | 0.000 | 0.000 | 0.463 | Wetlands/woods. | P2 |
| 2.175 | 0.000 | 0.000 | 0.000 | 0.000 | 2.175 | Woods, Fair | P3 |
| 9.268 | 0.000 | 2.145 | 0.000 | 0.000 | 11.413 | Woods, Good | P1, P2, P3, P4, P4a |
| **24.563** | **0.000** | **8.690** | **0.000** | **0.000** | **33.252** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Width (inches) | Diam/Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1P | 10.00 | 9.00 | 46.0 | 0.0217 | 0.013 | 0.0 | 12.0 | 0.0 |
| 2 | E-P2 | 12.83 | 12.83 | 18.0 | 0.0000 | 0.022 | 144.0 | 72.0 | 0.0 |

Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P1: Property offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=1.56"
Flow Length=343' Tc=31.4 min CN=80 Runoff=5.98 cfs 0.775 af

**Subcatchment P2: P2** Runoff Area=204,093 sf 7.43% Impervious Runoff Depth=0.57"
Flow Length=315' Tc=15.1 min CN=62 Runoff=1.70 cfs 0.222 af

**Subcatchment P3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.00"
Flow Length=400' Tc=12.0 min CN=33 Runoff=0.00 cfs 0.000 af

**Subcatchment P4: Central Overland** Runoff Area=276,292 sf 2.80% Impervious Runoff Depth=0.03"
Flow Length=190' Tc=17.0 min CN=42 Runoff=0.02 cfs 0.015 af

**Subcatchment P4a: Developed Site** Runoff Area=451,376 sf 48.35% Impervious Runoff Depth=0.95"
Tc=6.0 min CN=70 Runoff=10.49 cfs 0.818 af

**Reach DP-1: Wetland** Inflow=1.33 cfs 0.608 af
Outflow=1.33 cfs 0.608 af

**Reach DP-2: PL 248 Water St**
Outflow=0.00 cfs 0.000 af

**Reach DP-3: South PL**
Outflow=0.00 cfs 0.000 af

**Pond 1P: Infiltration Pond** Peak Elev=12.70' Storage=16,340 cf Inflow=10.49 cfs 0.818 af
Discarded=0.71 cfs 0.818 af Primary=0.00 cfs 0.000 af Outflow=0.71 cfs 0.818 af

**Pond E-P1: Wetland** Peak Elev=18.04' Storage=7,861 cf Inflow=5.98 cfs 0.775 af
Outflow=5.93 cfs 0.607 af

**Pond E-P2: Wetland** Peak Elev=13.02' Storage=15,091 cf Inflow=7.27 cfs 0.830 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=1.33 cfs 0.593 af

**Total Runoff Area = 33.252 ac Runoff Volume = 1.830 af Average Runoff Depth = 0.66"**
**71.78% Pervious = 23.868 ac 28.22% Impervious = 9.384 ac**

## Summary for Subcatchment P1: Property offsite

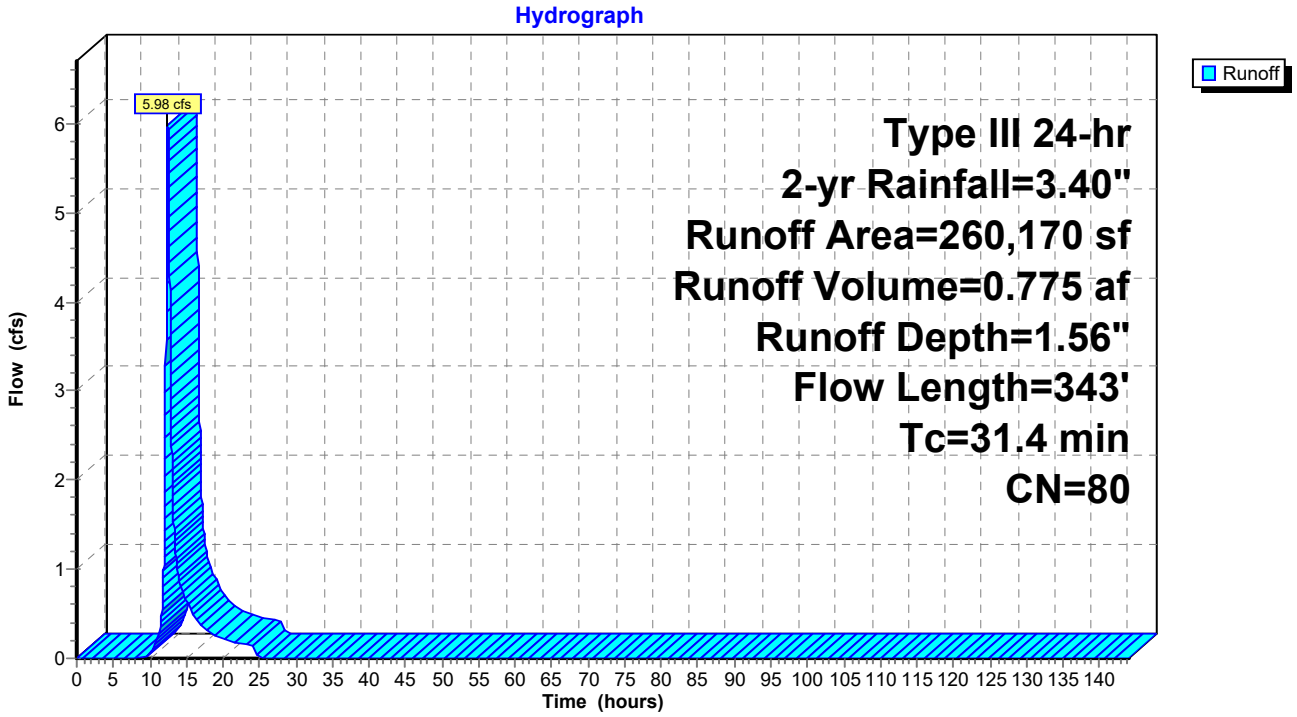
Runoff = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af, Depth= 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment P1: Property offsite



## Summary for Subcatchment P2: P2

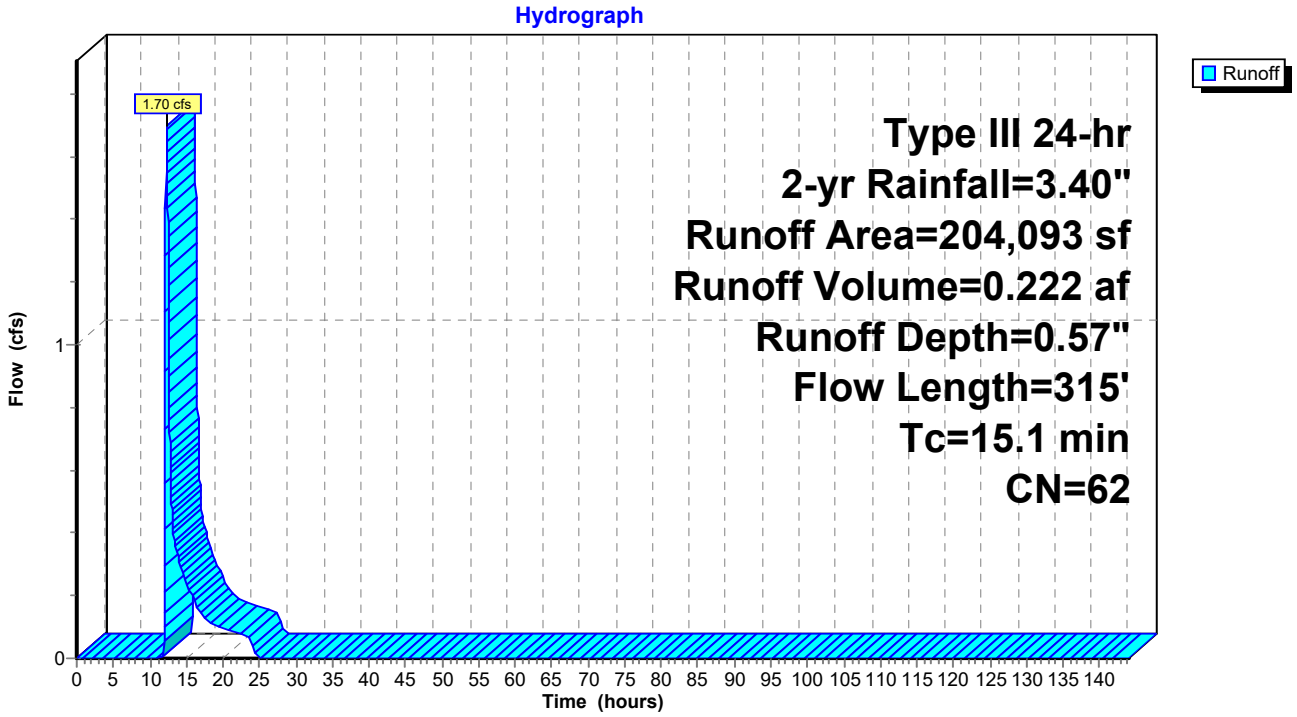
Runoff = 1.70 cfs @ 12.27 hrs, Volume= 0.222 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 15,787 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| * | 1,504 | 98 | Decks, HSG C |
| | 15,014 | 74 | >75% Grass cover, Good, HSG C |
| | 204,093 | 62 | Weighted Average |
| | 188,935 | | 92.57% Pervious Area |
| | 15,158 | | 7.43% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.2 | 50 | 0.0190 | 0.07 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.5 | 116 | 0.0690 | 1.31 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.1 | 20 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 1.3 | 129 | 0.1100 | 1.66 | | **Shallow Concentrated Flow, D-WETLAND**<br>Woodland Kv= 5.0 fps |
| 15.1 | 315 | Total | | | |

## Subcatchment P2: P2



## Summary for Subcatchment P3: SW Property

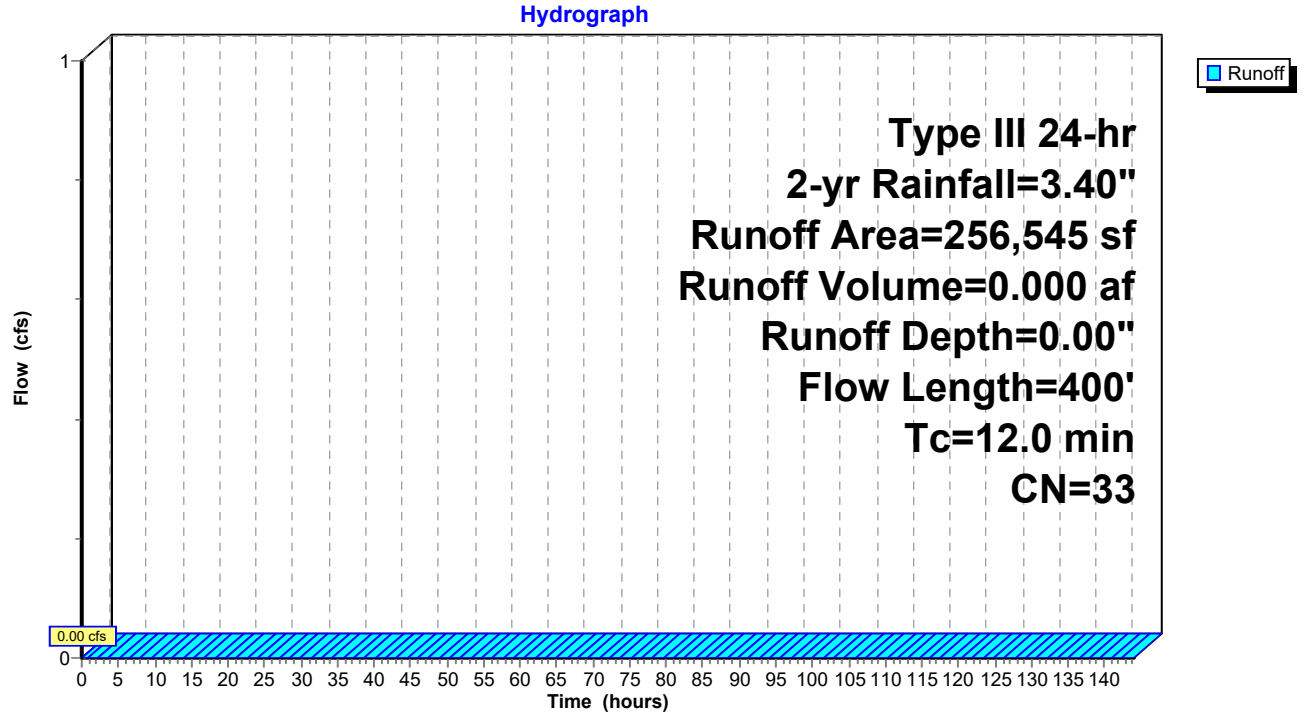
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 118,145 | 30 | Woods, Good, HSG A |
| | 33,865 | 39 | >75% Grass cover, Good, HSG A |
| | 5,100 | 76 | Gravel roads, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 33 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, START off property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 350 | 0.0410 | 3.26 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 12.0 | 400 | Total | | | |

## Subcatchment P3: SW Property



## Summary for Subcatchment P4: Central Overland

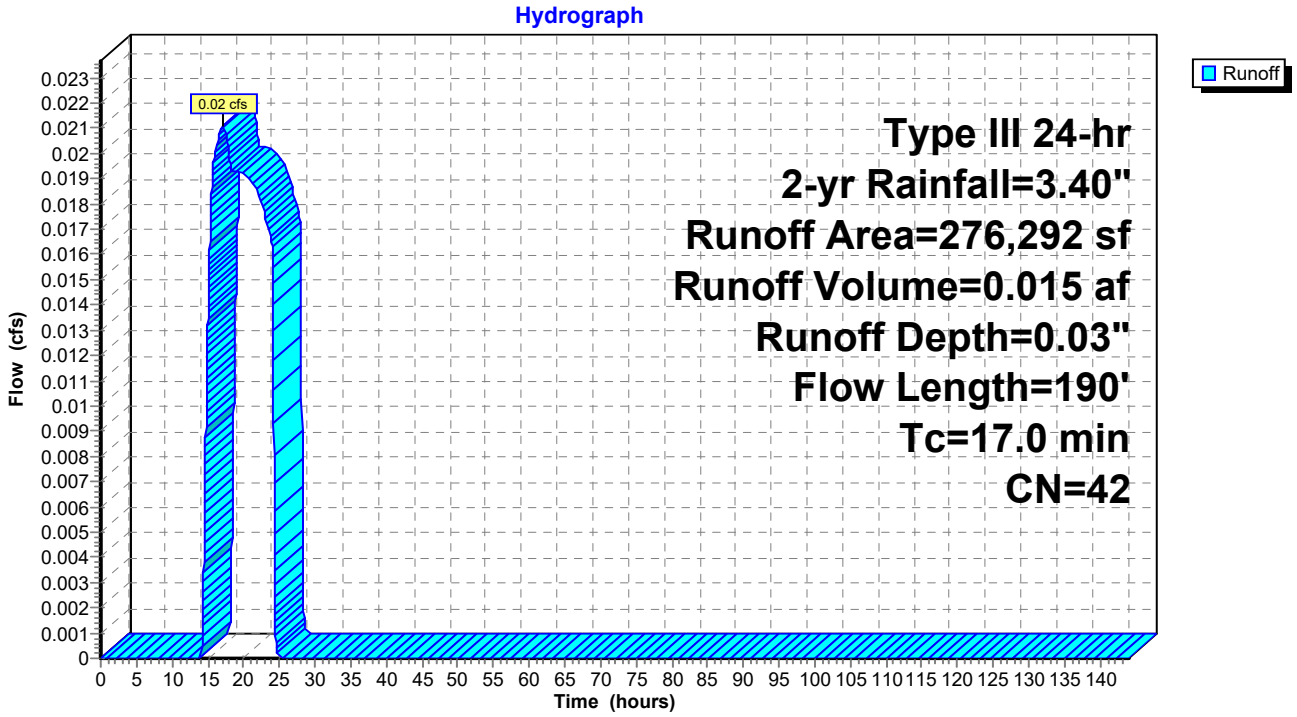
Runoff = 0.02 cfs @ 17.06 hrs, Volume= 0.015 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 154,403 | 30 | Woods, Good, HSG A |
| | 63,719 | 39 | >75% Grass cover, Good, HSG A |
| | 1,074 | 76 | Gravel roads, HSG A |
| | 17,086 | 70 | Woods, Good, HSG C |
| | 31,379 | 74 | >75% Grass cover, Good, HSG C |
| * | 5,169 | 98 | Decks, HSG C |
| * | 652 | 98 | Decks, HSG A |
| * | 1,860 | 98 | Roof, HSG A |
| * | 58 | 98 | Pavement, HSG A (OFFSITE) |
| * | 892 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| | 276,292 | 42 | Weighted Average |
| | 268,553 | | 97.20% Pervious Area |
| | 7,739 | | 2.80% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.2 | 140 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps |
| 17.0 | 190 | Total | | | |

## Subcatchment P4: Central Overland



## Summary for Subcatchment P4a: Developed Site

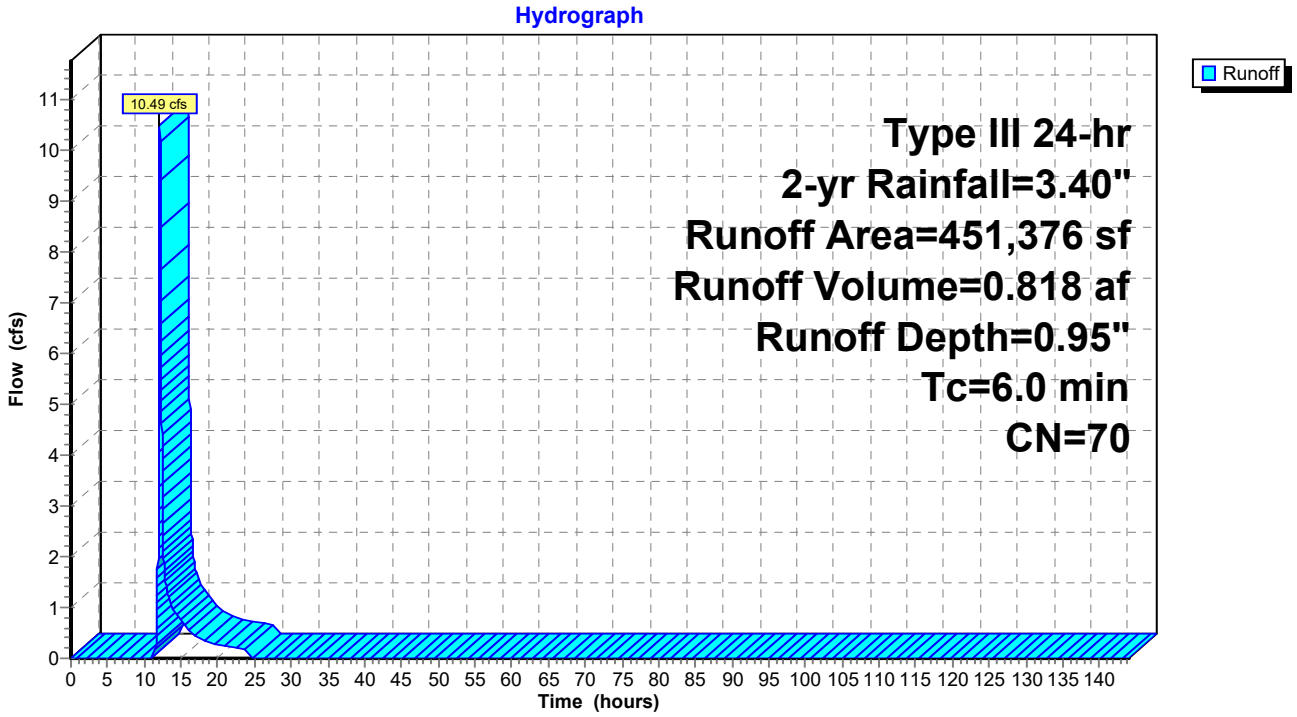
Runoff = 10.49 cfs @ 12.10 hrs, Volume= 0.818 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-yr Rainfall=3.40"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 67,047 | 39 | >75% Grass cover, Good, HSG A |
| | 47,531 | 98 | Paved parking, HSG A |
| | 32,505 | 98 | Roofs, HSG A |
| * | 2,709 | 98 | Decks, HSG A |
| * | 26,160 | 39 | Infiltration basin, HSG A |
| | 45,411 | 74 | >75% Grass cover, Good, HSG C |
| | 72,174 | 98 | Roofs, HSG C |
| * | 47,403 | 98 | Paved parking, HSG C |
| * | 1,771 | 98 | Decks, HSG C |
| * | 33,887 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 60,232 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 3,707 | 98 | Pavement, HSG A (OFFSITE) |
| * | 2,312 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| | 451,376 | 70 | Weighted Average |
| | 233,143 | | 51.65% Pervious Area |
| | 218,233 | | 48.35% Impervious Area |

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

## Subcatchment P4a: Developed Site

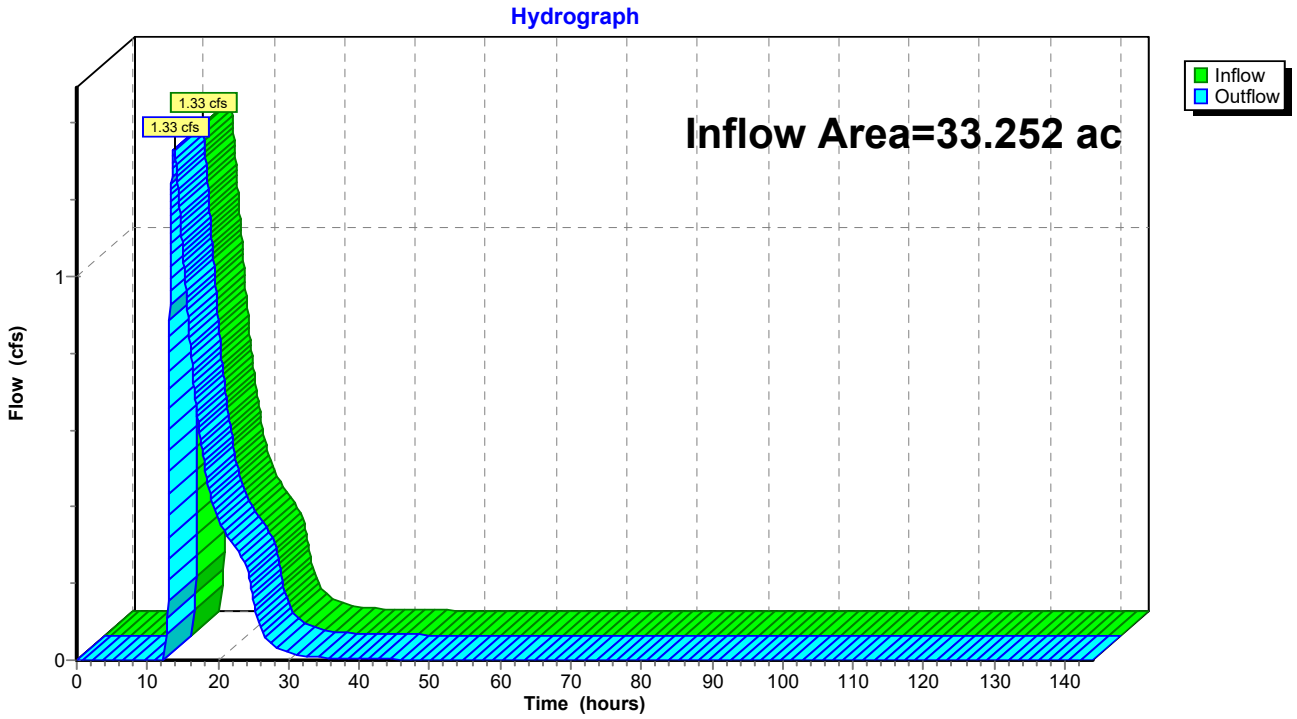


## Summary for Reach DP-1: Wetland

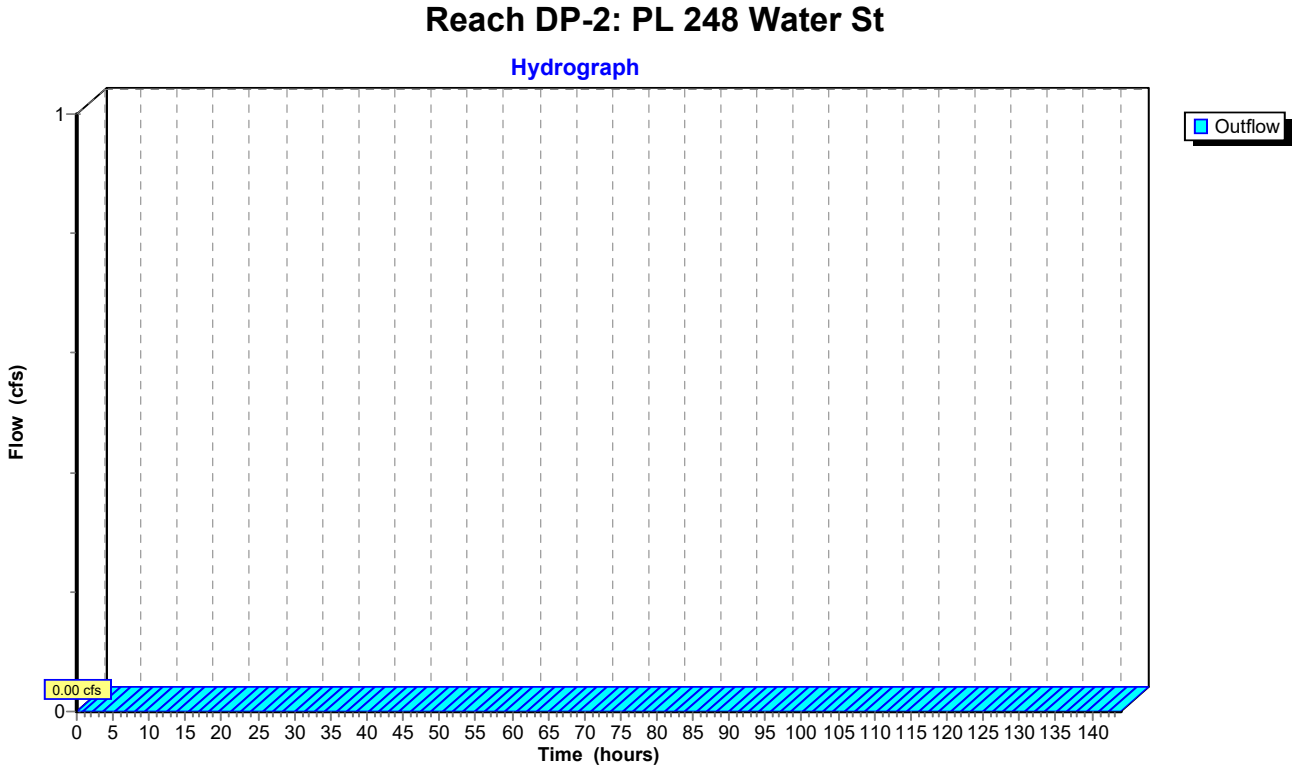
Inflow Area = 33.252 ac, 28.22% Impervious, Inflow Depth = 0.22" for 2-yr event
Inflow = 1.33 cfs @ 13.79 hrs, Volume= 0.608 af
Outflow = 1.33 cfs @ 13.79 hrs, Volume= 0.608 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

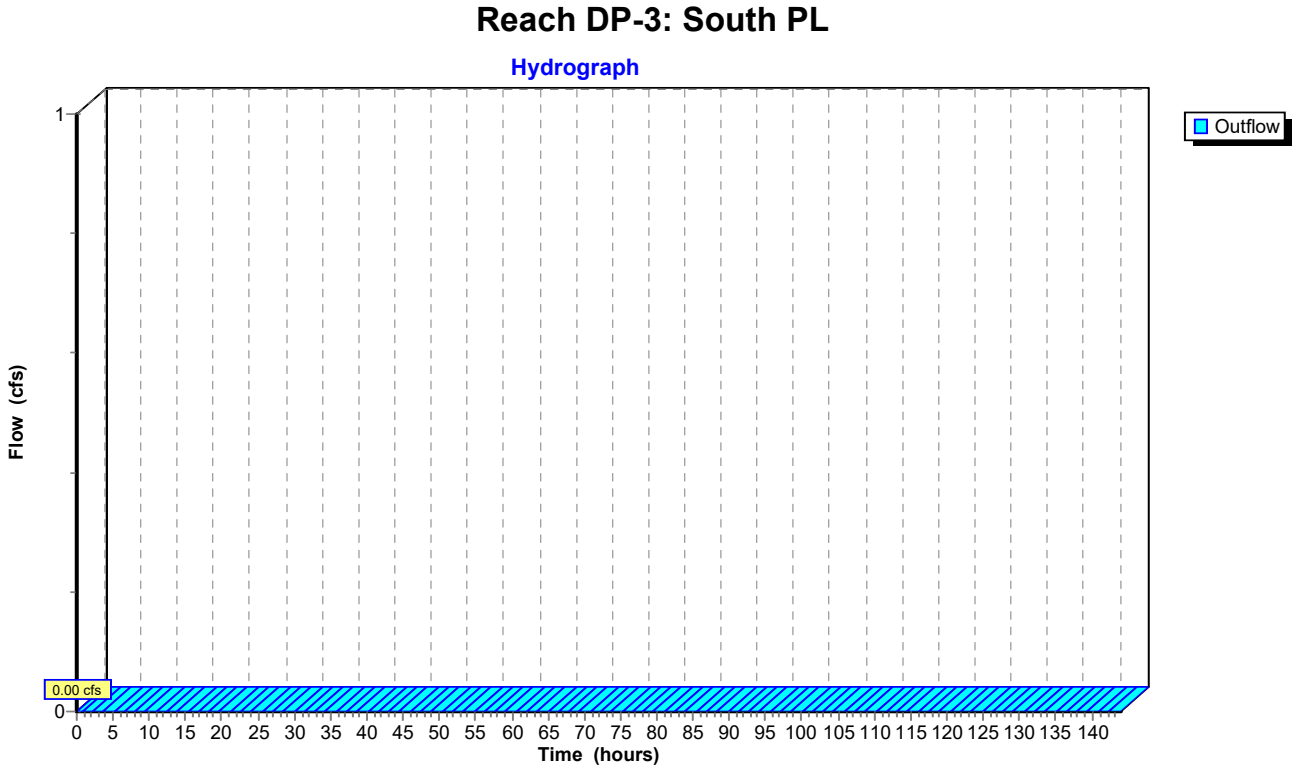
### Reach DP-1: Wetland



## Summary for Reach DP-2: PL 248 Water St



## Summary for Reach DP-3: South PL



## Summary for Pond 1P: Infiltration Pond

Inflow Area = 10.362 ac, 48.35% Impervious, Inflow Depth = 0.95" for 2-yr event
Inflow = 10.49 cfs @ 12.10 hrs, Volume= 0.818 af
Outflow = 0.71 cfs @ 11.94 hrs, Volume= 0.818 af, Atten= 93%, Lag= 0.0 min
Discarded = 0.71 cfs @ 11.94 hrs, Volume= 0.818 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 12.70' @ 15.13 hrs Surf.Area= 14,534 sf Storage= 16,340 cf

Plug-Flow detention time= 250.8 min calculated for 0.818 af (100% of inflow)
Center-of-Mass det. time= 250.8 min ( 1,122.1 - 871.3 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.50' | 81,727 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

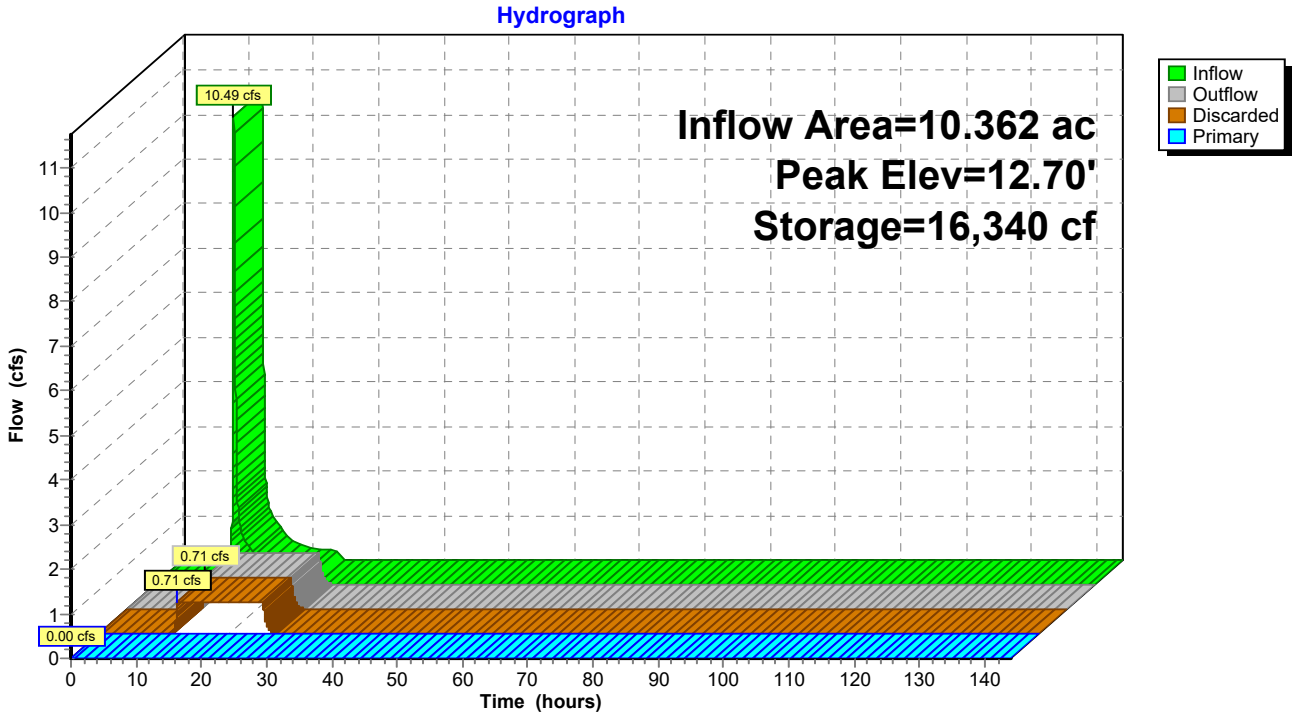
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.50 | 12,792 | 0 | 0 |
| 12.00 | 13,508 | 6,575 | 6,575 |
| 13.00 | 14,981 | 14,245 | 20,820 |
| 13.10 | 17,797 | 1,639 | 22,458 |
| 14.00 | 19,481 | 16,775 | 39,234 |
| 15.00 | 21,280 | 20,381 | 59,614 |
| 16.00 | 22,946 | 22,113 | 81,727 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 10.00' | **12.0" Round Culvert**<br>L= 46.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 10.00' / 9.00' S= 0.0217 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 13.40' | **2.0' long x 2.00' rise Sharp-Crested Rectangular Weir**<br>2 End Contraction(s) |
| #3 | Discarded | 11.50' | **Infiltration 2.41 In/Hr shut off for storms 10 yr and >**<br>Head (feet) 0.00 0.10 1.00 1.50 1.69 1.70 4.00<br>Disch. (cfs) 0.000 0.714 0.714 0.714 0.714 0.000 0.000 |

**Discarded OutFlow** Max=0.71 cfs @ 11.94 hrs HW=11.61' (Free Discharge)
↑**3=Infiltration 2.41 In/Hr shut off for storms 10 yr and >** (Custom Controls 0.71 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=11.50' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 0.00 cfs of 2.99 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Pond 1P: Infiltration Pond



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 1.56" for 2-yr event
Inflow = 5.98 cfs @ 12.45 hrs, Volume= 0.775 af
Outflow = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af, Atten= 1%, Lag= 2.1 min
Primary = 5.93 cfs @ 12.49 hrs, Volume= 0.607 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.04' @ 12.49 hrs Surf.Area= 12,960 sf Storage= 7,861 cf

Plug-Flow detention time= 126.0 min calculated for 0.607 af (78% of inflow)
Center-of-Mass det. time= 42.7 min ( 905.9 - 863.2 )

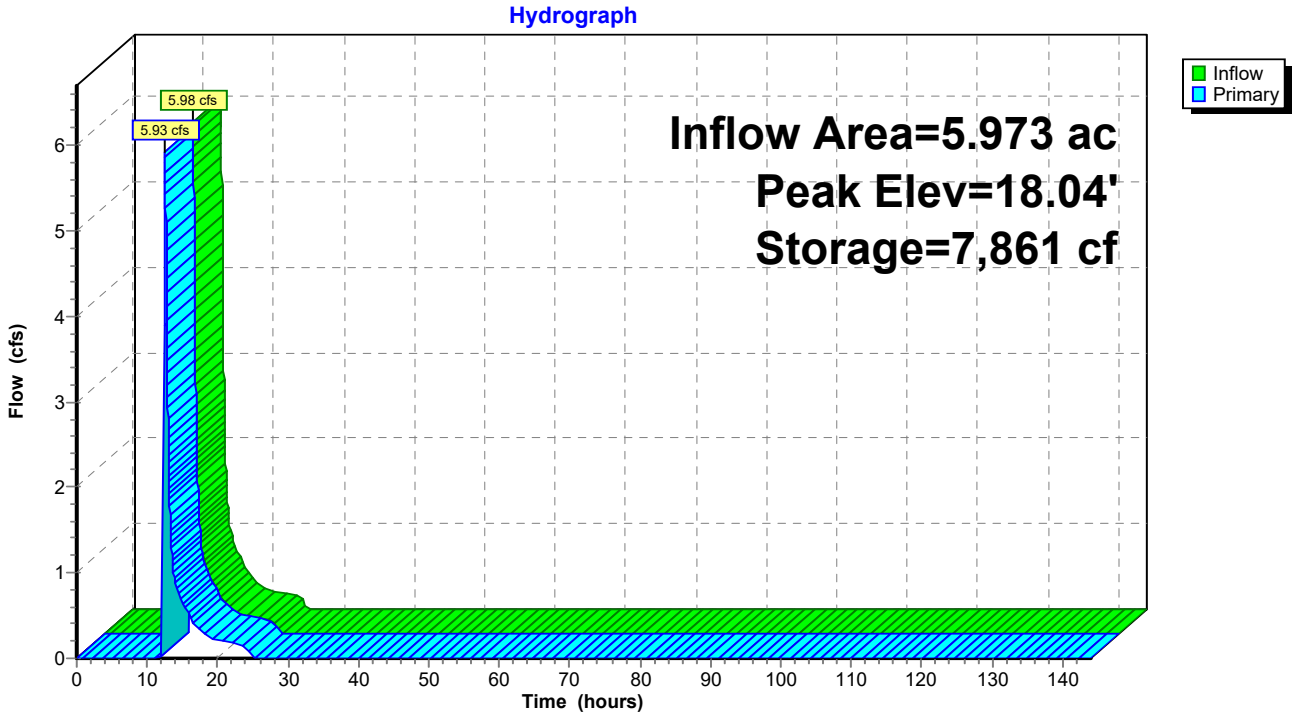
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=5.92 cfs @ 12.49 hrs HW=18.04' TW=12.48' (Dynamic Tailwater)
↑—**1=Asymmetrical Weir** (Weir Controls 5.92 cfs @ 0.67 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 10.658 ac, 38.36% Impervious, Inflow Depth = 0.93" for 2-yr event
Inflow = 7.27 cfs @ 12.48 hrs, Volume= 0.830 af
Outflow = 1.33 cfs @ 13.79 hrs, Volume= 0.593 af, Atten= 82%, Lag= 78.4 min
Primary = 1.33 cfs @ 13.79 hrs, Volume= 0.593 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.02' @ 13.79 hrs Surf.Area= 27,426 sf Storage= 15,091 cf

Plug-Flow detention time= 276.0 min calculated for 0.593 af (72% of inflow)
Center-of-Mass det. time= 172.2 min ( 1,079.4 - 907.3 )

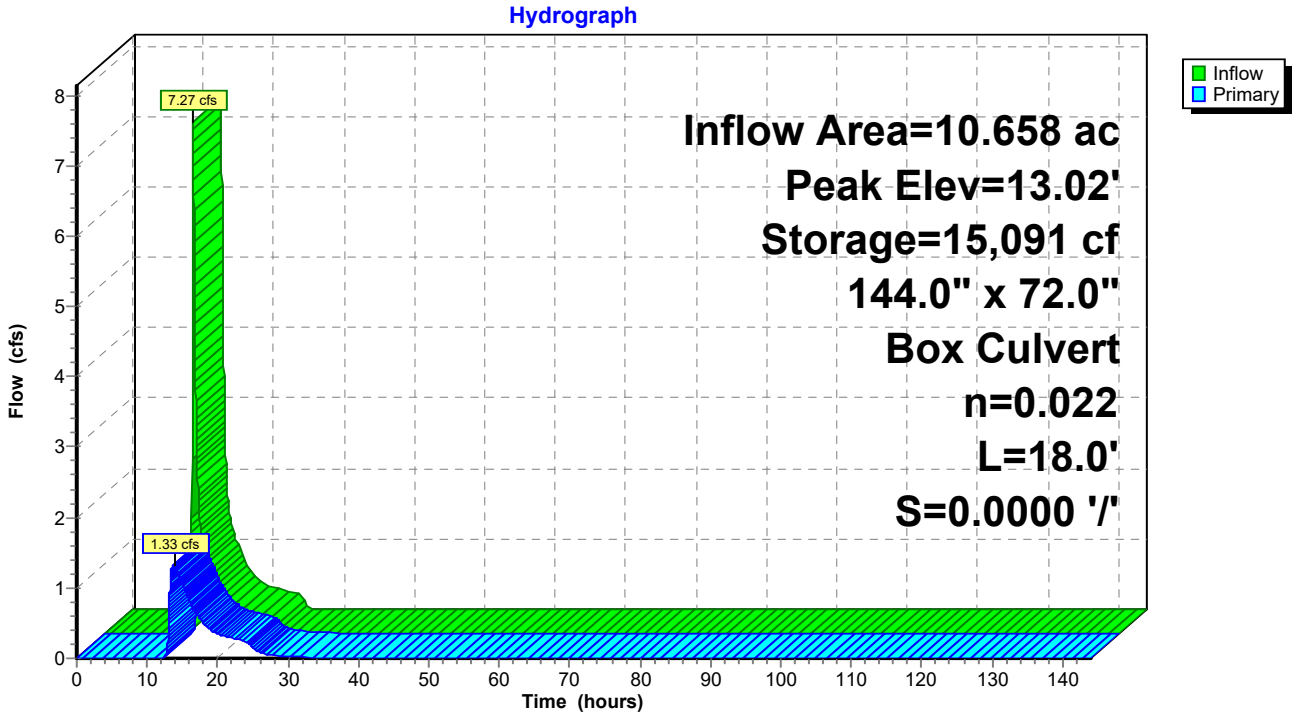
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **144.0" W x 72.0" H Box Culvert**<br>L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700<br>Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900<br>n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf |

**Primary OutFlow** Max=1.33 cfs @ 13.79 hrs HW=13.02' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.33 cfs @ 0.77 fps)

## Pond E-P2: Wetland



Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P1: Property offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=2.63"
Flow Length=343' Tc=31.4 min CN=80 Runoff=10.20 cfs 1.310 af

**Subcatchment P2: P2** Runoff Area=204,093 sf 7.43% Impervious Runoff Depth=1.26"
Flow Length=315' Tc=15.1 min CN=62 Runoff=4.65 cfs 0.491 af

**Subcatchment P3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.02"
Flow Length=400' Tc=12.0 min CN=33 Runoff=0.02 cfs 0.010 af

**Subcatchment P4: Central Overland** Runoff Area=276,292 sf 2.80% Impervious Runoff Depth=0.24"
Flow Length=190' Tc=17.0 min CN=42 Runoff=0.35 cfs 0.126 af

**Subcatchment P4a: Developed Site** Runoff Area=451,376 sf 48.35% Impervious Runoff Depth=1.82"
Tc=6.0 min CN=70 Runoff=21.49 cfs 1.569 af

**Reach DP-1: Wetland** Inflow=7.81 cfs 2.392 af
Outflow=7.81 cfs 2.392 af

**Reach DP-2: PL 248 Water St**
Outflow=0.00 cfs 0.000 af

**Reach DP-3: South PL**
Outflow=0.00 cfs 0.000 af

**Pond 1P: Infiltration Pond** Peak Elev=13.81' Storage=35,475 cf Inflow=21.49 cfs 1.569 af
Discarded=0.71 cfs 0.069 af Primary=1.62 cfs 0.859 af Outflow=1.62 cfs 0.929 af

**Pond E-P1: Wetland** Peak Elev=18.06' Storage=8,104 cf Inflow=10.20 cfs 1.310 af
Outflow=10.19 cfs 1.142 af

**Pond E-P2: Wetland** Peak Elev=13.29' Storage=22,838 cf Inflow=13.60 cfs 1.633 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=6.66 cfs 1.397 af

**Total Runoff Area = 33.252 ac Runoff Volume = 3.506 af Average Runoff Depth = 1.27"**
**71.78% Pervious = 23.868 ac 28.22% Impervious = 9.384 ac**

## Summary for Subcatchment P1: Property offsite

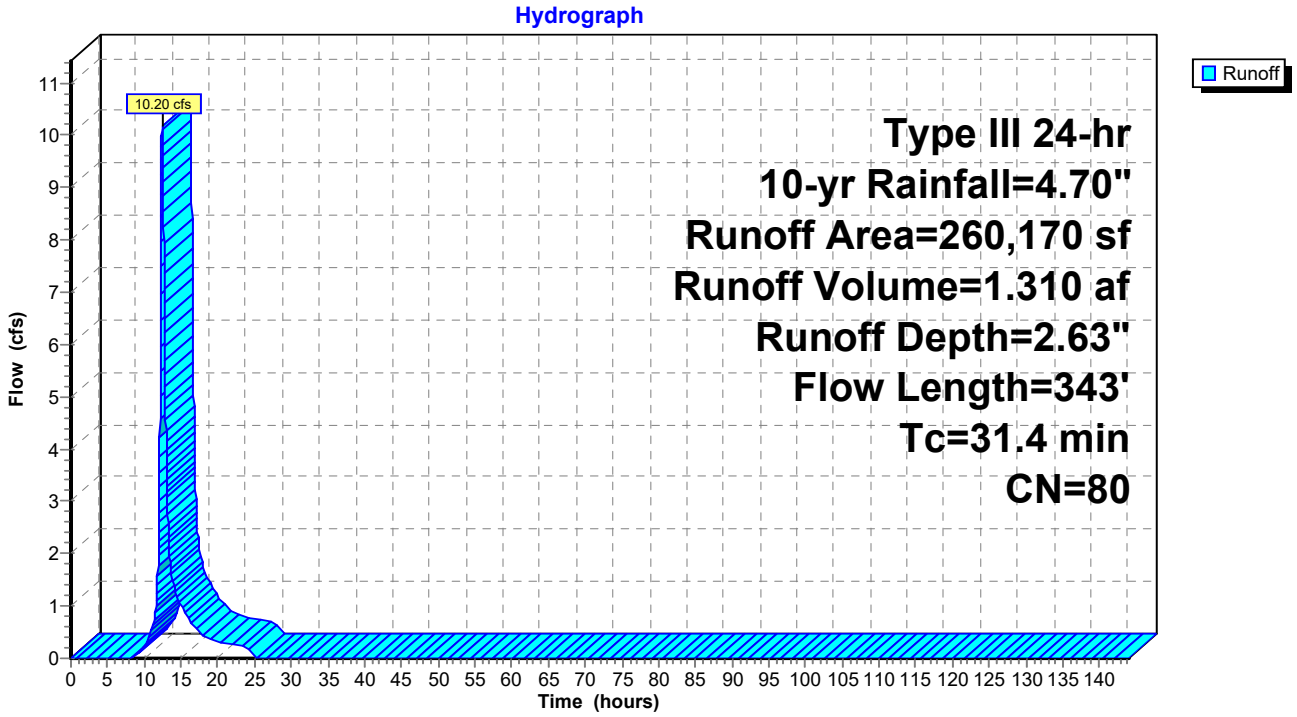
Runoff = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment P1: Property offsite



## Summary for Subcatchment P2: P2

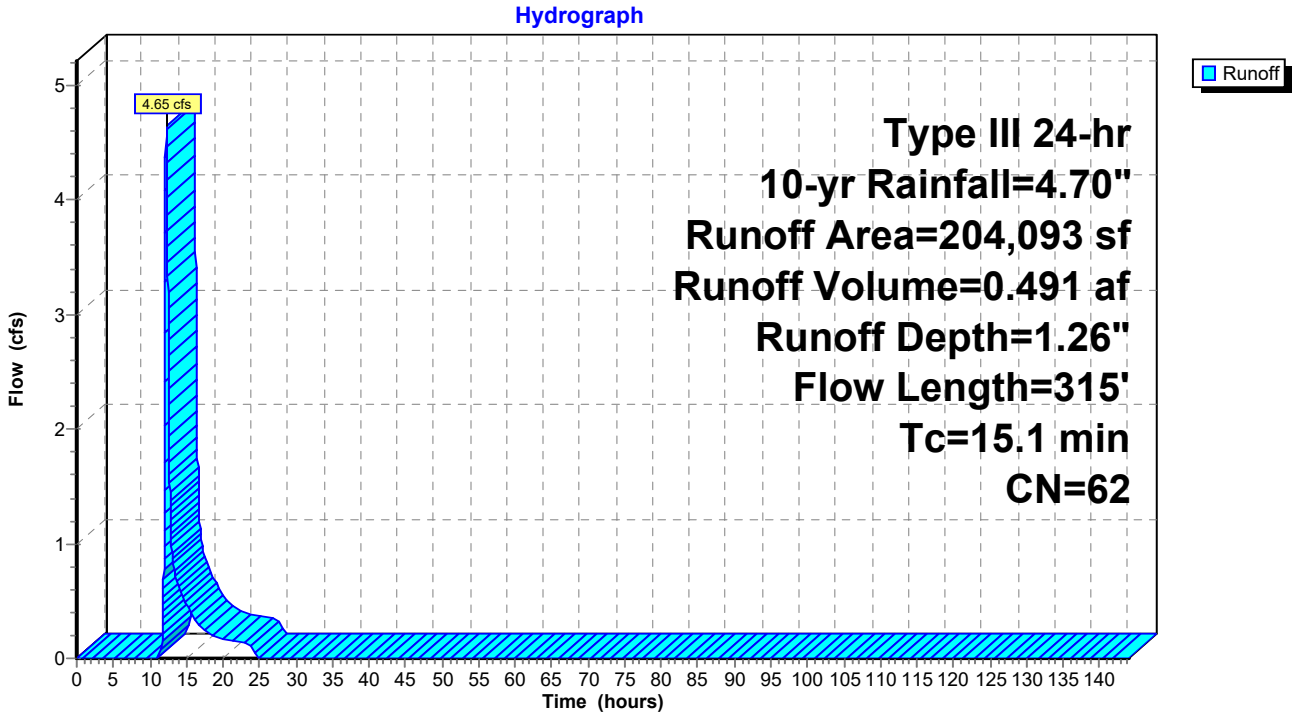
Runoff = 4.65 cfs @ 12.23 hrs, Volume= 0.491 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 15,787 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| * | 1,504 | 98 | Decks, HSG C |
| | 15,014 | 74 | >75% Grass cover, Good, HSG C |
| | 204,093 | 62 | Weighted Average |
| | 188,935 | | 92.57% Pervious Area |
| | 15,158 | | 7.43% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.2 | 50 | 0.0190 | 0.07 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.5 | 116 | 0.0690 | 1.31 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.1 | 20 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 1.3 | 129 | 0.1100 | 1.66 | | **Shallow Concentrated Flow, D-WETLAND**<br>Woodland Kv= 5.0 fps |
| 15.1 | 315 | Total | | | |

## Subcatchment P2: P2



## Summary for Subcatchment P3: SW Property

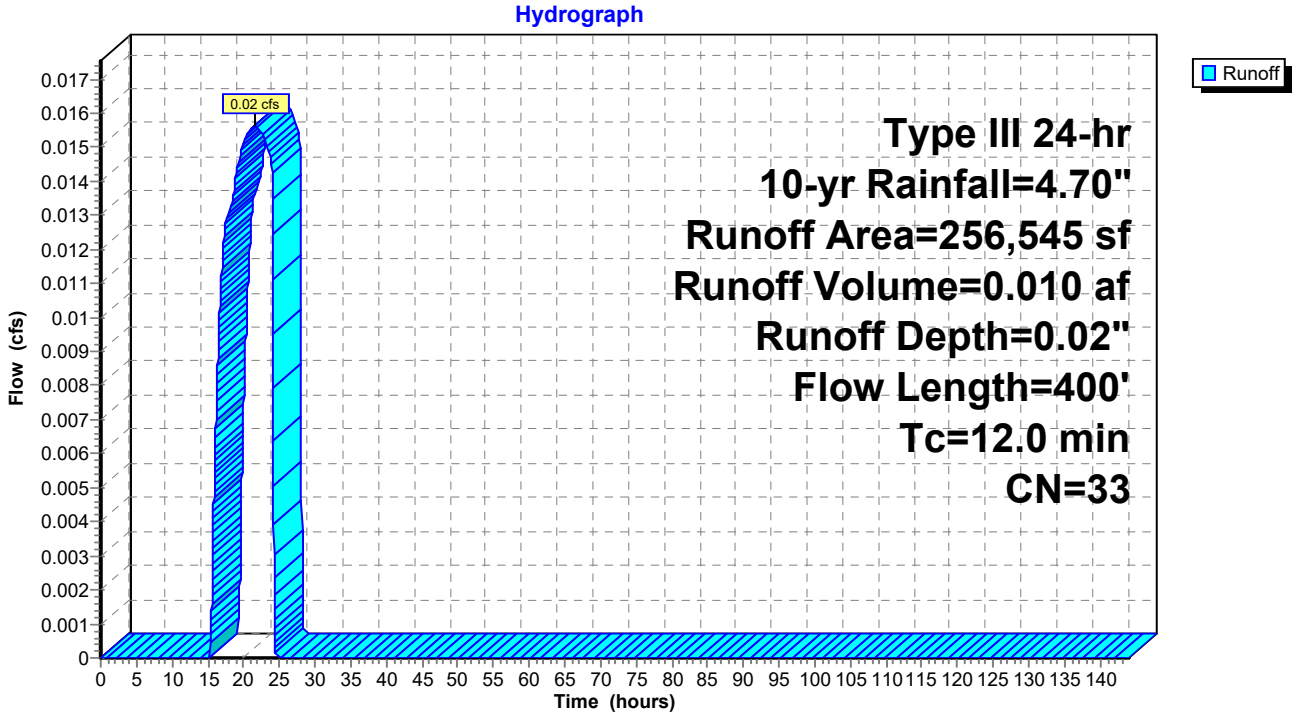
Runoff = 0.02 cfs @ 21.64 hrs, Volume= 0.010 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 118,145 | 30 | Woods, Good, HSG A |
| | 33,865 | 39 | >75% Grass cover, Good, HSG A |
| | 5,100 | 76 | Gravel roads, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 33 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, START off property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 350 | 0.0410 | 3.26 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 12.0 | 400 | Total | | | |

## Subcatchment P3: SW Property



## Summary for Subcatchment P4: Central Overland

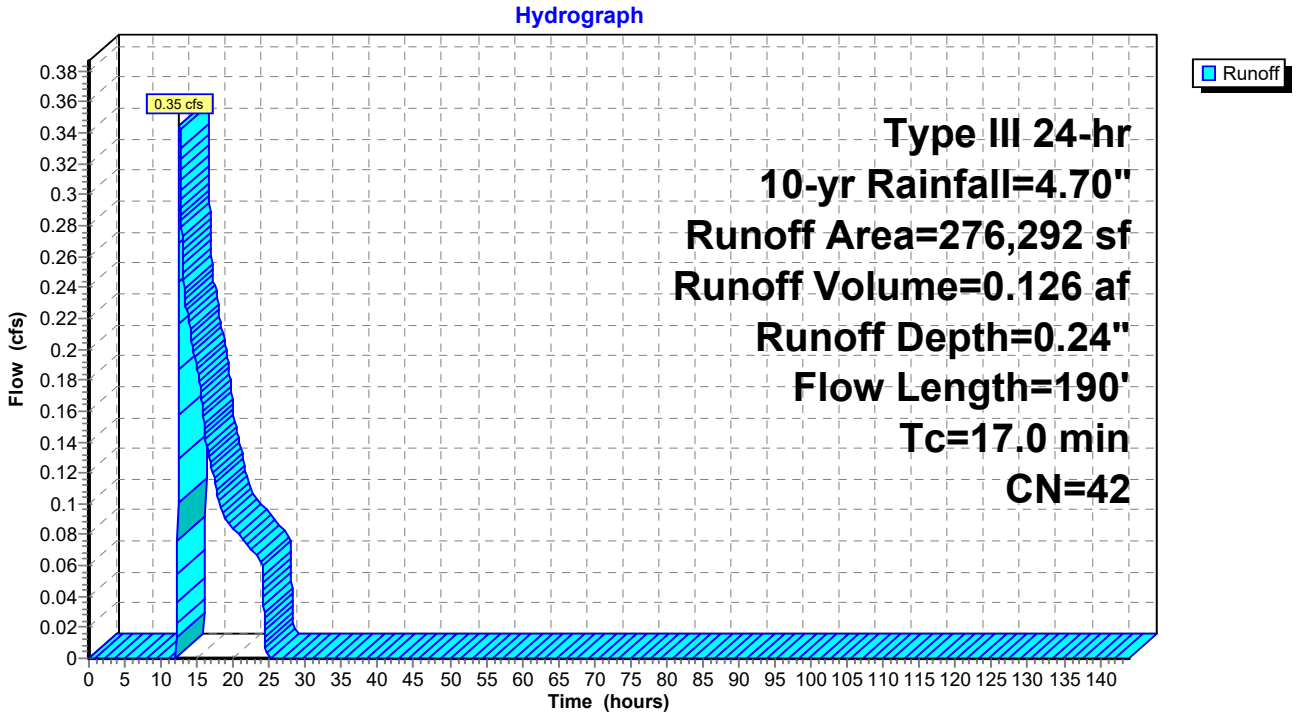
Runoff = 0.35 cfs @ 12.59 hrs, Volume= 0.126 af, Depth= 0.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 154,403 | 30 | Woods, Good, HSG A |
| | 63,719 | 39 | >75% Grass cover, Good, HSG A |
| | 1,074 | 76 | Gravel roads, HSG A |
| | 17,086 | 70 | Woods, Good, HSG C |
| | 31,379 | 74 | >75% Grass cover, Good, HSG C |
| * | 5,169 | 98 | Decks, HSG C |
| * | 652 | 98 | Decks, HSG A |
| * | 1,860 | 98 | Roof, HSG A |
| * | 58 | 98 | Pavement, HSG A (OFFSITE) |
| * | 892 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| | 276,292 | 42 | Weighted Average |
| | 268,553 | | 97.20% Pervious Area |
| | 7,739 | | 2.80% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.2 | 140 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 17.0 | 190 | Total | | | |

## Subcatchment P4: Central Overland



## Summary for Subcatchment P4a: Developed Site

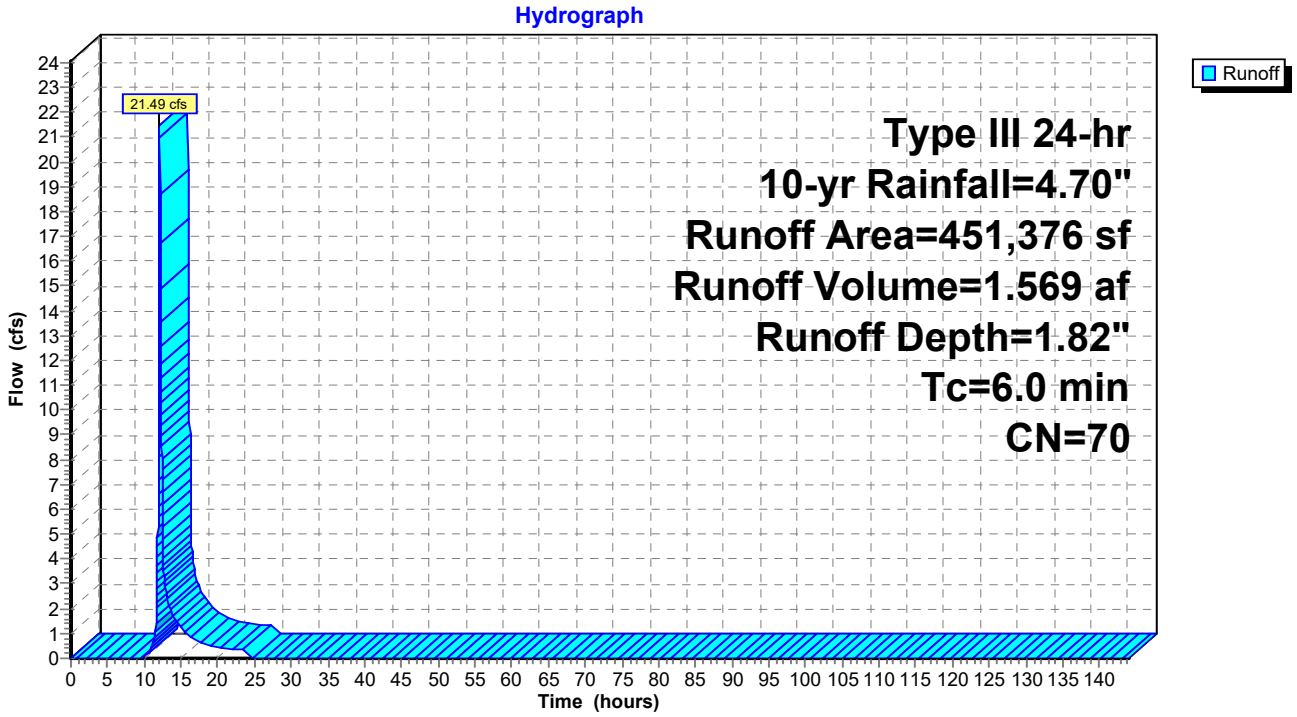
Runoff = 21.49 cfs @ 12.09 hrs, Volume= 1.569 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-yr Rainfall=4.70"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 67,047 | 39 | >75% Grass cover, Good, HSG A |
| | 47,531 | 98 | Paved parking, HSG A |
| | 32,505 | 98 | Roofs, HSG A |
| * | 2,709 | 98 | Decks, HSG A |
| * | 26,160 | 39 | Infiltration basin, HSG A |
| | 45,411 | 74 | >75% Grass cover, Good, HSG C |
| | 72,174 | 98 | Roofs, HSG C |
| * | 47,403 | 98 | Paved parking, HSG C |
| * | 1,771 | 98 | Decks, HSG C |
| * | 33,887 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 60,232 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 3,707 | 98 | Pavement, HSG A (OFFSITE) |
| * | 2,312 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| | 451,376 | 70 | Weighted Average |
| | 233,143 | | 51.65% Pervious Area |
| | 218,233 | | 48.35% Impervious Area |

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

## Subcatchment P4a: Developed Site

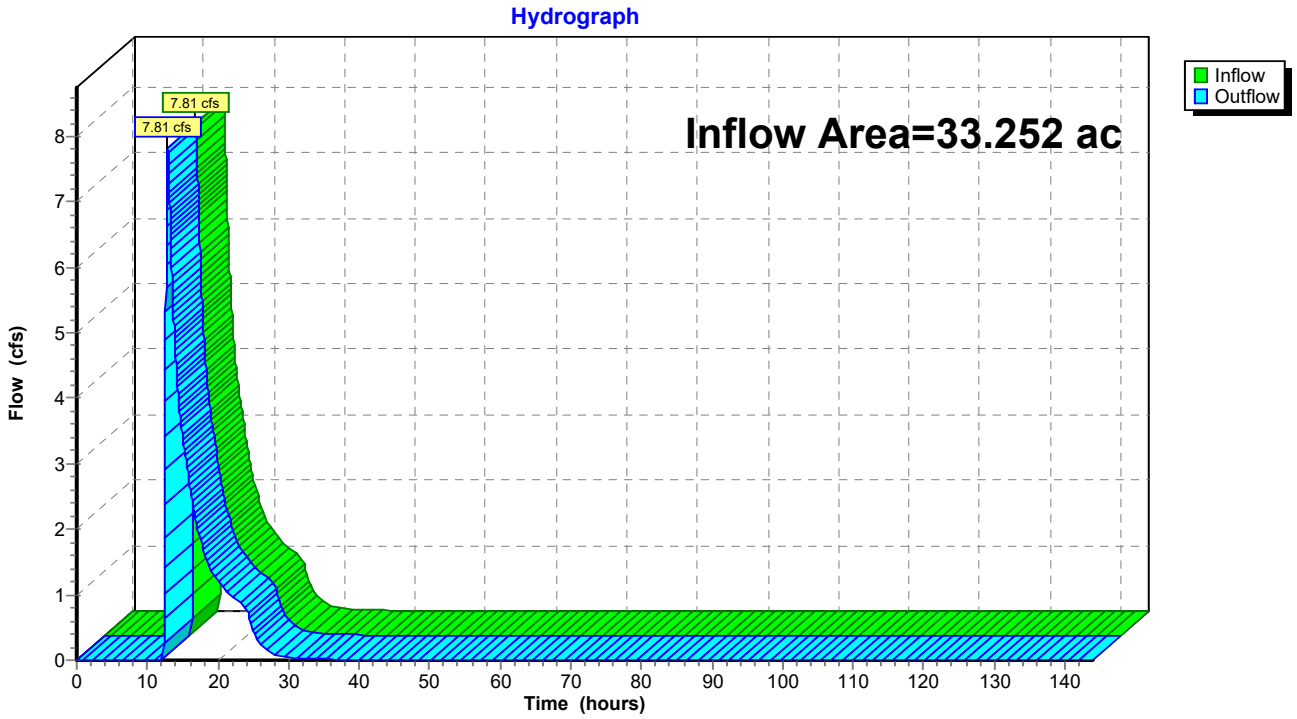


## Summary for Reach DP-1: Wetland

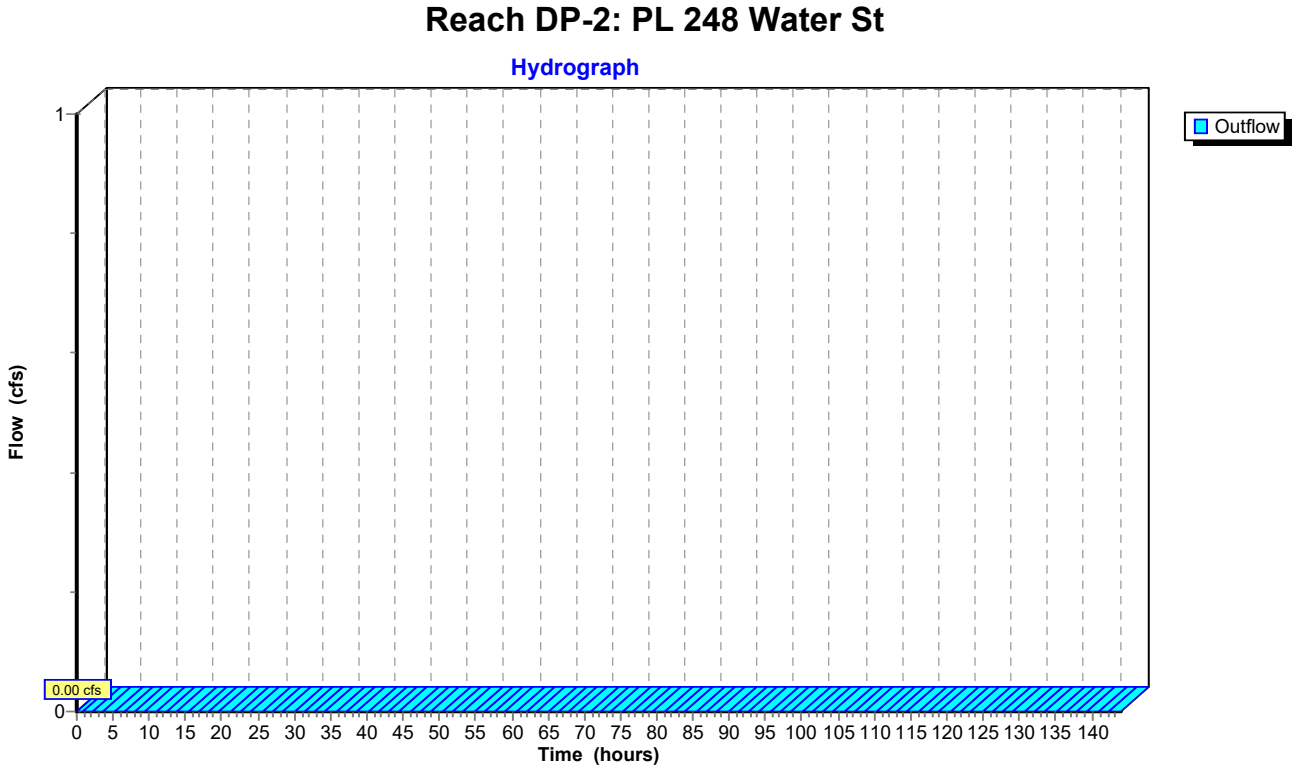
Inflow Area = 33.252 ac, 28.22% Impervious, Inflow Depth = 0.86" for 10-yr event
Inflow = 7.81 cfs @ 12.90 hrs, Volume= 2.392 af
Outflow = 7.81 cfs @ 12.90 hrs, Volume= 2.392 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

### Reach DP-1: Wetland

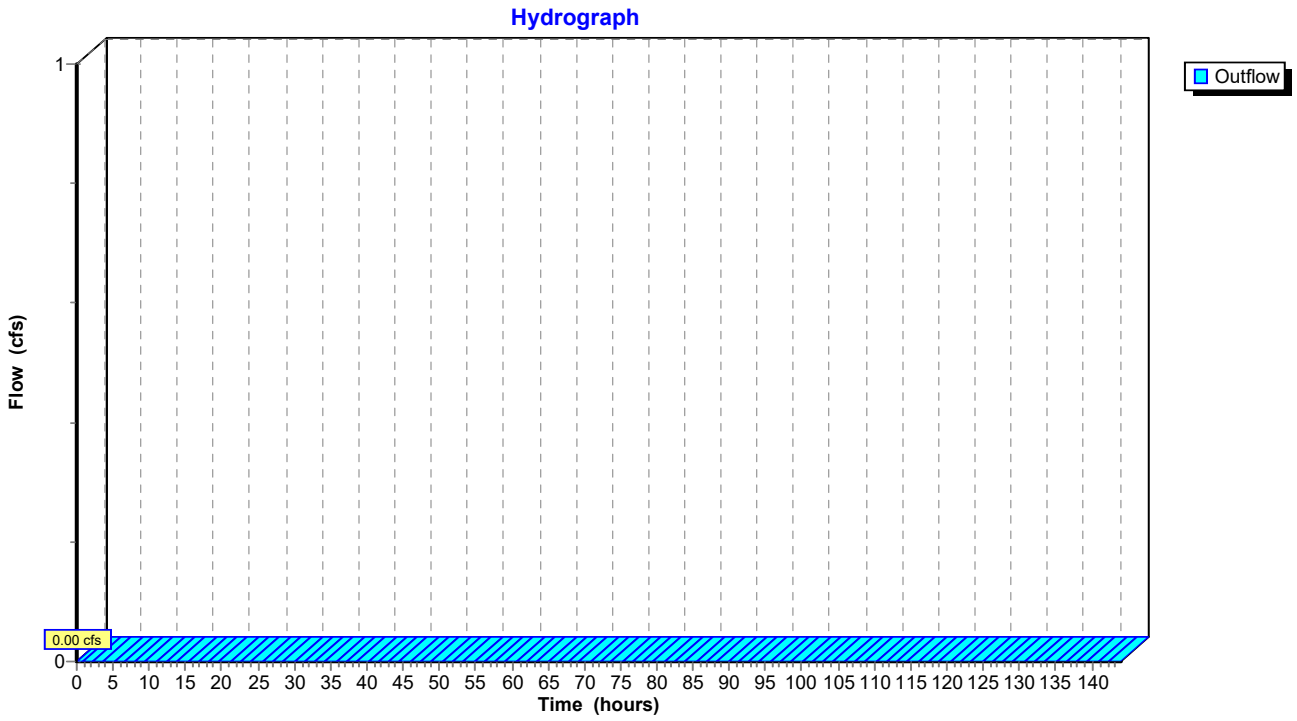


## Summary for Reach DP-2: PL 248 Water St



## Summary for Reach DP-3: South PL

### Reach DP-3: South PL



## Summary for Pond 1P: Infiltration Pond

Inflow Area = 10.362 ac, 48.35% Impervious, Inflow Depth = 1.82" for 10-yr event
Inflow = 21.49 cfs @ 12.09 hrs, Volume= 1.569 af
Outflow = 1.62 cfs @ 14.01 hrs, Volume= 0.929 af, Atten= 92%, Lag= 115.2 min
Discarded = 0.71 cfs @ 11.64 hrs, Volume= 0.069 af
Primary = 1.62 cfs @ 14.01 hrs, Volume= 0.859 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.81' @ 14.01 hrs Surf.Area= 19,117 sf Storage= 35,475 cf

Plug-Flow detention time= 300.0 min calculated for 0.929 af (59% of inflow)
Center-of-Mass det. time= 182.5 min ( 1,033.6 - 851.1 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.50' | 81,727 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

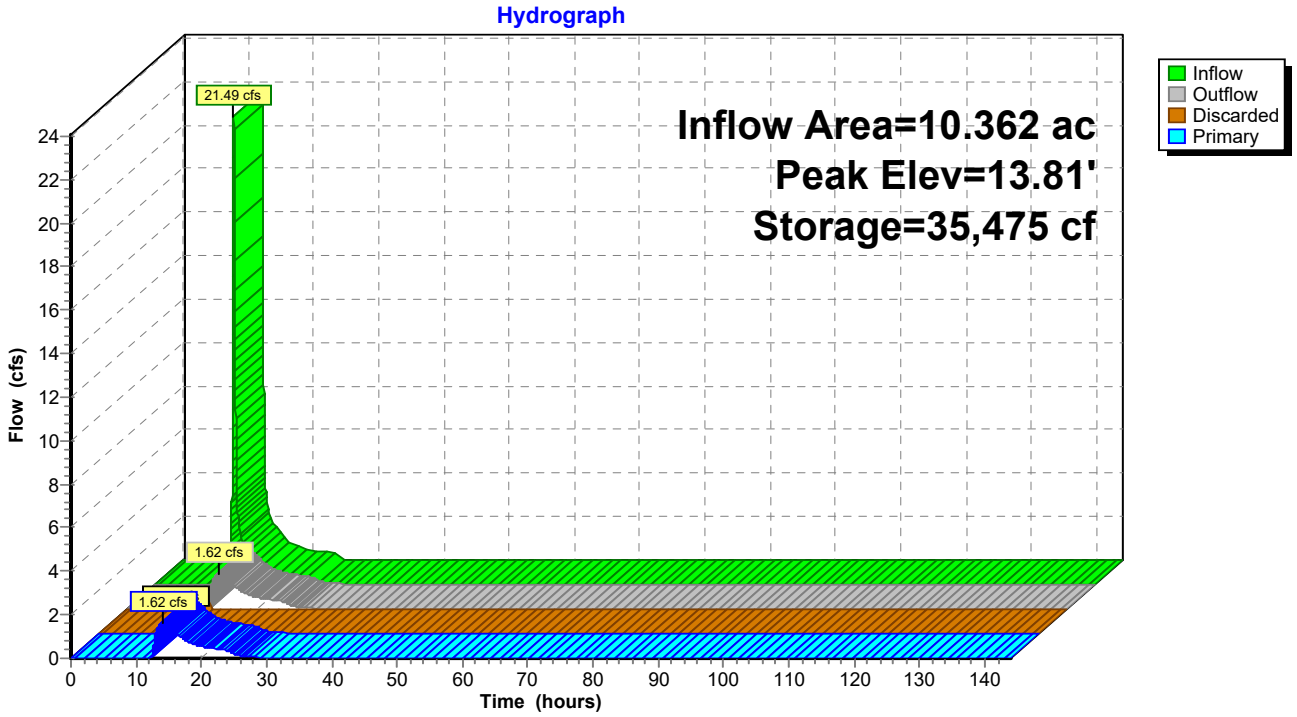
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.50 | 12,792 | 0 | 0 |
| 12.00 | 13,508 | 6,575 | 6,575 |
| 13.00 | 14,981 | 14,245 | 20,820 |
| 13.10 | 17,797 | 1,639 | 22,458 |
| 14.00 | 19,481 | 16,775 | 39,234 |
| 15.00 | 21,280 | 20,381 | 59,614 |
| 16.00 | 22,946 | 22,113 | 81,727 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 10.00' | **12.0" Round Culvert**<br>L= 46.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 10.00' / 9.00' S= 0.0217 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 13.40' | **2.0' long x 2.00' rise Sharp-Crested Rectangular Weir**<br>2 End Contraction(s) |
| #3 | Discarded | 11.50' | **Infiltration 2.41 In/Hr shut off for storms 10 yr and >**<br>Head (feet) 0.00 0.10 1.00 1.50 1.69 1.70 4.00<br>Disch. (cfs) 0.000 0.714 0.714 0.714 0.714 0.000 0.000 |

**Discarded OutFlow** Max=0.71 cfs @ 11.64 hrs HW=11.60' (Free Discharge)
↑**3=Infiltration 2.41 In/Hr shut off for storms 10 yr and >** (Custom Controls 0.71 cfs)

**Primary OutFlow** Max=1.62 cfs @ 14.01 hrs HW=13.81' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 1.62 cfs of 5.43 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.62 cfs @ 2.08 fps)

## Pond 1P: Infiltration Pond



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 2.63" for 10-yr event
Inflow = 10.20 cfs @ 12.44 hrs, Volume= 1.310 af
Outflow = 10.19 cfs @ 12.46 hrs, Volume= 1.142 af, Atten= 0%, Lag= 0.8 min
Primary = 10.19 cfs @ 12.46 hrs, Volume= 1.142 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.06' @ 12.46 hrs Surf.Area= 13,252 sf Storage= 8,104 cf

Plug-Flow detention time= 85.3 min calculated for 1.142 af (87% of inflow)
Center-of-Mass det. time= 27.0 min ( 875.0 - 848.0 )

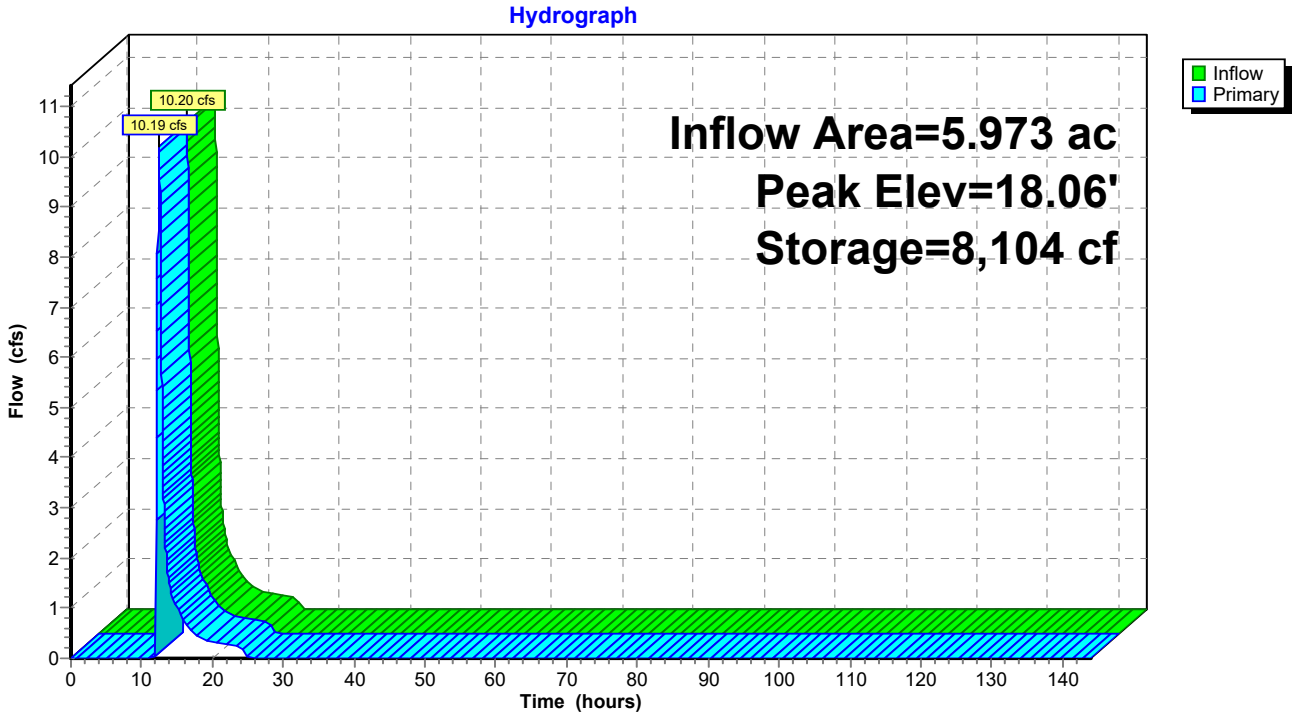
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=10.18 cfs @ 12.46 hrs HW=18.06' TW=13.03' (Dynamic Tailwater)
↑—**1=Asymmetrical Weir** (Weir Controls 10.18 cfs @ 0.80 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 10.658 ac, 38.36% Impervious, Inflow Depth = 1.84" for 10-yr event
Inflow = 13.60 cfs @ 12.40 hrs, Volume= 1.633 af
Outflow = 6.66 cfs @ 12.85 hrs, Volume= 1.397 af, Atten= 51%, Lag= 27.1 min
Primary = 6.66 cfs @ 12.85 hrs, Volume= 1.397 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.29' @ 12.85 hrs Surf.Area= 30,605 sf Storage= 22,838 cf

Plug-Flow detention time= 156.1 min calculated for 1.397 af (86% of inflow)
Center-of-Mass det. time= 91.7 min ( 968.9 - 877.2 )

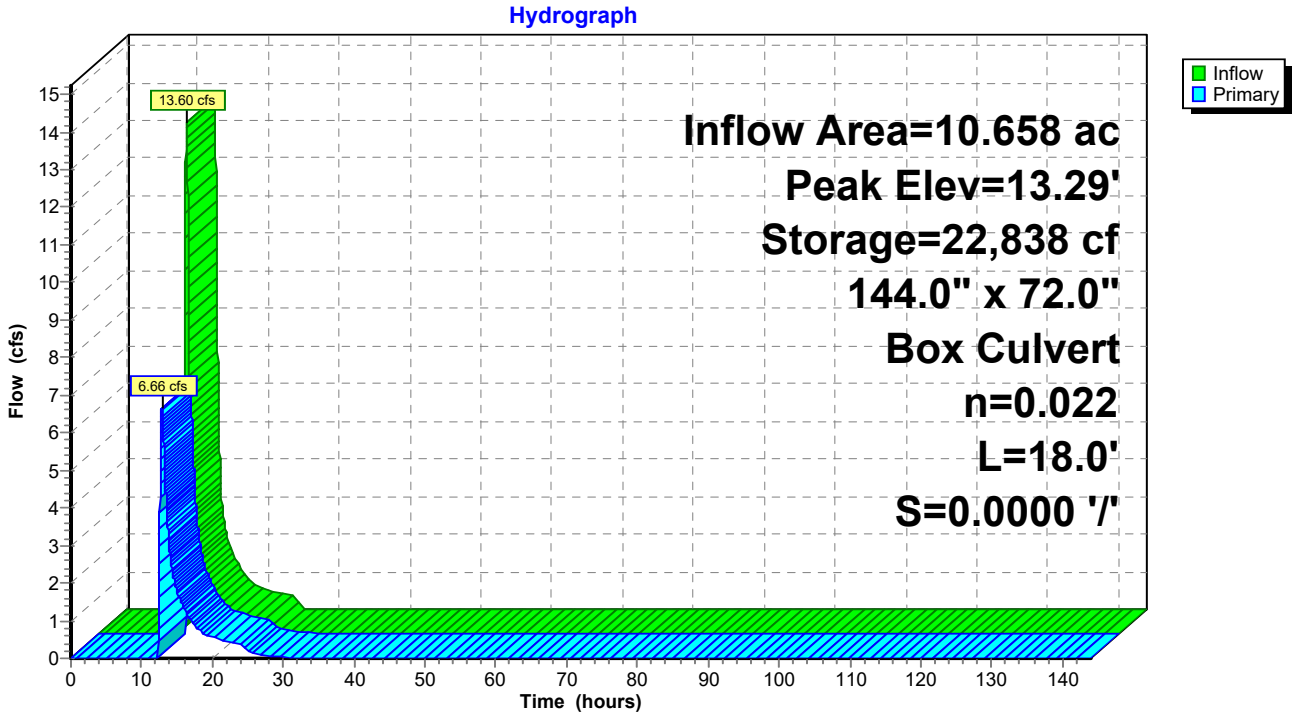
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **144.0" W x 72.0" H Box Culvert**<br>L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700<br>Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900<br>n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf |

**Primary OutFlow** Max=6.66 cfs @ 12.85 hrs HW=13.29' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Barrel Controls 6.66 cfs @ 1.61 fps)

## Pond E-P2: Wetland



Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P1: Property offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=3.42"
Flow Length=343' Tc=31.4 min CN=80 Runoff=13.24 cfs 1.703 af

**Subcatchment P2: P2** Runoff Area=204,093 sf 7.43% Impervious Runoff Depth=1.82"
Flow Length=315' Tc=15.1 min CN=62 Runoff=7.09 cfs 0.711 af

**Subcatchment P3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.11"
Flow Length=400' Tc=12.0 min CN=33 Runoff=0.08 cfs 0.053 af

**Subcatchment P4: Central Overland** Runoff Area=276,292 sf 2.80% Impervious Runoff Depth=0.48"
Flow Length=190' Tc=17.0 min CN=42 Runoff=1.20 cfs 0.256 af

**Subcatchment P4a: Developed Site** Runoff Area=451,376 sf 48.35% Impervious Runoff Depth=2.49"
Tc=6.0 min CN=70 Runoff=29.92 cfs 2.151 af

**Reach DP-1: Wetland** Inflow=16.04 cfs 3.740 af
Outflow=16.04 cfs 3.740 af

**Reach DP-2: PL 248 Water St**
Outflow=0.00 cfs 0.000 af

**Reach DP-3: South PL**
Outflow=0.00 cfs 0.000 af

**Pond 1P: Infiltration Pond** Peak Elev=14.13' Storage=41,730 cf Inflow=29.92 cfs 2.151 af
Discarded=0.71 cfs 0.090 af Primary=3.76 cfs 1.421 af Outflow=3.76 cfs 1.511 af

**Pond E-P1: Wetland** Peak Elev=18.07' Storage=8,260 cf Inflow=13.24 cfs 1.703 af
Outflow=13.23 cfs 1.535 af

**Pond E-P2: Wetland** Peak Elev=13.46' Storage=28,229 cf Inflow=18.31 cfs 2.247 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=11.48 cfs 2.010 af

**Total Runoff Area = 33.252 ac Runoff Volume = 4.875 af Average Runoff Depth = 1.76"**
**71.78% Pervious = 23.868 ac 28.22% Impervious = 9.384 ac**

## Summary for Subcatchment P1: Property offsite

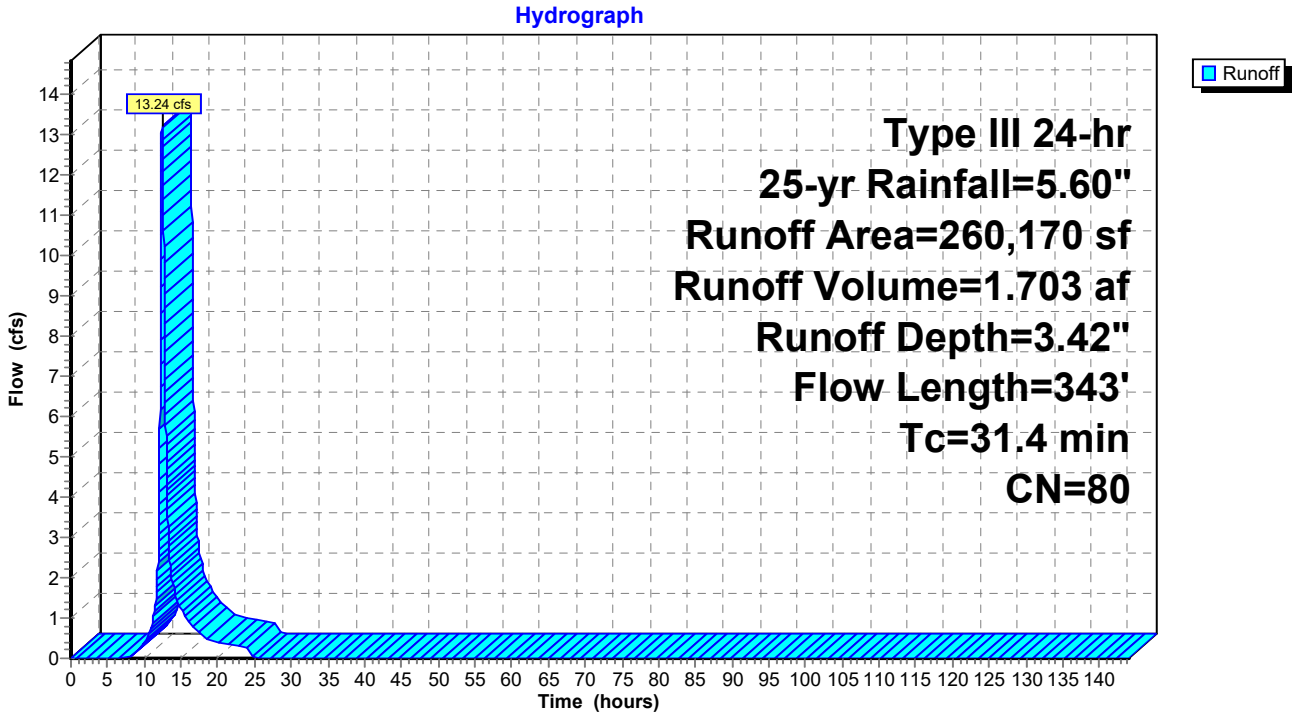
Runoff = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af, Depth= 3.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment P1: Property offsite



## Summary for Subcatchment P2: P2

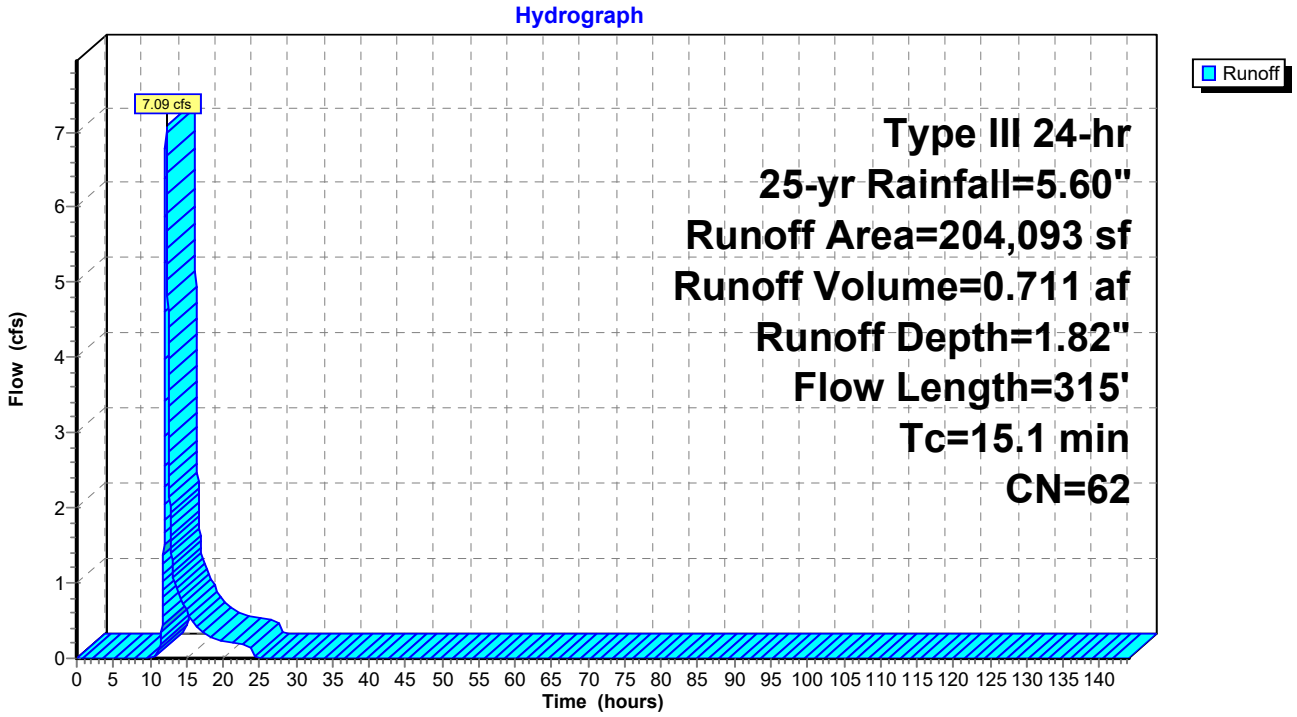
Runoff = 7.09 cfs @ 12.22 hrs, Volume= 0.711 af, Depth= 1.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 15,787 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| * | 1,504 | 98 | Decks, HSG C |
| | 15,014 | 74 | >75% Grass cover, Good, HSG C |
| | 204,093 | 62 | Weighted Average |
| | 188,935 | | 92.57% Pervious Area |
| | 15,158 | | 7.43% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.2 | 50 | 0.0190 | 0.07 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.5 | 116 | 0.0690 | 1.31 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.1 | 20 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 1.3 | 129 | 0.1100 | 1.66 | | **Shallow Concentrated Flow, D-WETLAND**<br>Woodland Kv= 5.0 fps |
| 15.1 | 315 | Total | | | |

## Subcatchment P2: P2



## Summary for Subcatchment P3: SW Property

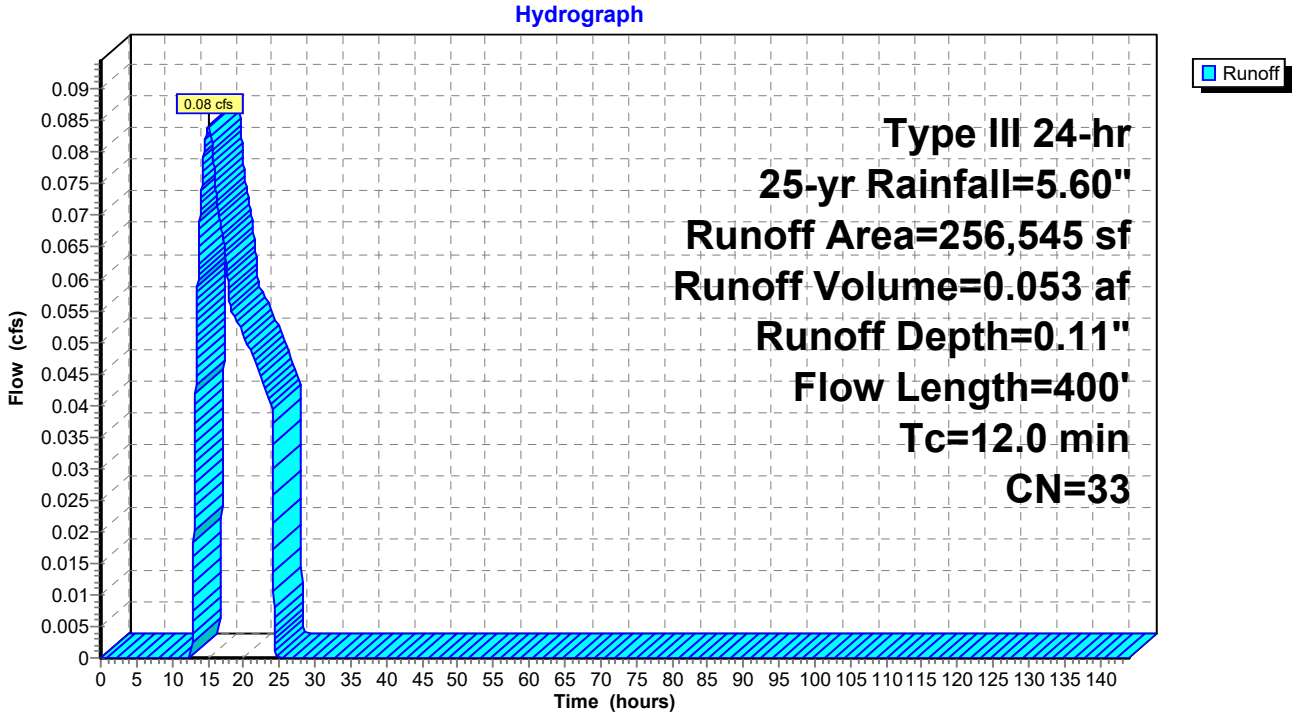
Runoff = 0.08 cfs @ 15.08 hrs, Volume= 0.053 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 118,145 | 30 | Woods, Good, HSG A |
| | 33,865 | 39 | >75% Grass cover, Good, HSG A |
| | 5,100 | 76 | Gravel roads, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 33 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, START off property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 350 | 0.0410 | 3.26 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 12.0 | 400 | Total | | | |

## Subcatchment P3: SW Property



## Summary for Subcatchment P4: Central Overland

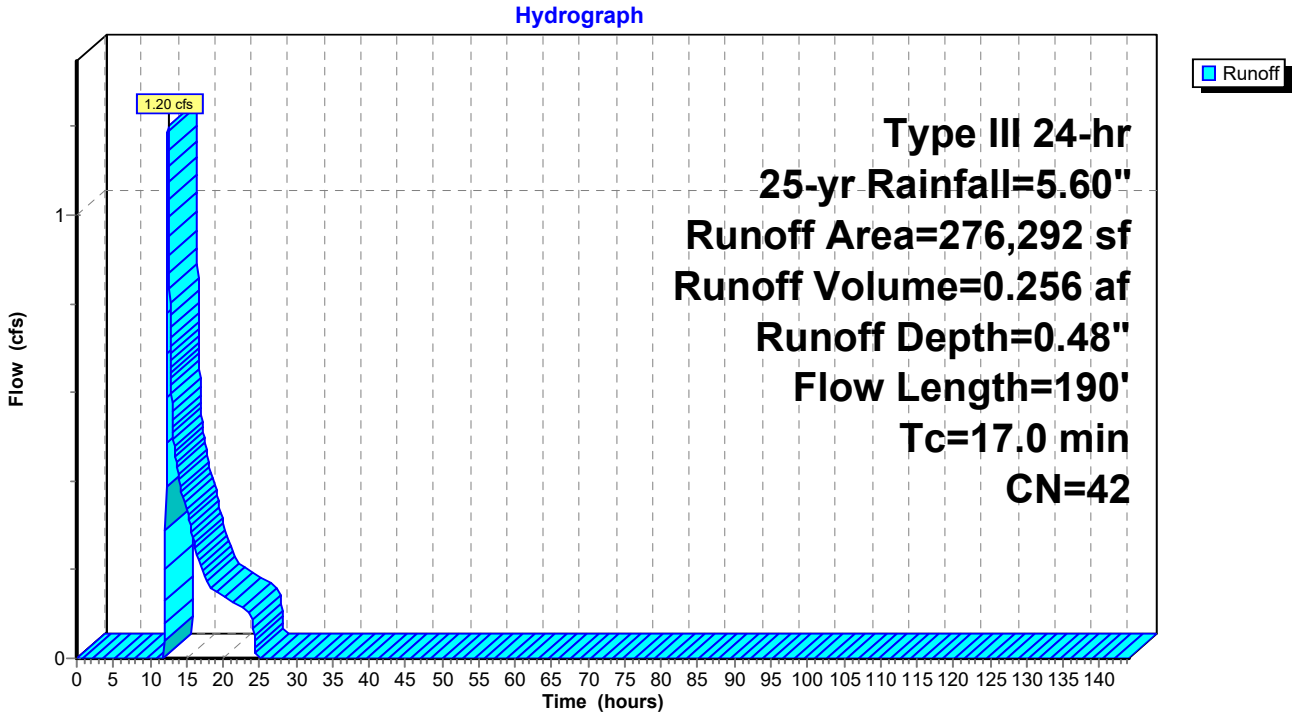
Runoff = 1.20 cfs @ 12.48 hrs, Volume= 0.256 af, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 154,403 | 30 | Woods, Good, HSG A |
| | 63,719 | 39 | >75% Grass cover, Good, HSG A |
| | 1,074 | 76 | Gravel roads, HSG A |
| | 17,086 | 70 | Woods, Good, HSG C |
| | 31,379 | 74 | >75% Grass cover, Good, HSG C |
| * | 5,169 | 98 | Decks, HSG C |
| * | 652 | 98 | Decks, HSG A |
| * | 1,860 | 98 | Roof, HSG A |
| * | 58 | 98 | Pavement, HSG A (OFFSITE) |
| * | 892 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| | 276,292 | 42 | Weighted Average |
| | 268,553 | | 97.20% Pervious Area |
| | 7,739 | | 2.80% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.2 | 140 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, B-C**<br>Unpaved Kv= 16.1 fps |
| 17.0 | 190 | Total | | | |

## Subcatchment P4: Central Overland



## Summary for Subcatchment P4a: Developed Site

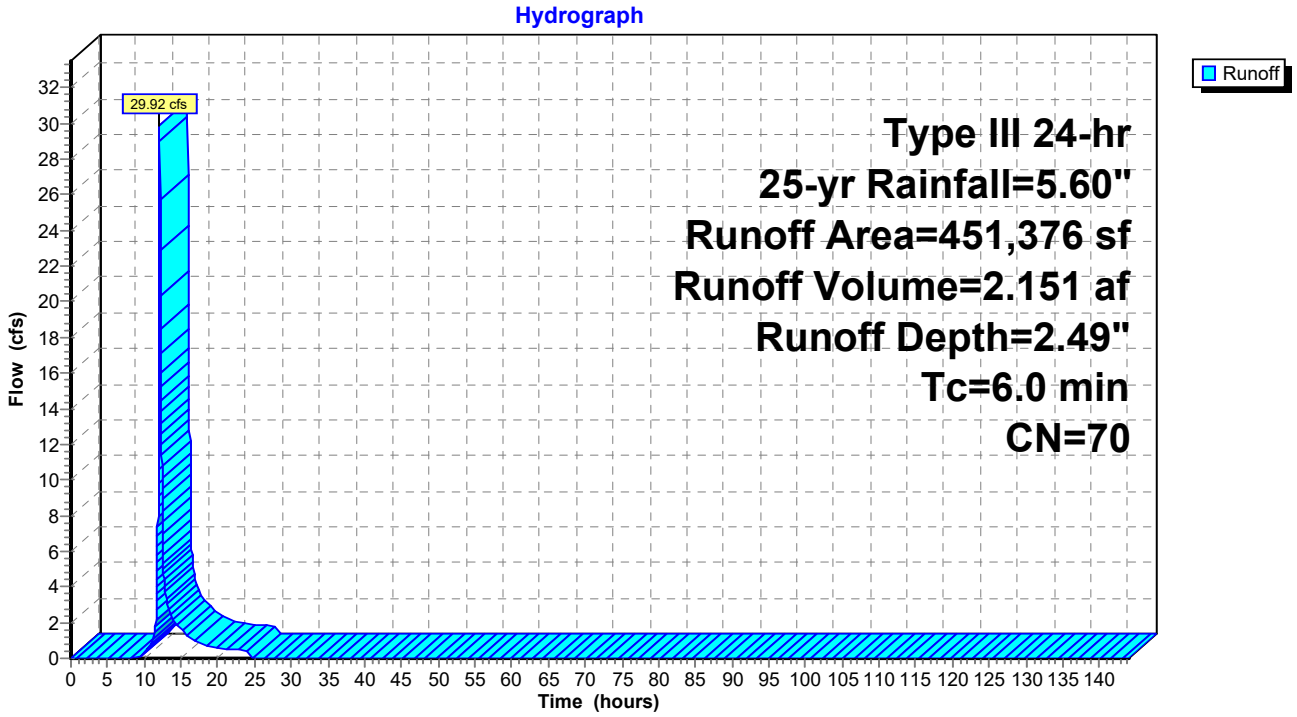
Runoff = 29.92 cfs @ 12.09 hrs, Volume= 2.151 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-yr Rainfall=5.60"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 67,047 | 39 | >75% Grass cover, Good, HSG A |
| | 47,531 | 98 | Paved parking, HSG A |
| | 32,505 | 98 | Roofs, HSG A |
| * | 2,709 | 98 | Decks, HSG A |
| * | 26,160 | 39 | Infiltration basin, HSG A |
| | 45,411 | 74 | >75% Grass cover, Good, HSG C |
| | 72,174 | 98 | Roofs, HSG C |
| * | 47,403 | 98 | Paved parking, HSG C |
| * | 1,771 | 98 | Decks, HSG C |
| * | 33,887 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 60,232 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 3,707 | 98 | Pavement, HSG A (OFFSITE) |
| * | 2,312 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| | 451,376 | 70 | Weighted Average |
| | 233,143 | | 51.65% Pervious Area |
| | 218,233 | | 48.35% Impervious Area |

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

## Subcatchment P4a: Developed Site

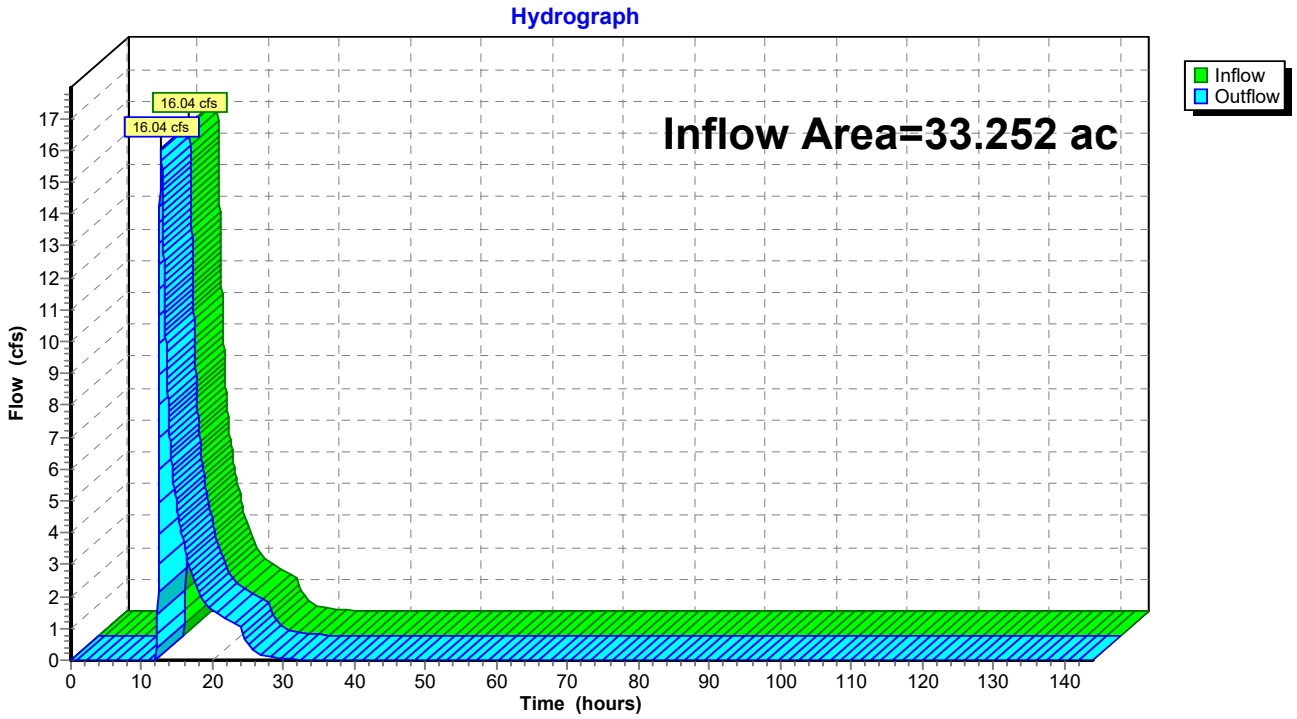


## Summary for Reach DP-1: Wetland

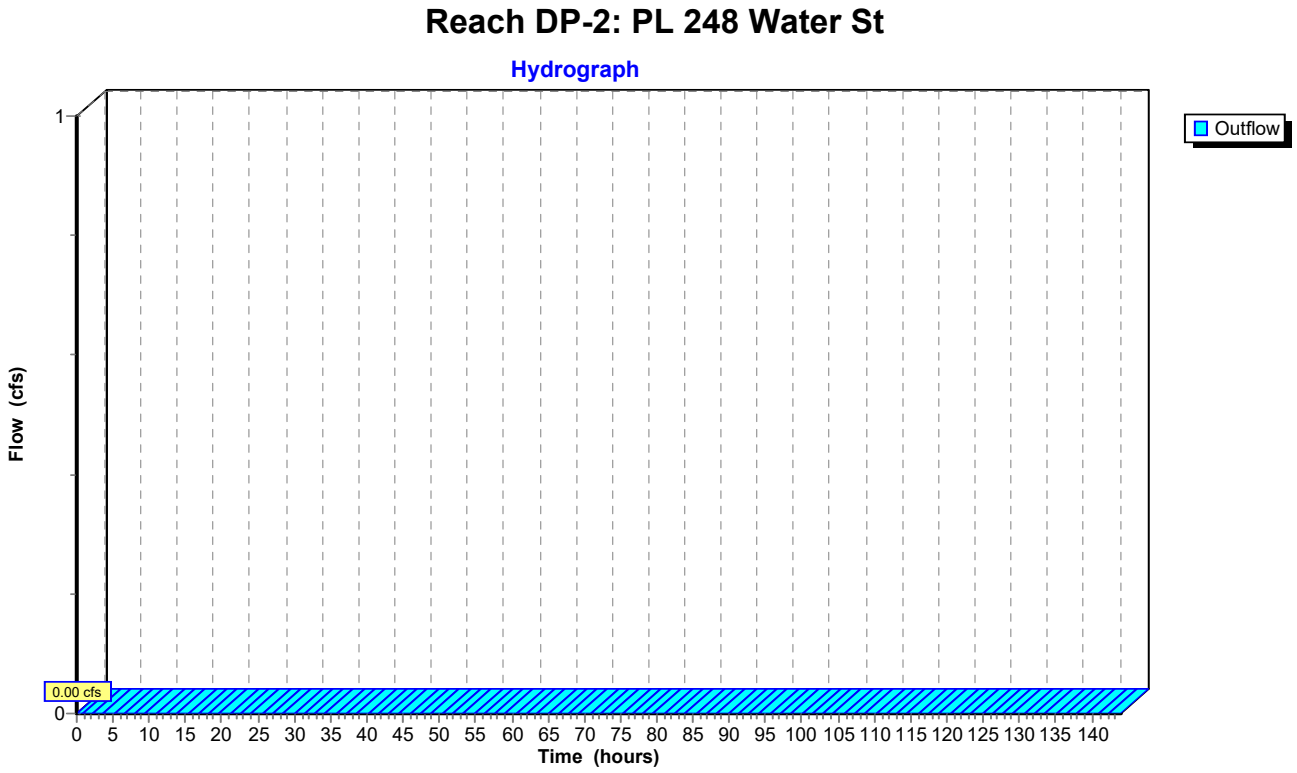
Inflow Area = 33.252 ac, 28.22% Impervious, Inflow Depth = 1.35" for 25-yr event
Inflow = 16.04 cfs @ 12.71 hrs, Volume= 3.740 af
Outflow = 16.04 cfs @ 12.71 hrs, Volume= 3.740 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

### Reach DP-1: Wetland

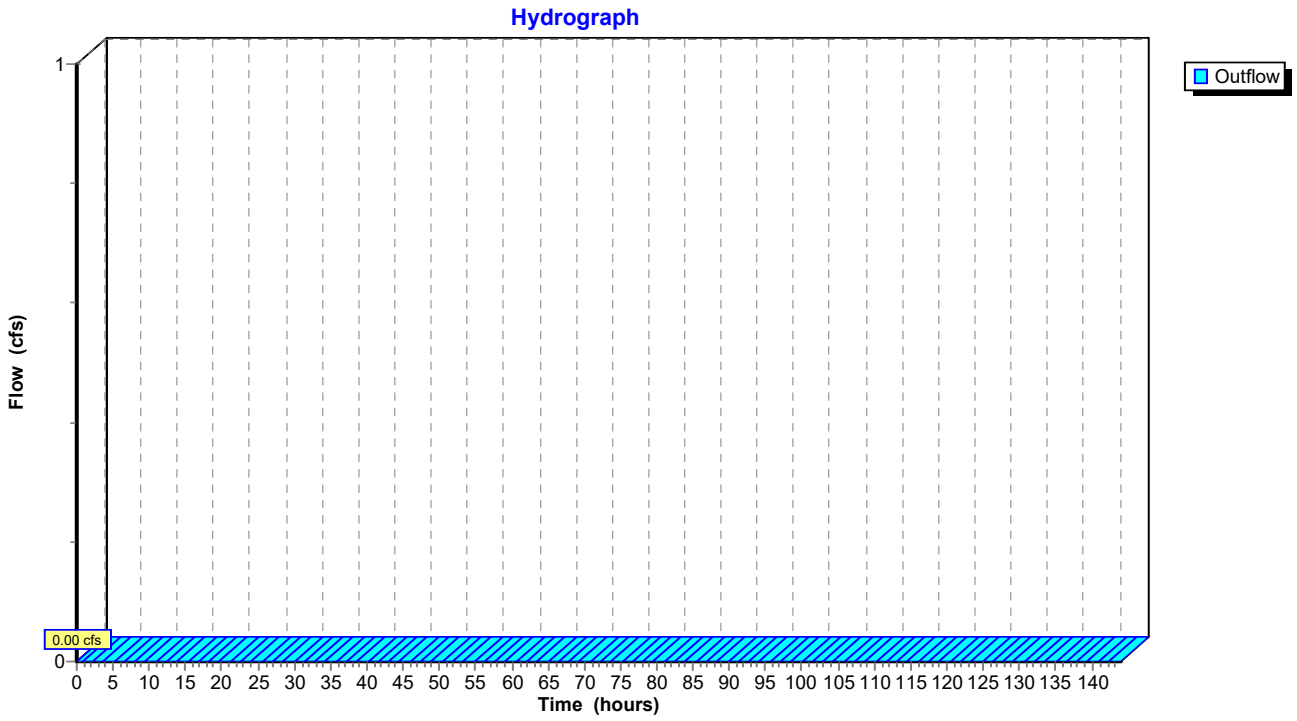


## Summary for Reach DP-2: PL 248 Water St



## Summary for Reach DP-3: South PL

### Reach DP-3: South PL



## Summary for Pond 1P: Infiltration Pond

Inflow Area = 10.362 ac, 48.35% Impervious, Inflow Depth = 2.49" for 25-yr event
Inflow = 29.92 cfs @ 12.09 hrs, Volume= 2.151 af
Outflow = 3.76 cfs @ 12.85 hrs, Volume= 1.511 af, Atten= 87%, Lag= 45.5 min
Discarded = 0.71 cfs @ 11.26 hrs, Volume= 0.090 af
Primary = 3.76 cfs @ 12.85 hrs, Volume= 1.421 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 14.13' @ 12.85 hrs Surf.Area= 19,710 sf Storage= 41,730 cf

Plug-Flow detention time= 232.5 min calculated for 1.511 af (70% of inflow)
Center-of-Mass det. time= 133.8 min ( 975.5 - 841.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.50' | 81,727 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

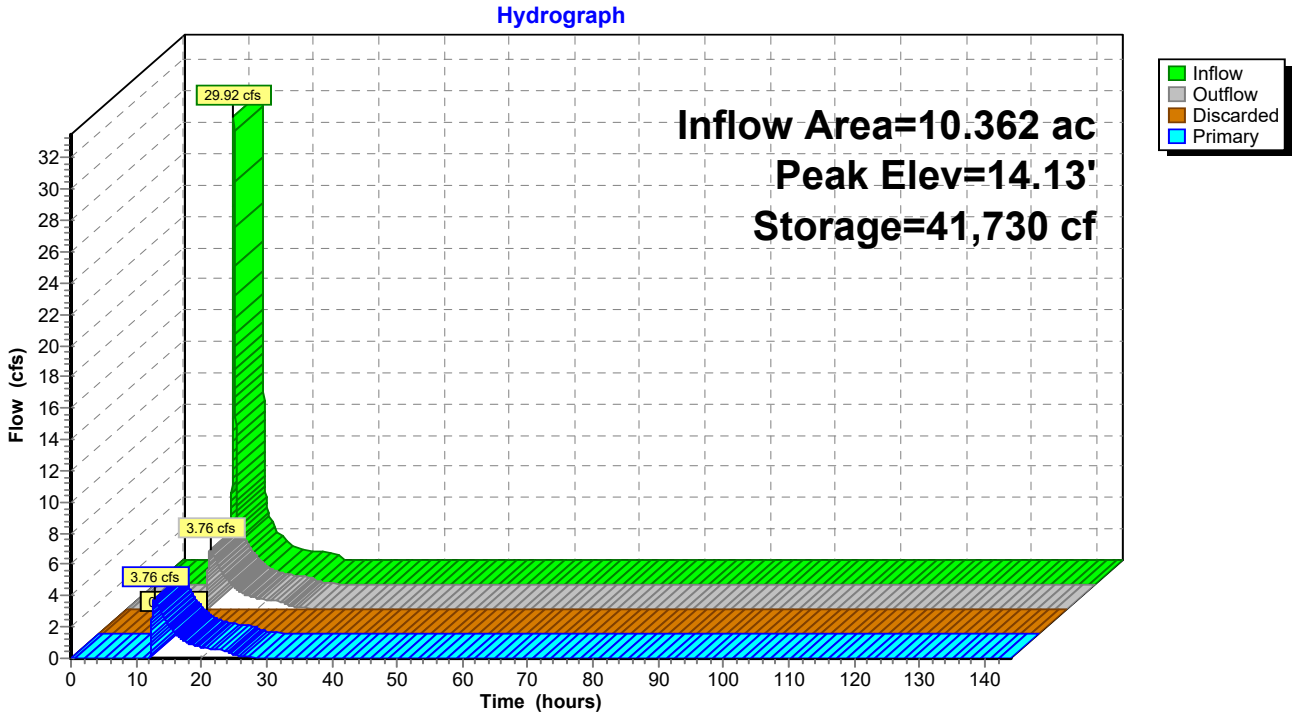
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.50 | 12,792 | 0 | 0 |
| 12.00 | 13,508 | 6,575 | 6,575 |
| 13.00 | 14,981 | 14,245 | 20,820 |
| 13.10 | 17,797 | 1,639 | 22,458 |
| 14.00 | 19,481 | 16,775 | 39,234 |
| 15.00 | 21,280 | 20,381 | 59,614 |
| 16.00 | 22,946 | 22,113 | 81,727 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 10.00' | **12.0" Round Culvert**<br>L= 46.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 10.00' / 9.00' S= 0.0217 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 13.40' | **2.0' long x 2.00' rise Sharp-Crested Rectangular Weir**<br>2 End Contraction(s) |
| #3 | Discarded | 11.50' | **Infiltration 2.41 In/Hr shut off for storms 10 yr and >**<br>Head (feet) 0.00 0.10 1.00 1.50 1.69 1.70 4.00<br>Disch. (cfs) 0.000 0.714 0.714 0.714 0.714 0.000 0.000 |

**Discarded OutFlow** Max=0.71 cfs @ 11.26 hrs HW=11.60' (Free Discharge)
↑—**3=Infiltration 2.41 In/Hr shut off for storms 10 yr and >** (Custom Controls 0.71 cfs)

**Primary OutFlow** Max=3.76 cfs @ 12.85 hrs HW=14.13' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Passes 3.76 cfs of 5.69 cfs potential flow)
↑—**2=Sharp-Crested Rectangular Weir** (Weir Controls 3.76 cfs @ 2.79 fps)

## Pond 1P: Infiltration Pond



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 3.42" for 25-yr event
Inflow = 13.24 cfs @ 12.44 hrs, Volume= 1.703 af
Outflow = 13.23 cfs @ 12.45 hrs, Volume= 1.535 af, Atten= 0%, Lag= 0.8 min
Primary = 13.23 cfs @ 12.45 hrs, Volume= 1.535 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.07' @ 12.45 hrs Surf.Area= 13,435 sf Storage= 8,260 cf

Plug-Flow detention time= 71.3 min calculated for 1.535 af (90% of inflow)
Center-of-Mass det. time= 23.2 min ( 863.7 - 840.5 )

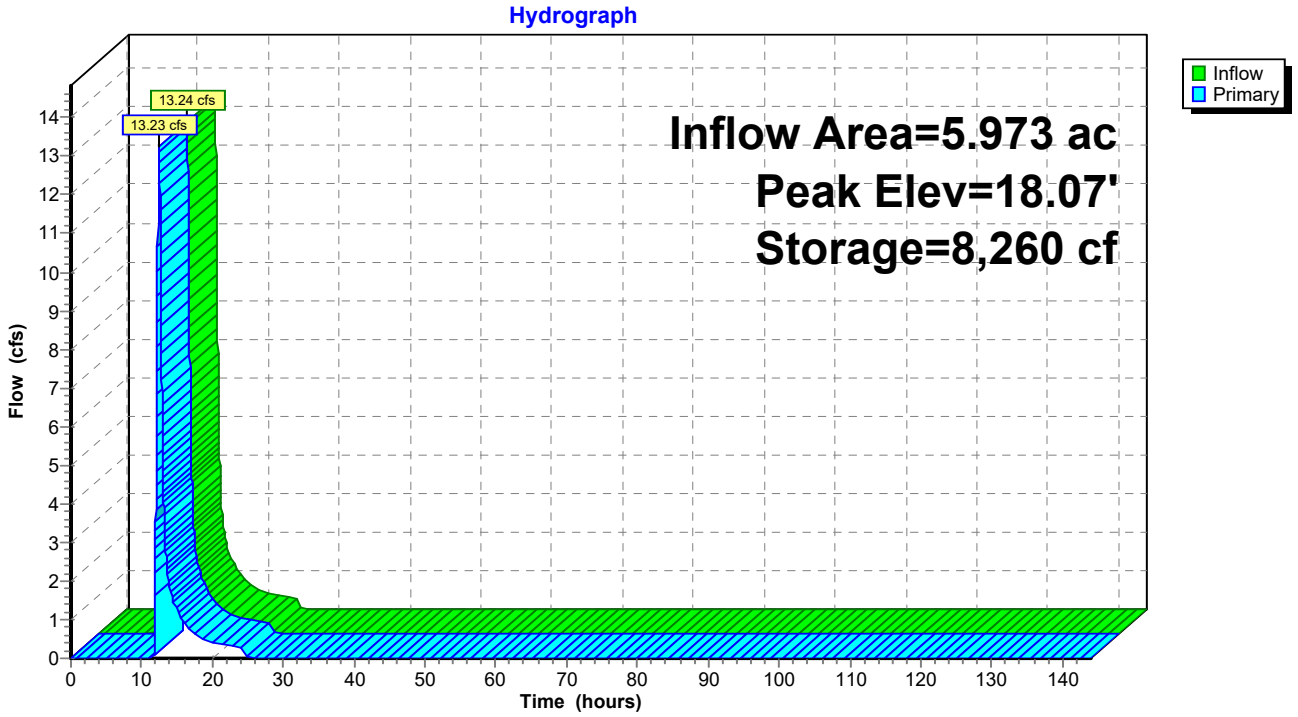
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=13.22 cfs @ 12.45 hrs HW=18.07' TW=13.31' (Dynamic Tailwater)
↑—**1=Asymmetrical Weir** (Weir Controls 13.22 cfs @ 0.87 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 10.658 ac, 38.36% Impervious, Inflow Depth = 2.53" for 25-yr event
Inflow = 18.31 cfs @ 12.39 hrs, Volume= 2.247 af
Outflow = 11.48 cfs @ 12.72 hrs, Volume= 2.010 af, Atten= 37%, Lag= 20.0 min
Primary = 11.48 cfs @ 12.72 hrs, Volume= 2.010 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.46' @ 12.72 hrs Surf.Area= 32,635 sf Storage= 28,229 cf

Plug-Flow detention time= 121.6 min calculated for 2.010 af (89% of inflow)
Center-of-Mass det. time= 72.1 min ( 937.9 - 865.8 )

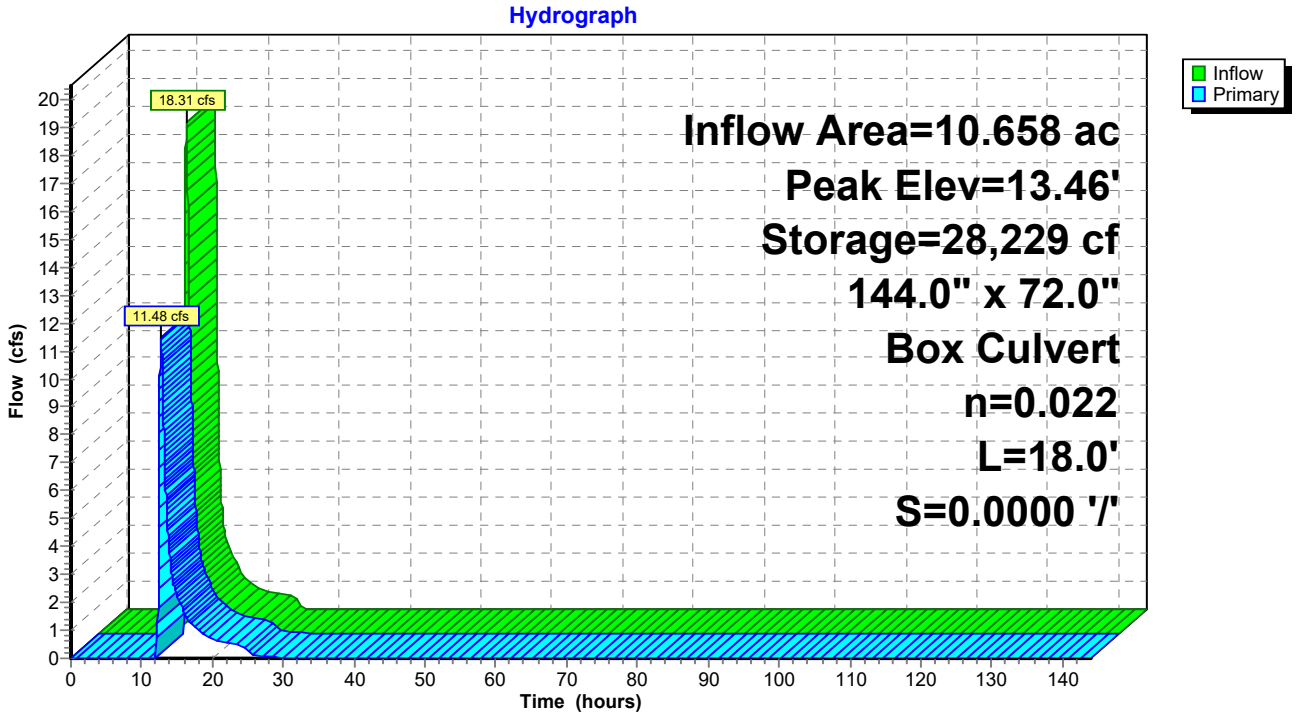
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **144.0" W x 72.0" H Box Culvert**<br>L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700<br>Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900<br>n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf |

**Primary OutFlow** Max=11.47 cfs @ 12.72 hrs HW=13.46' TW=0.00' (Dynamic Tailwater)
**1=Culvert** (Barrel Controls 11.47 cfs @ 2.03 fps)

## Pond E-P2: Wetland



Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P1: Property offsite** Runoff Area=260,170 sf 62.63% Impervious Runoff Depth=4.69"
Flow Length=343' Tc=31.4 min CN=80 Runoff=18.06 cfs 2.337 af

**Subcatchment P2: P2** Runoff Area=204,093 sf 7.43% Impervious Runoff Depth=2.80"
Flow Length=315' Tc=15.1 min CN=62 Runoff=11.31 cfs 1.094 af

**Subcatchment P3: SW Property** Runoff Area=256,545 sf 1.84% Impervious Runoff Depth=0.37"
Flow Length=400' Tc=12.0 min CN=33 Runoff=0.58 cfs 0.182 af

**Subcatchment P4: Central Overland** Runoff Area=276,292 sf 2.80% Impervious Runoff Depth=1.00"
Flow Length=190' Tc=17.0 min CN=42 Runoff=3.48 cfs 0.526 af

**Subcatchment P4a: Developed Site** Runoff Area=451,376 sf 48.35% Impervious Runoff Depth=3.62"
Tc=6.0 min CN=70 Runoff=43.87 cfs 3.125 af

**Reach DP-1: Wetland** Inflow=28.68 cfs 6.089 af
Outflow=28.68 cfs 6.089 af

**Reach DP-2: PL 248 Water St**
Outflow=0.00 cfs 0.000 af

**Reach DP-3: South PL**
Outflow=0.00 cfs 0.000 af

**Pond 1P: Infiltration Pond** Peak Elev=14.95' Storage=58,603 cf Inflow=43.87 cfs 3.125 af
Discarded=0.71 cfs 0.130 af Primary=6.30 cfs 2.354 af Outflow=6.30 cfs 2.484 af

**Pond E-P1: Wetland** Peak Elev=18.09' Storage=8,487 cf Inflow=18.06 cfs 2.337 af
Outflow=18.05 cfs 2.169 af

**Pond E-P2: Wetland** Peak Elev=13.69' Storage=36,111 cf Inflow=26.03 cfs 3.262 af
144.0" x 72.0" Box Culvert n=0.022 L=18.0' S=0.0000 '/' Outflow=19.35 cfs 3.026 af

**Total Runoff Area = 33.252 ac Runoff Volume = 7.263 af Average Runoff Depth = 2.62"**
**71.78% Pervious = 23.868 ac 28.22% Impervious = 9.384 ac**

## Summary for Subcatchment P1: Property offsite

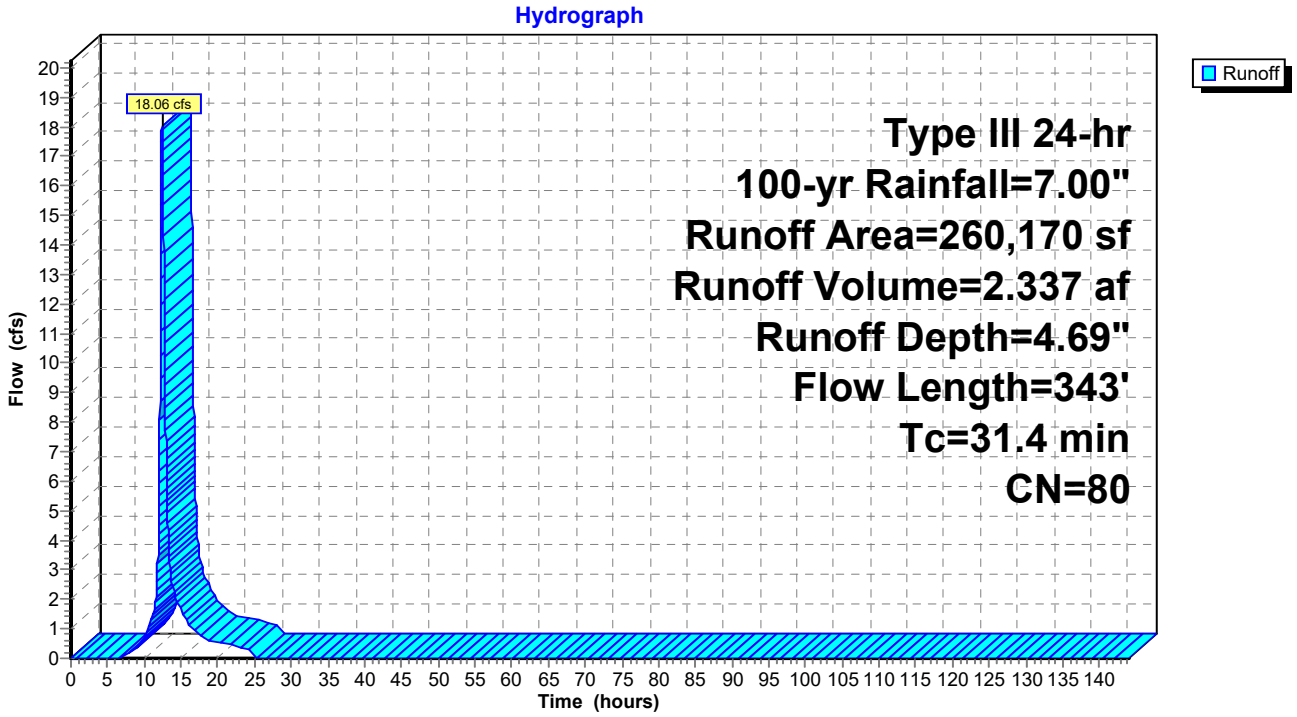
Runoff = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 142,754 | 89 | Urban commercial, 85% imp, HSG A (OFFSITE) |
| * | 31,587 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 48,943 | 94 | Urban commercial, 85% imp, HSG C (OFFSITE) |
| * | 8,690 | 78 | Wetlands/woods, HSG A (OFFSITE) |
| * | 25,996 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 2,200 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 260,170 | 80 | Weighted Average |
| | 97,228 | | 37.37% Pervious Area |
| | 162,942 | | 62.63% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 22.8 | 50 | 0.0040 | 0.04 | | **Sheet Flow, Start**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 6.6 | 126 | 0.0040 | 0.32 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 2.0 | 167 | 0.0800 | 1.41 | | **Shallow Concentrated Flow, C-WETLAND**<br>Woodland Kv= 5.0 fps |
| 31.4 | 343 | Total | | | |

## Subcatchment P1: Property offsite



## Summary for Subcatchment P2: P2

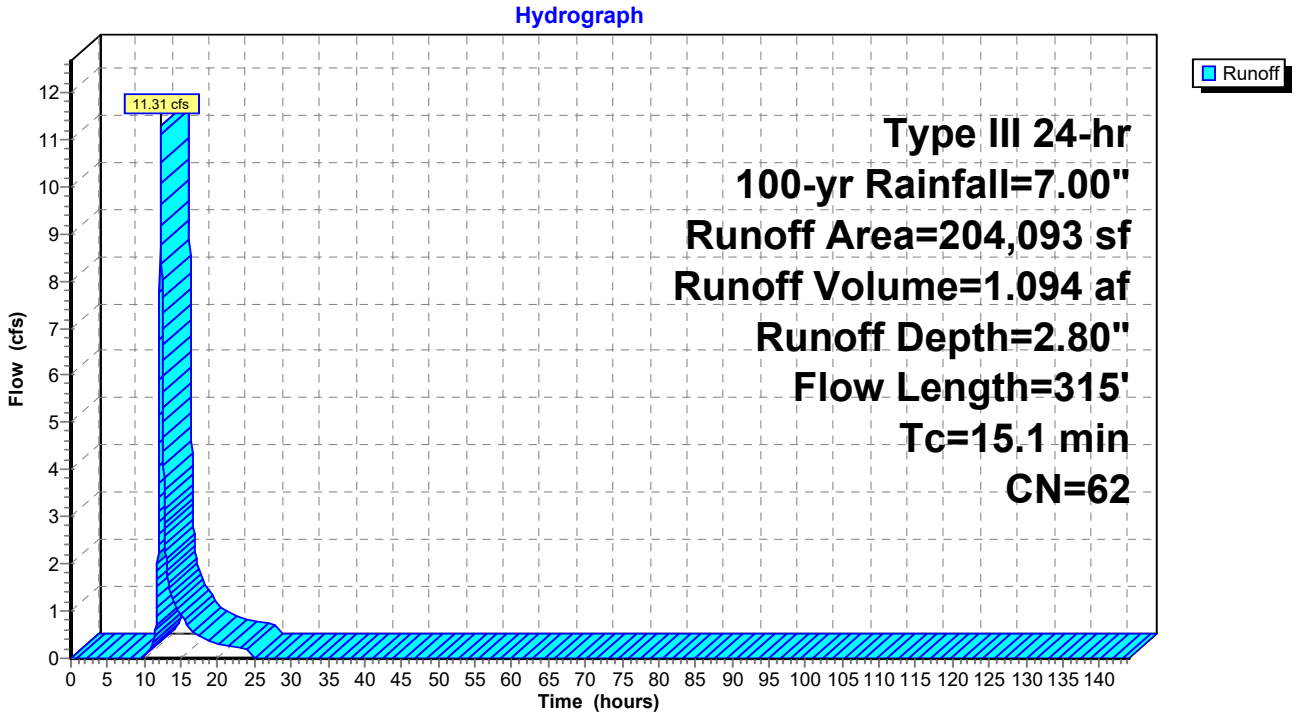
Runoff = 11.31 cfs @ 12.22 hrs, Volume= 1.094 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 9,050 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 49,865 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 20,149 | 78 | Wetlands/woods. HSG A (OFFSITE) |
| * | 4,604 | 98 | Paved parking, HSG C (OFFSITE) |
| * | 34,156 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 3,605 | 78 | Wetlands/woods, HSG C (OFFSITE) |
| | 15,787 | 70 | Woods, Good, HSG C |
| * | 5,924 | 78 | Wetlands/woods, HSG C |
| * | 28,611 | 78 | Wetlands/woods, HSG A |
| | 15,824 | 30 | Woods, Good, HSG A |
| * | 1,504 | 98 | Decks, HSG C |
| | 15,014 | 74 | >75% Grass cover, Good, HSG C |
| | 204,093 | 62 | Weighted Average |
| | 188,935 | | 92.57% Pervious Area |
| | 15,158 | | 7.43% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 12.2 | 50 | 0.0190 | 0.07 | | **Sheet Flow, START**<br>Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.5 | 116 | 0.0690 | 1.31 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.1 | 20 | 0.0200 | 2.87 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 1.3 | 129 | 0.1100 | 1.66 | | **Shallow Concentrated Flow, D-WETLAND**<br>Woodland Kv= 5.0 fps |
| 15.1 | 315 | Total | | | |

## Subcatchment P2: P2



## Summary for Subcatchment P3: SW Property

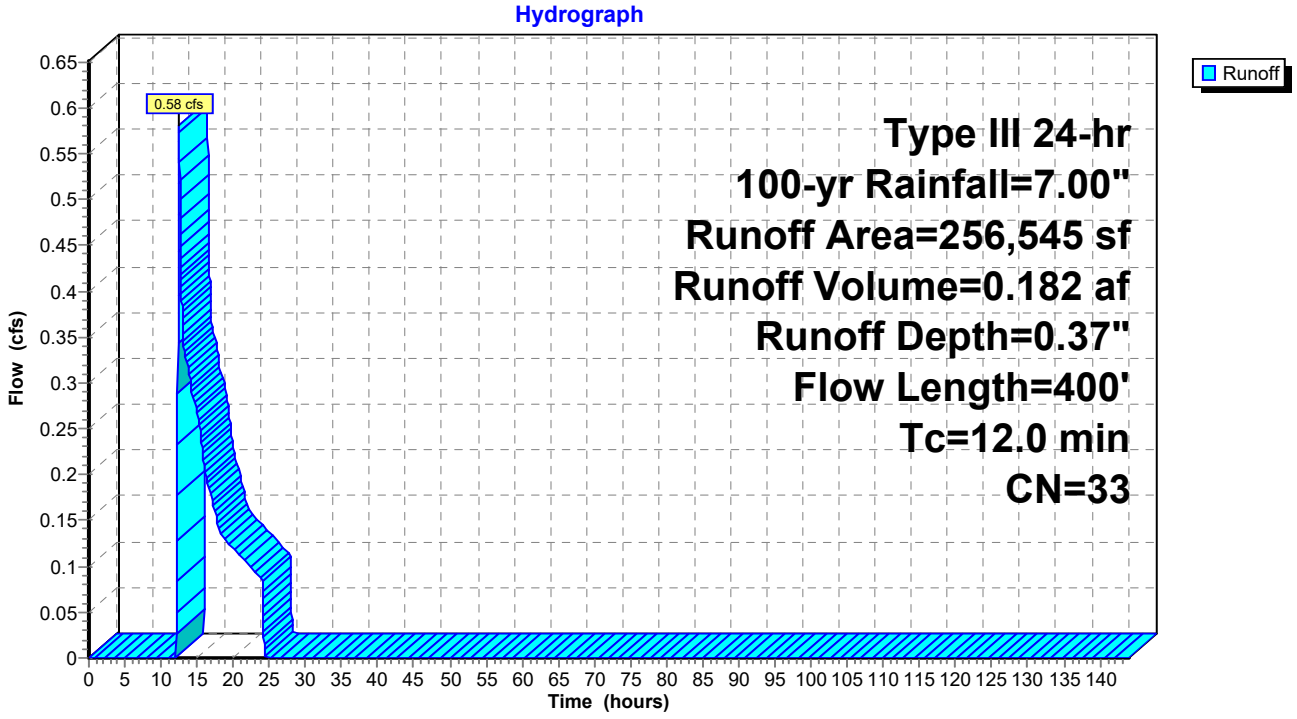
Runoff = 0.58 cfs @ 12.51 hrs, Volume= 0.182 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 118,145 | 30 | Woods, Good, HSG A |
| | 33,865 | 39 | >75% Grass cover, Good, HSG A |
| | 5,100 | 76 | Gravel roads, HSG A |
| * | 94,725 | 30 | Woods, Fair, HSG A (OFFSITE) |
| * | 4,710 | 98 | Impervious, HSG A (OFFSITE) |
| | 256,545 | 33 | Weighted Average |
| | 251,835 | | 98.16% Pervious Area |
| | 4,710 | | 1.84% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.2 | 50 | 0.0300 | 0.08 | | **Sheet Flow, START off property** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.8 | 350 | 0.0410 | 3.26 | | **Shallow Concentrated Flow, To Wetland** Unpaved Kv= 16.1 fps |
| 12.0 | 400 | Total | | | |

## Subcatchment P3: SW Property



## Summary for Subcatchment P4: Central Overland

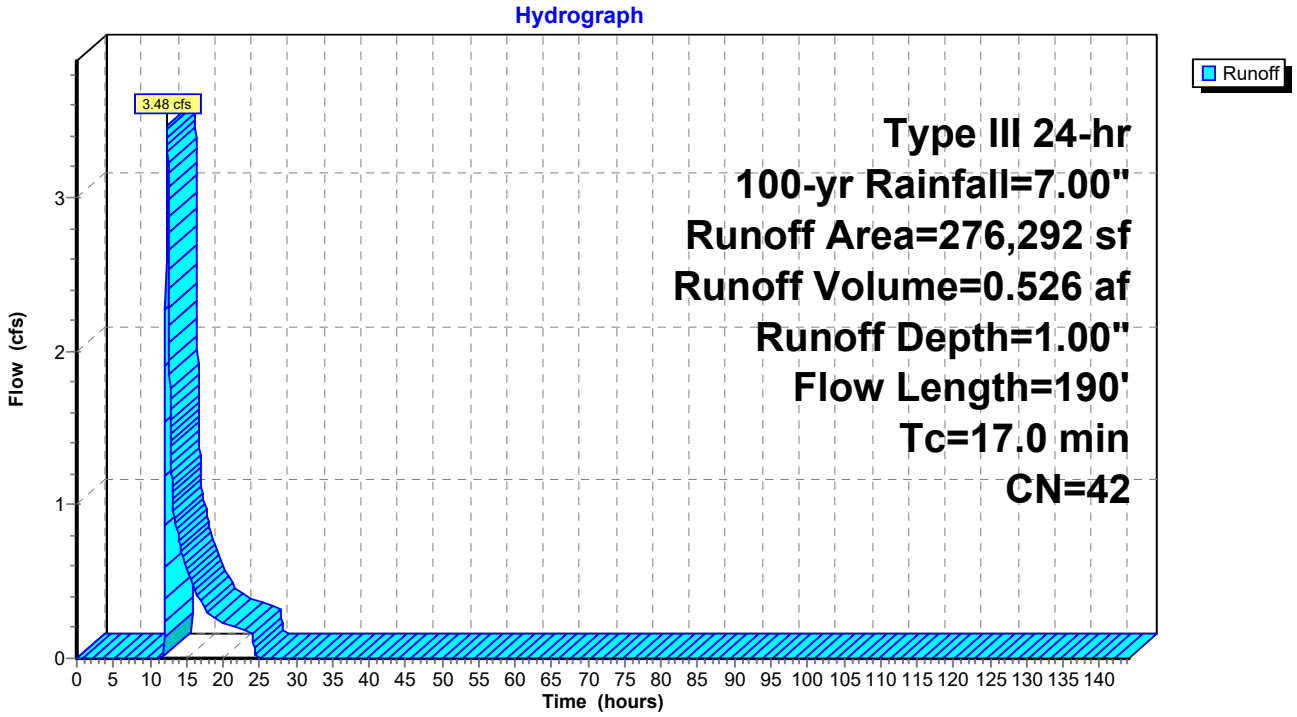
Runoff = 3.48 cfs @ 12.34 hrs, Volume= 0.526 af, Depth= 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 154,403 | 30 | Woods, Good, HSG A |
| | 63,719 | 39 | >75% Grass cover, Good, HSG A |
| | 1,074 | 76 | Gravel roads, HSG A |
| | 17,086 | 70 | Woods, Good, HSG C |
| | 31,379 | 74 | >75% Grass cover, Good, HSG C |
| * | 5,169 | 98 | Decks, HSG C |
| * | 652 | 98 | Decks, HSG A |
| * | 1,860 | 98 | Roof, HSG A |
| * | 58 | 98 | Pavement, HSG A (OFFSITE) |
| * | 892 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| | 276,292 | 42 | Weighted Average |
| | 268,553 | | 97.20% Pervious Area |
| | 7,739 | | 2.80% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 15.8 | 50 | 0.0100 | 0.05 | | **Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.40" |
| 1.2 | 140 | 0.0150 | 1.97 | | **Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps |
| 17.0 | 190 | Total | | | |

## Subcatchment P4: Central Overland



## Summary for Subcatchment P4a: Developed Site

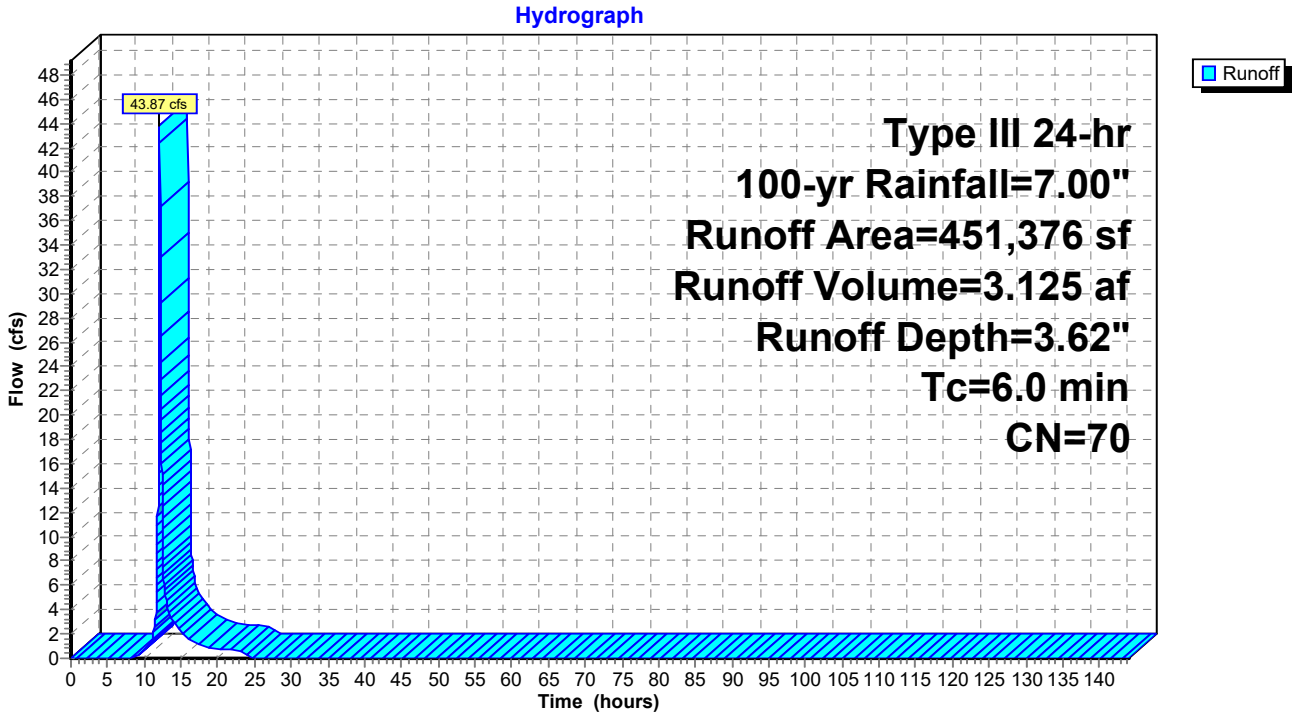
Runoff = 43.87 cfs @ 12.09 hrs, Volume= 3.125 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 67,047 | 39 | >75% Grass cover, Good, HSG A |
| | 47,531 | 98 | Paved parking, HSG A |
| | 32,505 | 98 | Roofs, HSG A |
| * | 2,709 | 98 | Decks, HSG A |
| * | 26,160 | 39 | Infiltration basin, HSG A |
| | 45,411 | 74 | >75% Grass cover, Good, HSG C |
| | 72,174 | 98 | Roofs, HSG C |
| * | 47,403 | 98 | Paved parking, HSG C |
| * | 1,771 | 98 | Decks, HSG C |
| * | 33,887 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 60,232 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 3,707 | 98 | Pavement, HSG A (OFFSITE) |
| * | 2,312 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| | 451,376 | 70 | Weighted Average |
| | 233,143 | | 51.65% Pervious Area |
| | 218,233 | | 48.35% Impervious Area |

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

## Subcatchment P4a: Developed Site

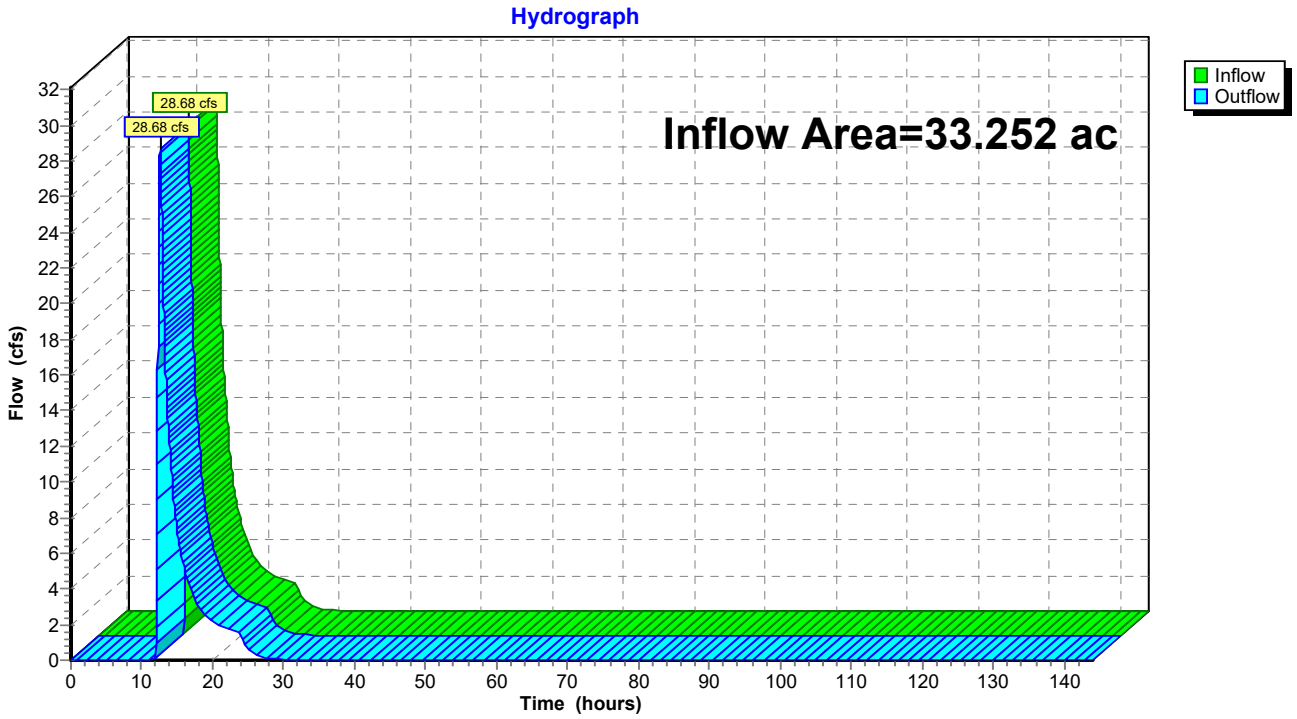


## Summary for Reach DP-1: Wetland

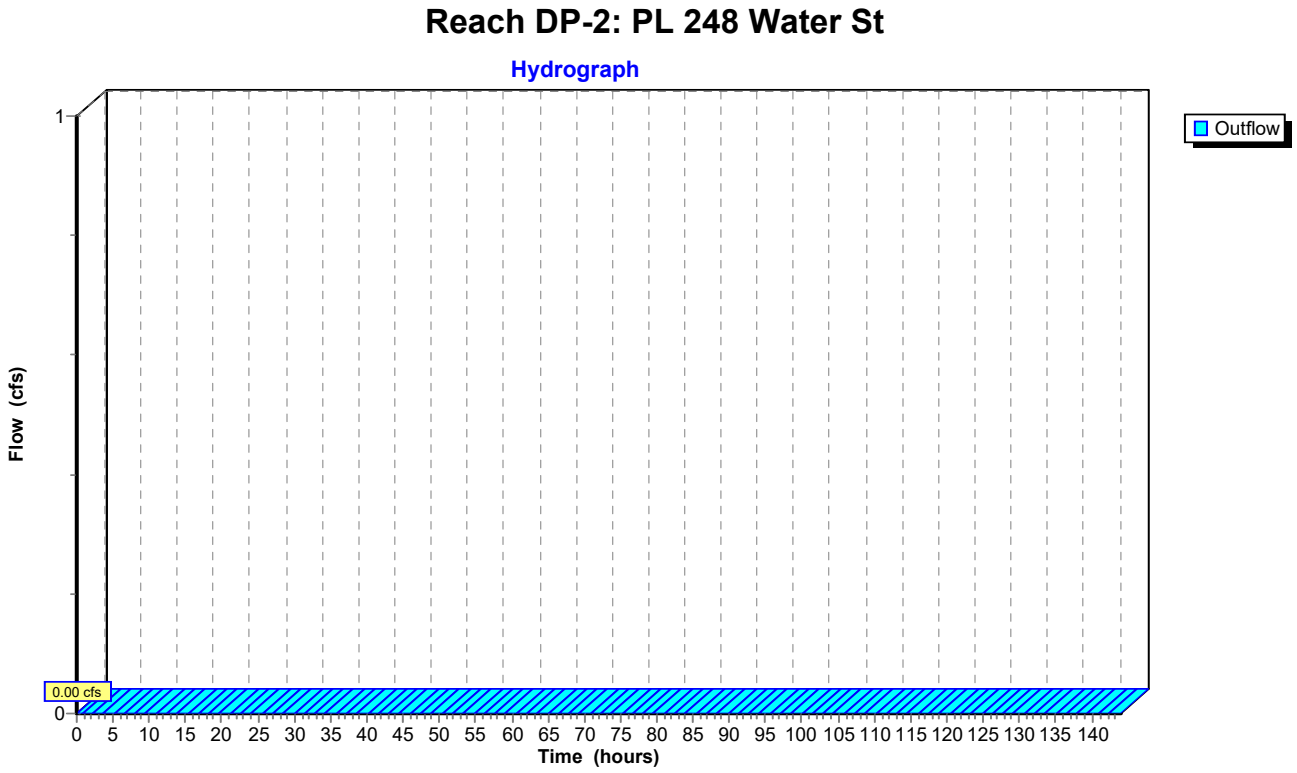
Inflow Area = 33.252 ac, 28.22% Impervious, Inflow Depth = 2.20" for 100-yr event
Inflow = 28.68 cfs @ 12.58 hrs, Volume= 6.089 af
Outflow = 28.68 cfs @ 12.58 hrs, Volume= 6.089 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2

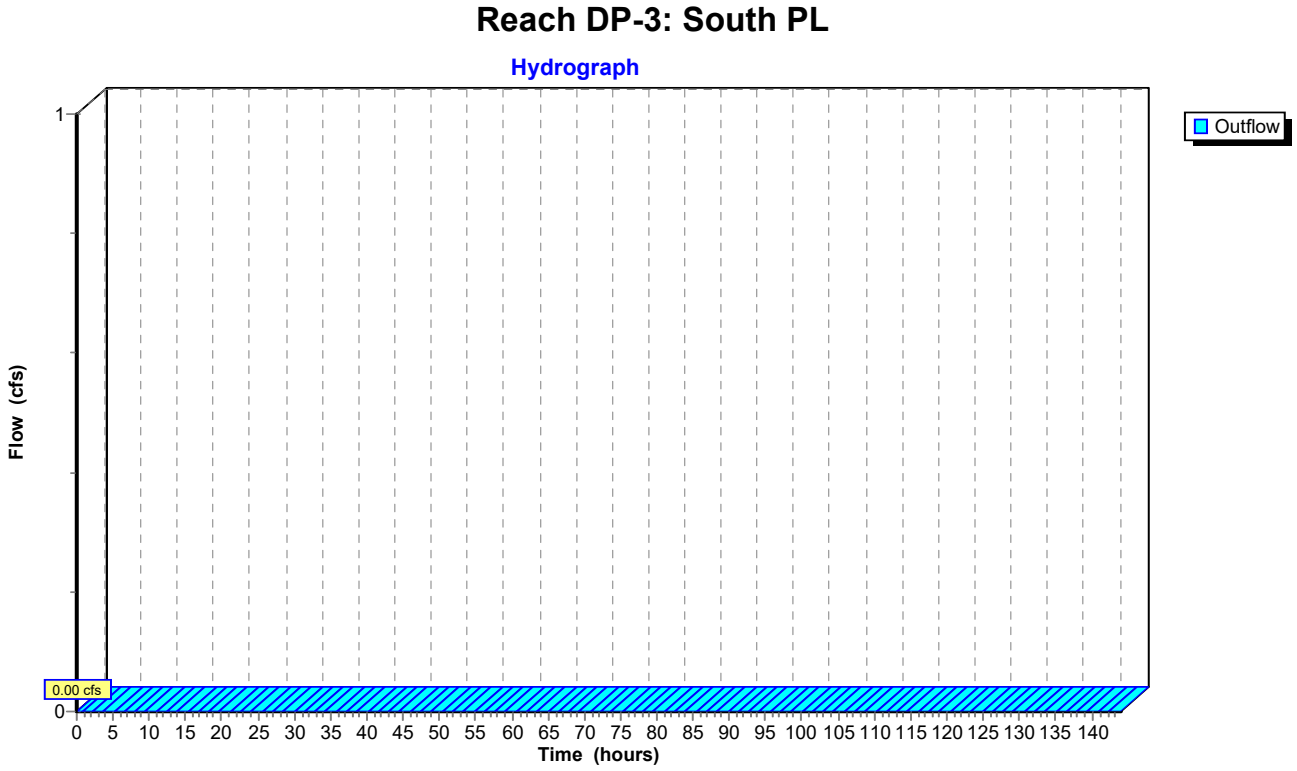
### Reach DP-1: Wetland



## Summary for Reach DP-2: PL 248 Water St



## Summary for Reach DP-3: South PL



## Summary for Pond 1P: Infiltration Pond

Inflow Area = 10.362 ac, 48.35% Impervious, Inflow Depth = 3.62" for 100-yr event
Inflow = 43.87 cfs @ 12.09 hrs, Volume= 3.125 af
Outflow = 6.30 cfs @ 12.65 hrs, Volume= 2.484 af, Atten= 86%, Lag= 33.8 min
Discarded = 0.71 cfs @ 10.58 hrs, Volume= 0.130 af
Primary = 6.30 cfs @ 12.65 hrs, Volume= 2.354 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 14.95' @ 12.65 hrs Surf.Area= 21,194 sf Storage= 58,603 cf

Plug-Flow detention time= 186.3 min calculated for 2.484 af (80% of inflow)
Center-of-Mass det. time= 107.5 min ( 938.3 - 830.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.50' | 81,727 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

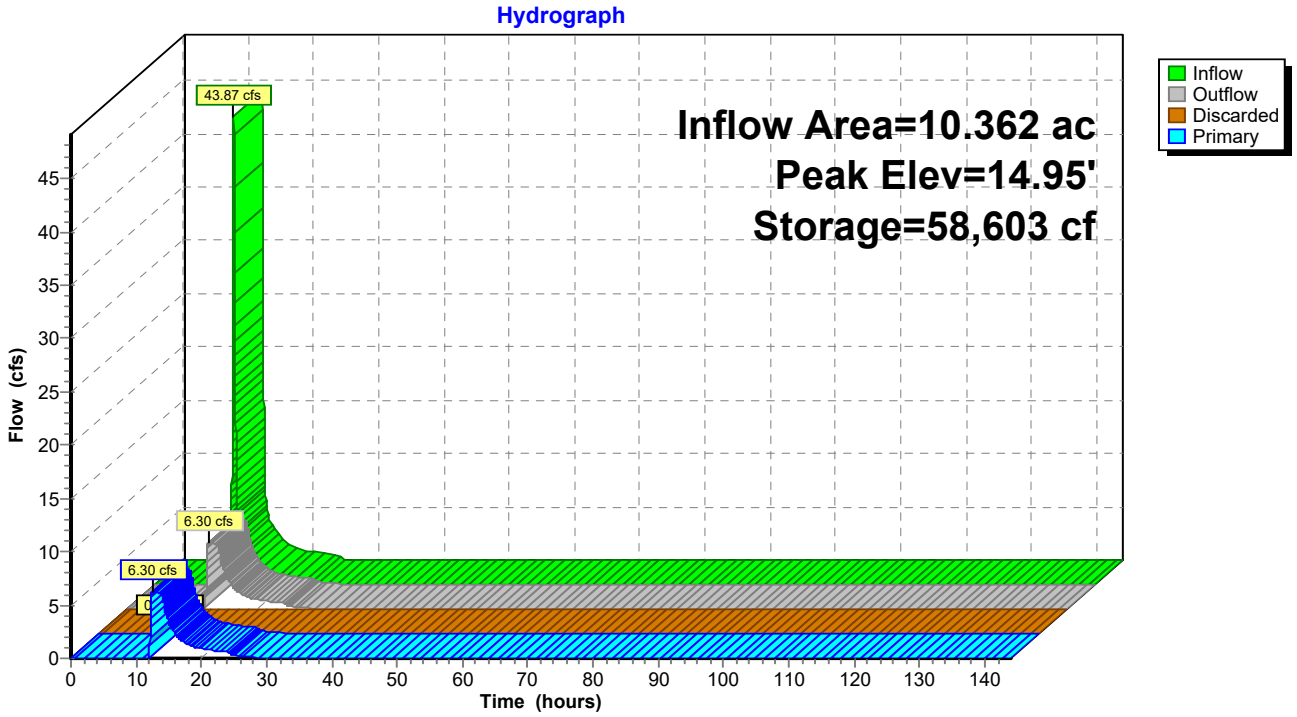
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.50 | 12,792 | 0 | 0 |
| 12.00 | 13,508 | 6,575 | 6,575 |
| 13.00 | 14,981 | 14,245 | 20,820 |
| 13.10 | 17,797 | 1,639 | 22,458 |
| 14.00 | 19,481 | 16,775 | 39,234 |
| 15.00 | 21,280 | 20,381 | 59,614 |
| 16.00 | 22,946 | 22,113 | 81,727 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 10.00' | **12.0" Round Culvert**<br>L= 46.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 10.00' / 9.00' S= 0.0217 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 13.40' | **2.0' long x 2.00' rise Sharp-Crested Rectangular Weir**<br>2 End Contraction(s) |
| #3 | Discarded | 11.50' | **Infiltration 2.41 In/Hr shut off for storms 10 yr and >**<br>Head (feet) 0.00 0.10 1.00 1.50 1.69 1.70 4.00<br>Disch. (cfs) 0.000 0.714 0.714 0.714 0.714 0.000 0.000 |

**Discarded OutFlow** Max=0.71 cfs @ 10.58 hrs HW=11.60' (Free Discharge)
└**3=Infiltration 2.41 In/Hr shut off for storms 10 yr and >** (Custom Controls 0.71 cfs)

**Primary OutFlow** Max=6.30 cfs @ 12.65 hrs HW=14.95' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 6.30 cfs @ 8.02 fps)
└**2=Sharp-Crested Rectangular Weir** (Passes 6.30 cfs of 10.69 cfs potential flow)

## Pond 1P: Infiltration Pond



## Summary for Pond E-P1: Wetland

Inflow Area = 5.973 ac, 62.63% Impervious, Inflow Depth = 4.69" for 100-yr event
Inflow = 18.06 cfs @ 12.43 hrs, Volume= 2.337 af
Outflow = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af, Atten= 0%, Lag= 0.8 min
Primary = 18.05 cfs @ 12.44 hrs, Volume= 2.169 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 18.09' @ 12.44 hrs Surf.Area= 13,697 sf Storage= 8,487 cf

Plug-Flow detention time= 57.5 min calculated for 2.168 af (93% of inflow)
Center-of-Mass det. time= 19.9 min ( 851.5 - 831.5 )

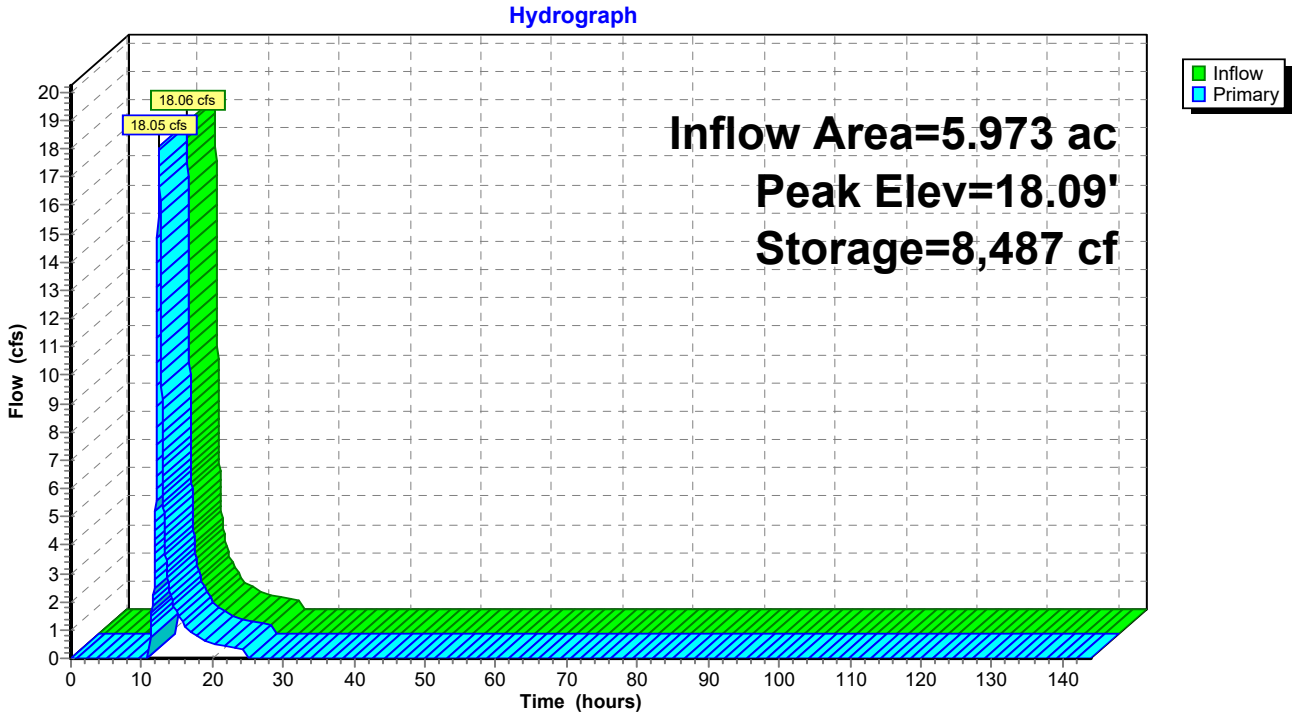
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 17.00' | 236,253 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 17.00 | 2,349 | 0 | 0 |
| 18.00 | 12,281 | 7,315 | 7,315 |
| 19.00 | 27,986 | 20,134 | 27,449 |
| 20.00 | 37,607 | 32,797 | 60,245 |
| 21.00 | 49,582 | 43,595 | 103,840 |
| 22.00 | 66,971 | 58,277 | 162,116 |
| 23.00 | 81,302 | 74,137 | 236,253 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 18.00' | **Asymmetrical Weir, C= 3.27**<br>Offset (feet) 0.00 10.80 18.43 23.94 57.50 86.92 287.08 357.73 427.57 483.95 528.04 555.94<br>Elev. (feet) 23.00 22.00 21.00 20.00 19.00 18.00 18.00 19.00 20.00 21.00 22.00 23.00 |

**Primary OutFlow** Max=18.05 cfs @ 12.44 hrs HW=18.09' TW=13.61' (Dynamic Tailwater)
↑—**1=Asymmetrical Weir** (Weir Controls 18.05 cfs @ 0.96 fps)

## Pond E-P1: Wetland



## Summary for Pond E-P2: Wetland

Inflow Area = 10.658 ac, 38.36% Impervious, Inflow Depth = 3.67" for 100-yr event
Inflow = 26.03 cfs @ 12.36 hrs, Volume= 3.262 af
Outflow = 19.35 cfs @ 12.63 hrs, Volume= 3.026 af, Atten= 26%, Lag= 15.7 min
Primary = 19.35 cfs @ 12.63 hrs, Volume= 3.026 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 13.69' @ 12.63 hrs Surf.Area= 35,394 sf Storage= 36,111 cf

Plug-Flow detention time= 93.6 min calculated for 3.026 af (93% of inflow)
Center-of-Mass det. time= 57.1 min ( 910.5 - 853.4 )

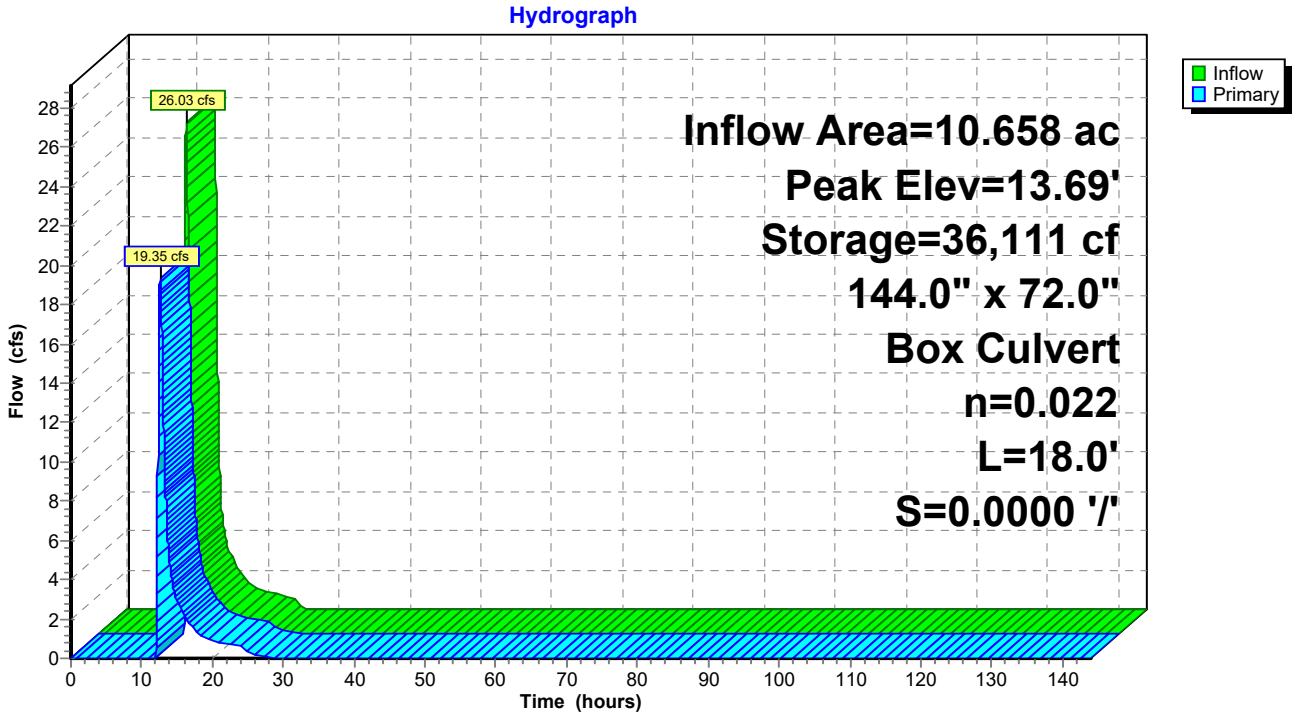
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 12.00' | 47,617 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 12.00 | 1,826 | 0 | 0 |
| 13.00 | 27,167 | 14,497 | 14,497 |
| 14.00 | 39,073 | 33,120 | 47,617 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 12.83' | **144.0" W x 72.0" H Box Culvert**<br>L= 18.0' Box, 0° wingwalls, square crown edge, Ke= 0.700<br>Inlet / Outlet Invert= 12.83' / 12.83' S= 0.0000 '/' Cc= 0.900<br>n= 0.022 Earth, clean & straight, Flow Area= 72.00 sf |

**Primary OutFlow** Max=19.34 cfs @ 12.63 hrs HW=13.69' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 19.34 cfs @ 2.50 fps)

## Pond E-P2: Wetland



# A P P E N D I X C

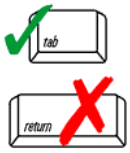
## Checklist for Stormwater Report

**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 4-5-21

## Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

# Checklist for Stormwater Report

## Checklist (continued)

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

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

**Standard 1: No New Untreated Discharges**

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

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 2: Peak Rate Attenuation**

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

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

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

**Standard 3: Recharge**

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 3: Recharge** (continued)

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

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

**Standard 4: Water Quality**

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

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

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

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

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

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

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

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 4: Water Quality** (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

**Standard 6: Critical Areas**

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

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

# Checklist for Stormwater Report

## Checklist (continued)

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

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

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

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

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

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

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

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

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

# Checklist for Stormwater Report

## Checklist (continued)

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

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

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

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

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

**Standard 9: Operation and Maintenance Plan**

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

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

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

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

**Standard 10: Prohibition of Illicit Discharges**

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

☒ An Illicit Discharge Compliance Statement is attached;

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

# A P P E N D I X  D

**Illicit Discharge Compliance Statement**
**Supplemental BMP Calculations**

# Illicit Discharge Compliance Statement

I, Bradley C. Mckenzie, P.E., hereby notify the Pembroke Conservation Commission that I have not witnessed, nor am aware of any existing illicit discharges at the site known as Assessor's Map E-17, Lot 0 & E-17A, Lot 274 Water Street in Pembroke, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "River Marsh Village Comprehensive Permit Plan (Assessor's Map E-17, Lot 0 & E-17A, Lot 274) Water Street, Pembroke, Mass," prepared by McKenzie Engineering Group. Inc. dated September 22, 2016 and as revised and approved by the Pembroke Conservation Commission and maintenance thereof in accordance with the "Construction Phase Operations and Maintenance Plan" and "Long-Term Operations and Maintenance Plan" prepared by McKenzie Engineering Group, Inc. dated April 5, 2021 and as revised and approved by the Pembroke Conservation Commission will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

**Name:** Bradley Mckenzie, P.E.

**Company:** McKenzie Engineering Group, Inc.

**Title:** President

**Signature:** _____

**Date:** 4-5-21

MCKENZIE ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061

**COMPREHENSIVE PERMIT PLAN** **4/5/2021**
**RIVER MARSH VILLAGE**
**PEMBROKE, MA**

## MASSACHUSETTS RIVER AND STREAM CROSSING STANDARDS

*Culvert Width (Spans a minimum of 1.2 times the bankfull width)*

Banfull width should be determined as the average of a least three typical widths, measured at proposed structures's location

Widths of bank

12.98
10.42
7.94
7.52

Average 9.715

Minimum culvert width = 1.2 (9.72)= 11.658 Use 12 foot wide culvert.

*Openness ratio (minimum)=0.82 feet*

Openness is the cross-sectional area of a structure opening divided by its crossing length
Box culvert, openness = (height x width)/length

Length of proposed culvert = 17.99 feet

.82 = H x 12/17.99= 1.22932 Minimum height of culvert = 1.30 feet

Use a 12' x 6' open bottom box culvert (for footings to be 4' below grade)

Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061

**RIVER MARSH VILLAGE**
**PEMBROKE, MA**

**4/5/2021**

**STANDARD 1 - OUTLET PTOTECTION**

Outlet From P-1 TO DP-2

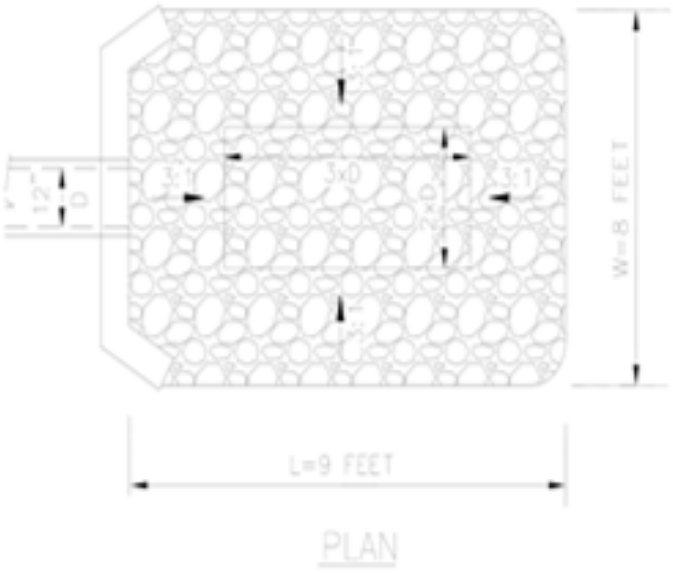
| | |
|---|---|
| Outlet Pipe (inches) = | 12 |
| Q50 (cfs) = | 5.91 |
| TW = 0 (Assume 0.2') | 0.2 |

Y = Depth of Trap = 1/2 Pipe Size (Min.) = 6" - use 12" (1')

d50 = 0.0125 (Q)^4/3 / TW * Do

d50 (feet)= 0.667826003 Use Minimum 8" diamater stone

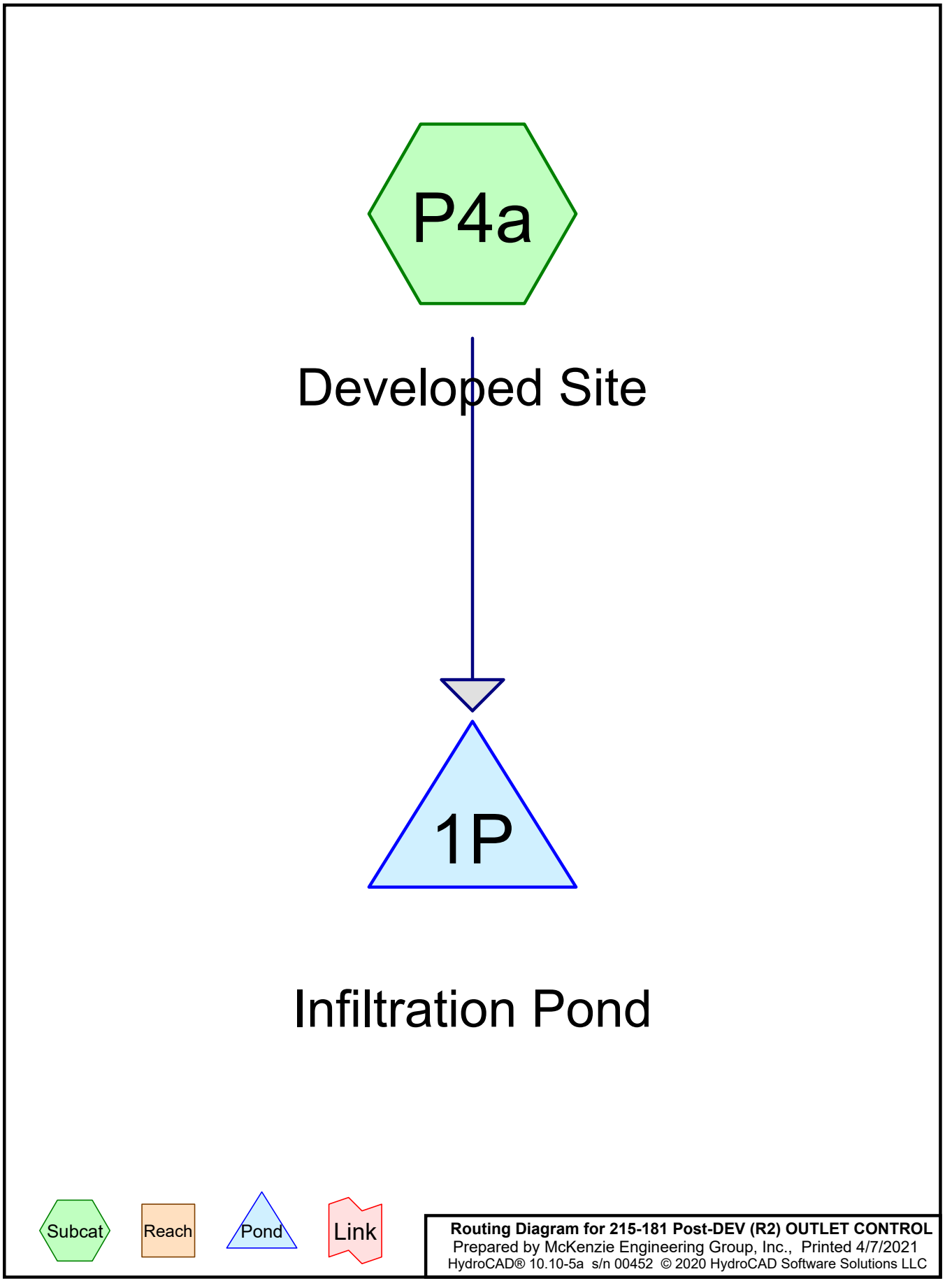
Trap Size




PLAN

W= 3+2+3 = 8 Feet

L=3+3+3 = 9 Feet




**Routing Diagram for 215-181 Post-DEV (R2) OUTLET CONTROL**
Prepared by McKenzie Engineering Group, Inc., Printed 4/7/2021

## Project Notes

Rainfall events imported from "TP-40-Rain.txt" for 447 MA Plymouth

## Rainfall Events Listing (selected events)

| Event# | Event Name | Storm Type | Curve | Mode | Duration (hours) | B/B | Depth (inches) | AMC |
|---|---|---|---|---|---|---|---|---|
| 1 | 50-Year | Type III 24-hr | | Default | 24.00 | 1 | 6.20 | 2 |

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 1.539 | 39 | >75% Grass cover, Good, HSG A (P4a) |
| 1.383 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) (P4a) |
| 1.042 | 74 | >75% Grass cover, Good, HSG C (P4a) |
| 0.062 | 98 | Decks, HSG A (P4a) |
| 0.041 | 98 | Decks, HSG C (P4a) |
| 0.186 | 98 | Impervious, HSG A (OFFSITE) (P4a) |
| 0.601 | 39 | Infiltration basin, HSG A (P4a) |
| 1.091 | 98 | Paved parking, HSG A (P4a) |
| 0.053 | 98 | Paved parking, HSG A (OFFSITE) (P4a) |
| 1.088 | 98 | Paved parking, HSG C (P4a) |
| 0.085 | 98 | Pavement, HSG A (OFFSITE) (P4a) |
| 0.746 | 98 | Roofs, HSG A (P4a) |
| 1.657 | 98 | Roofs, HSG C (P4a) |
| 0.778 | 30 | Woods, Good, HSG A (OFFSITE) (P4a) |
| 0.009 | 70 | Woods, Good, HSG C (OFFSITE) (P4a) |
| **10.362** | **70** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 6.525 | HSG A | P4a |
| 0.000 | HSG B | |
| 3.838 | HSG C | P4a |
| 0.000 | HSG D | |
| 0.000 | Other | |
| **10.362** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 2.922 | 0.000 | 1.042 | 0.000 | 0.000 | 3.964 | >75% Grass cover, Good | P4a |
| 0.062 | 0.000 | 0.041 | 0.000 | 0.000 | 0.103 | Decks | P4a |
| 0.186 | 0.000 | 0.000 | 0.000 | 0.000 | 0.186 | Impervious | P4a |
| 0.601 | 0.000 | 0.000 | 0.000 | 0.000 | 0.601 | Infiltration basin | P4a |
| 1.144 | 0.000 | 1.088 | 0.000 | 0.000 | 2.232 | Paved parking | P4a |
| 0.085 | 0.000 | 0.000 | 0.000 | 0.000 | 0.085 | Pavement | P4a |
| 0.746 | 0.000 | 1.657 | 0.000 | 0.000 | 2.403 | Roofs | P4a |
| 0.778 | 0.000 | 0.009 | 0.000 | 0.000 | 0.787 | Woods, Good | P4a |
| **6.525** | **0.000** | **3.838** | **0.000** | **0.000** | **10.362** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Width (inches) | Diam/Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1P | 10.00 | 9.00 | 46.0 | 0.0217 | 0.013 | 0.0 | 12.0 | 0.0 |

Time span=0.00-144.00 hrs, dt=0.02 hrs, 7201 points x 2
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment P4a: Developed Site** Runoff Area=451,376 sf 48.35% Impervious Runoff Depth=2.96"
Tc=6.0 min CN=70 Runoff=35.78 cfs 2.560 af

**Pond 1P: Infiltration Pond** Peak Elev=14.42' Storage=47,503 cf Inflow=35.78 cfs 2.560 af
Discarded=0.71 cfs 0.108 af Primary=5.91 cfs 1.812 af Outflow=5.91 cfs 1.920 af

**Total Runoff Area = 10.362 ac Runoff Volume = 2.560 af Average Runoff Depth = 2.96"**
**51.65% Pervious = 5.352 ac 48.35% Impervious = 5.010 ac**

## Summary for Subcatchment P4a: Developed Site

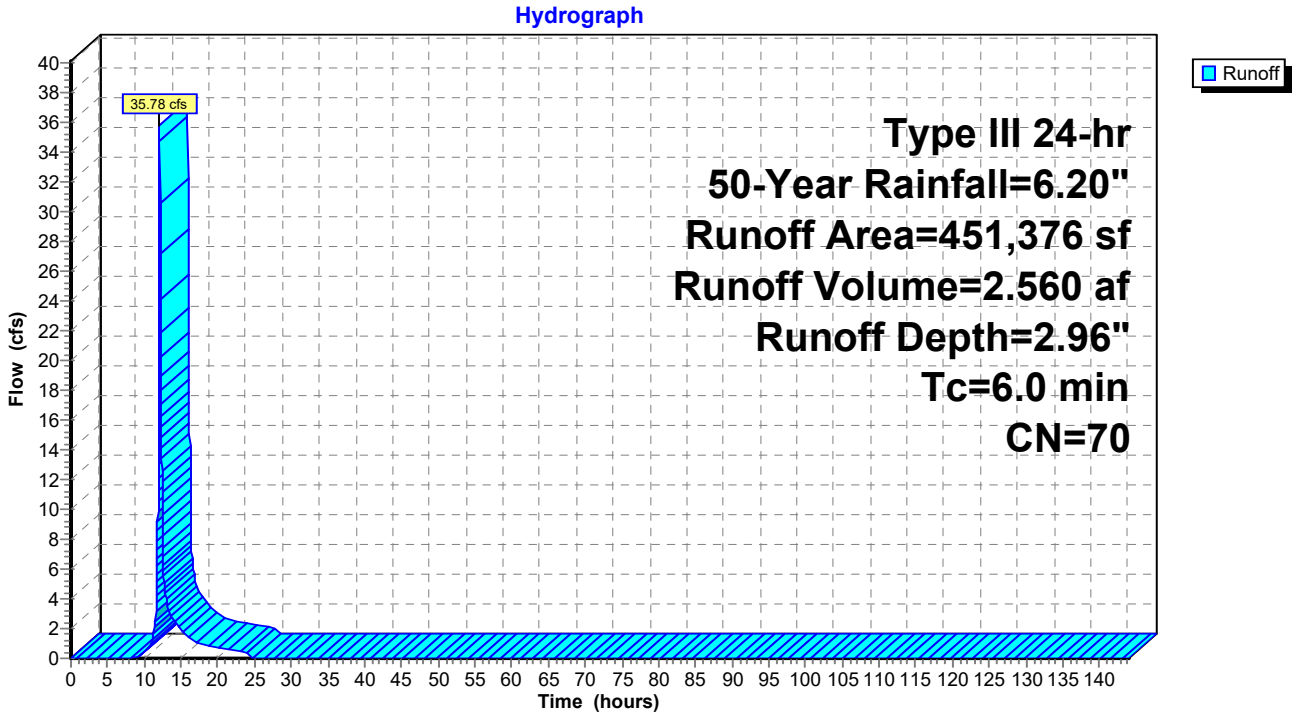
Runoff = 35.78 cfs @ 12.09 hrs, Volume= 2.560 af, Depth= 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs
Type III 24-hr 50-Year Rainfall=6.20"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 67,047 | 39 | >75% Grass cover, Good, HSG A |
| | 47,531 | 98 | Paved parking, HSG A |
| | 32,505 | 98 | Roofs, HSG A |
| * | 2,709 | 98 | Decks, HSG A |
| * | 26,160 | 39 | Infiltration basin, HSG A |
| | 45,411 | 74 | >75% Grass cover, Good, HSG C |
| | 72,174 | 98 | Roofs, HSG C |
| * | 47,403 | 98 | Paved parking, HSG C |
| * | 1,771 | 98 | Decks, HSG C |
| * | 33,887 | 30 | Woods, Good, HSG A (OFFSITE) |
| * | 406 | 70 | Woods, Good, HSG C (OFFSITE) |
| * | 60,232 | 39 | >75% Grass cover, Good, HSG A (OFFSITE) |
| * | 3,707 | 98 | Pavement, HSG A (OFFSITE) |
| * | 2,312 | 98 | Paved parking, HSG A (OFFSITE) |
| * | 8,121 | 98 | Impervious, HSG A (OFFSITE) |
| | 451,376 | 70 | Weighted Average |
| | 233,143 | | 51.65% Pervious Area |
| | 218,233 | | 48.35% Impervious Area |

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

## Subcatchment P4a: Developed Site



## Summary for Pond 1P: Infiltration Pond

Inflow Area = 10.362 ac, 48.35% Impervious, Inflow Depth = 2.96" for 50-Year event
Inflow = 35.78 cfs @ 12.09 hrs, Volume= 2.560 af
Outflow = 5.91 cfs @ 12.60 hrs, Volume= 1.920 af, Atten= 83%, Lag= 30.4 min
Discarded = 0.71 cfs @ 10.96 hrs, Volume= 0.108 af
Primary = 5.91 cfs @ 12.60 hrs, Volume= 1.812 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-144.00 hrs, dt= 0.02 hrs / 2
Peak Elev= 14.42' @ 12.60 hrs Surf.Area= 20,230 sf Storage= 47,503 cf

Plug-Flow detention time= 205.8 min calculated for 1.920 af (75% of inflow)
Center-of-Mass det. time= 115.9 min ( 952.5 - 836.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 11.50' | 81,727 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

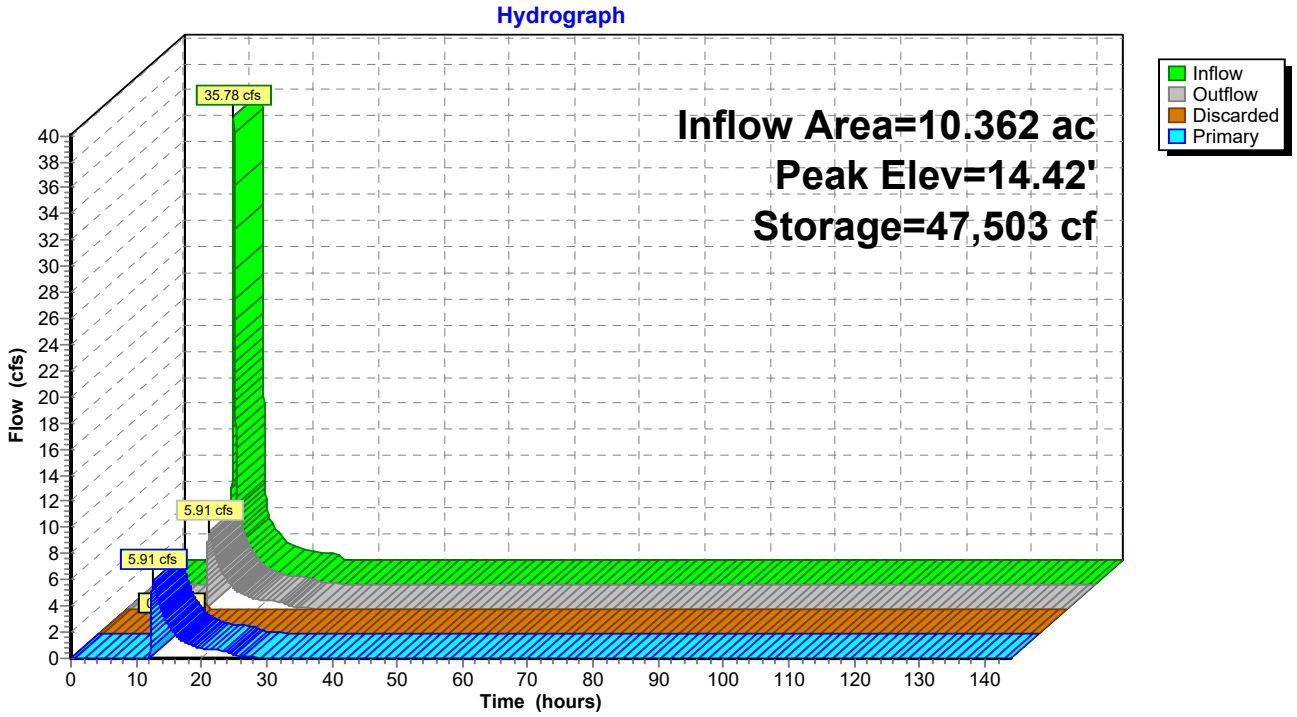
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 11.50 | 12,792 | 0 | 0 |
| 12.00 | 13,508 | 6,575 | 6,575 |
| 13.00 | 14,981 | 14,245 | 20,820 |
| 13.10 | 17,797 | 1,639 | 22,458 |
| 14.00 | 19,481 | 16,775 | 39,234 |
| 15.00 | 21,280 | 20,381 | 59,614 |
| 16.00 | 22,946 | 22,113 | 81,727 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 10.00' | **12.0" Round Culvert**<br>L= 46.0' CPP, projecting, no headwall, Ke= 0.900<br>Inlet / Outlet Invert= 10.00' / 9.00' S= 0.0217 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf |
| #2 | Device 1 | 13.40' | **2.0' long x 2.00' rise Sharp-Crested Rectangular Weir**<br>2 End Contraction(s) |
| #3 | Discarded | 11.50' | **Infiltration 2.41 In/Hr shut off for storms 10 yr and >**<br>Head (feet) 0.00 0.10 1.00 1.50 1.69 1.70 4.00<br>Disch. (cfs) 0.000 0.714 0.714 0.714 0.714 0.000 0.000 |

**Discarded OutFlow** Max=0.71 cfs @ 10.96 hrs HW=11.60' (Free Discharge)
↑**3=Infiltration 2.41 In/Hr shut off for storms 10 yr and >** (Custom Controls 0.71 cfs)

**Primary OutFlow** Max=5.91 cfs @ 12.60 hrs HW=14.42' (Free Discharge)
↑**1=Culvert** (Inlet Controls 5.91 cfs @ 7.52 fps)
↑**2=Sharp-Crested Rectangular Weir** (Passes 5.91 cfs of 6.02 cfs potential flow)

## Pond 1P: Infiltration Pond



MCKENZIE ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061

**RIVER MARSH VILLAGE**
**PEMBROKE, MA**

**4/5/2021**

**REQUIRED RECHARGE VOLUME (CF) *"STATIC METHOD"***

| WATERSHED # | IMPERVIOUS AREA (SF) | TARGET DEPTH FACTOR (F) A SOIL | IMPERVIOUS AREA (SF) | TARGET DEPTH FACTOR (F) B SOIL | IMPERVIOUS AREA (SF) | TARGET DEPTH FACTOR (F) C SOIL | IMPERVIOUS AREA (SF) | TARGET DEPTH FACTOR (F) D SOIL | | REQUIRED RECHARGE VOLUME (CF) |
|---|---|---|---|---|---|---|---|---|---|---|
| P1 | 4,710 | 0.60 | | 0.35 | | 0.25 | | 0.10 | | 236 |
| P2 | 2,550 | 0.60 | | 0.35 | 5,169 | 0.25 | | 0.10 | | 235 |
| P2a | 96,885 | 0.60 | | 0.35 | 121,348 | 0.25 | | 0.10 | | 7,372 |
| | | | | | | | | | | |
| | | | | | | | **TOTAL** | | | **7,843** |

**CAPTURE ADJUSTMENT**

| WATERSHED # | TOTAL IMPERVIOUS AREA (SF) | TOTAL IMPERVIOUS COLLECTED | % DIRECTED TOWARDS INFILTRATION SYSTEM | STANDARD NO. 3 > 65% CAPTURED | CAPTURE ADJUSTMENT | ADJUSTED REQUIRED RECHARGE VOLUME (CF) |
|---|---|---|---|---|---|---|
| TOTAL SITE | 230,662 | 218,233 | 94.61% | **CAPTURE ADJUSTMENT REQUIRED** | 1.06 | 8,290 |

* Required Water Quality Volume based on 1 inch of runoff; Required Recharge Volume based on 0.60 inches (1 >0.60); Target Volume is Required Water Quality Volume of 17,153 CF

**PROVIDED RECHARGE VOLUME (CF)**

**UP TO WEIR INVERT ELEV. 10.80**

| | REQUIRED RECHARGE VOLUME (CF) | POND | STORAGE VOLUME PROVIDED (CF) | NET STORAGE VOLUME PROVIDED (CF) |
|---|---|---|---|---|
| | 18,186 | 1P | 27,882 | 9,696 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| **TOTAL** | **18,186** | | **27,882** | **9,696** |

MCKENZIE ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061

**RIVER MARSH VILLAGE**
**PEMBROKE, MA**

**4/5/2021**

**WATER QUALITY VOLUME ANALYSIS**

| POND | IMPERVIOUS AREA (SF) CN=98 | PRECIPITATION (IN) | WATER QUALITY VOLUME REQUIRED (CF) | TREATMENT VOLUME PROVIDED (CF) UP TO WEIR INVERT ELEV. 13.40 | NET TREATMENT VOLUME PROVIDED (CF) |
|---|---|---|---|---|---|
| BASIN 1P | 218,233 | 1.00 | 18,186 | 27,882 | 9,696 |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| **TOTAL** | **218,233** | | **18,186** | **27,882** | **9,696** |

Infiltration Basin Requires 44% TSS removal prior to infiltration use Sediment Forebay

**SEDIMENT FOREBAY SIZING (0.1-INCH / IMPERVIOUS ACRE)**

| WATERSHED | IMPERVIOUS AREA (SF) CN=98 | 0.1 INCH / IMPERVIOUS ACRE | WATER QUALITY VOLUME REQUIRED (CF) |
|---|---|---|---|
| 2PA | 218,233 | 0.10 | 1819 |
| | | | |
| | | | |
| | | | |
| **TOTAL** | **218,233** | | **1,819** |

**SEDIMENT FOREBAY VOLUME PROVIDED**

| FOREBAY | ELEVATION | AREA (SF) | CUMULATIVE VOLUME (CF) | TREATMENT VOLUME PROVIDED (CF) ELEVATIONS 9.50 TO 11 | NET TREATMENT VOLUME PROVIDED (CF) |
|---|---|---|---|---|---|
| BASIN 1P | 11.50 | 999.00 | 0 | 2003 | 184 |
| | 12 | 1,217.00 | 554 | | |
| | 13 | 1,677.00 | 1,447 | | |
| **TOTAL** | | | **2,001** | | **184** |

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ENGINEERING GROUP

Assinippi Office Park
150 Longwater Drive, Suite 101
Norwell, MA 02061

**RIVER MARSH VILLAGE** **4/5/2021**
**PEMBROKE, MA**

## DRAWDOWN WITHIN 72 HOURS ANALYSIS

| POND | RAWLS RATE (IN/HR) | STORAGE VOLUME PROVIDED (CF) | BOTTOM AREA (FT2) | DRAWDOWN (HR) |
|---|---|---|---|---|
| 1P | 2.41 | 27,882 | 12,792 | 11 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

MCKENZIE ENGINEERING GROUP

**Standard 4: Total Suspended Solids Calculation:**
**Infiltration basin 1P**

**NAME:** River Marsh Village
Pembroke, MA
**CLIENT:** River Marsh, LLC
**COUNTY:** Plymouth

**Proj. No.:** 215-181
**Date:** 4/5/2021
**Revised:**
**Computed by:** SBS
**Checked by:** BCM

Assinippi Office Park
150 Longwater Drive, Suite 10
Norwell, MA 02061

**TSS Removal Calculation**

| B<br>BMP | C<br>TSS Removal Rate | D<br>Starting TSS Load (*F) | E<br>Amount Removed (C*D) | F<br>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%

*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

MCKENZIE ENGINEERING GROUP

**Standard 4: Pretreatment Calculation:**
**Infiltration basin 1P**

**NAME:** River Marsh Village
Pembroke, MA
**CLIENT:** River Marsh, LLC
**COUNTY:** Plymouth

**Proj. No.:** 215-181
**Date:** 4/5/2021
**Revised:**
**Computed by:** SBS
**Checked by:** BCM

Assinippi Office Park
150 Longwater Drive, Suite 10
Norwell, MA 02061

**TSS Removal Calculation**

| B<br>BMP | C<br>TSS Removal Rate | D<br>Starting TSS Load (*F) | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| Deep Sump and Hooded Catch Basin | 0.25 | 1.00 | 0.25 | 0.75 |
| Sediment Forebay | 0.25 | 0.75 | 0.19 | 0.56 |
| | 0.00 | 0.56 | 0.00 | 0.56 |
| | 0.00 | 0.56 | 0.00 | 0.56 |
| | 0.00 | 0.56 | 0.00 | 0.56 |

**Total TSS Removal =** 44%

*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

# A P P E N D I X  E

## Soil Testing Data

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

## B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

Squamscott fine sand loam & Eldridge fine s.l.
Soil Name

Seasonal high watertables / slow permeability
Soil Limitations

Sandy eolian deposits/sandy glaciofluvial deposits

Lake terraces, Lake Plains
Landform

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

Till deposits less than 10 - 15 ft. thick
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:
Wetland Type

7. Current Water Resource Conditions (USGS): March 16, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

**Deep Observation Hole Number:** SW-1 (Hole #) | 3/16/21 (Date) | 12:55 PM (Time) | Sunny 34 degrees (Weather) | 42 6' 29.2" (Latitude) | 70 46' 57.3" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-3% (Slope (%))

Description of Location:

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Property Line 145+/- feet | Drainage Way >100 feet | Drinking Water Well >100 feet | Wetlands >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 82" Depth Weeping from Pit _____ Depth Standing Water in Hole

**Soil Log**

| Depth (in) | Soil Horizon /Layer | Soil Texture (USDA | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features | | | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Depth | Color | Percent | Gravel | Cobbles & Stones | | | |
| 0"-11" | Ap | Sandy loam | 10YR2/2 | | | | 5% | 5-10% | Massive | Friable | |
| 11"-27" | Bw | Loamy sand | 10YR4/6 | | | | 5% | 5-10% | Granular | Friable | |
| 27"-46" | C1 | Loamy sand | 10YR5/6 | 36" | 2.5Y6/3 10YR4/6 | 25% | 5% | 5-10% | Granular | Very friable | Medium |
| 46"-126" | C2 | Sandy loam | 2.5Y5/4 | | | 50% | 30-40% | 30-40% | Massive | Friable to firm | Very stony/ angular coarse particles |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

**Deep Observation Hole Number:** SW-2 (Hole #) | 3/16/21 (Date) | 12:00 PM (Time) | Sunny 34 degrees (Weather) | 42 6' 29.2" (Latitude) | 70 46' 58.1" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.) | 1-3% (Slope (%)

Description of Location:

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | (Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line 180+/- feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 72" Depth Weeping from Pit _____ Depth Standing Water in Hole

**Soil Log**

| Depth (in) | Soil Horizon /Layer | Soil Texture (USDA) | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features | | | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Depth | Color | Percent | Gravel | Cobbles & Stones | | | |
| 0"-12" | Ap | Sandy loam | 7.5YR3/3 | | | | <5% | <5% | Massive | Friable | |
| 12"-25" | Bw | Loamy sand | 10YR4/6 | | | | <5% | <5% | Granular | Friable | |
| 25"-52" | C1 | Sand | 10YR4/4 | 30" | 2.5Y6/3 10YR4/6 | 15% | <5% | <5% | Single grain | Very friable | Medium |
| 52"-72" | C2 | Sandy loam | 2.5Y4/4 | 52" | | 40% | <5% | <5% | Blocky | Moderately firm | |
| 72"-126" | C3 | Sand/loamy sand | 10YR4/4 | | | | <5% | <5% | Single grain | Very friable | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## D. Determination of High Groundwater Elevation

1. Method Used:

| | Obs. Hole #SW-1 | Obs. Hole #SW-2 |
|---|---|---|
| ☐ Depth observed standing water in observation hole | _____ inches | _____ inches |
| ☐ Depth weeping from side of observation hole | _____ inches | _____ inches |
| ☒ Depth to soil redoximorphic features (mottles) | 36 inches | 30 inches |
| ☐ Depth to adjusted seasonal high groundwater ($S_h$) (USGS methodology) | _____ inches | _____ inches |

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ $S_c$ _____ $S_r$ _____ $OW_c$ _____ $OW_{max}$ _____ $OW_r$ _____ $S_h$ _____

2. Estimated Depth to High Groundwater: _____ inches

## E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☒ Yes ☐ No

| | | | | |
|---|---|---|---|---|
| b. If yes, at what depth was it observed (exclude A and O Horizons)? | Upper boundary: | 12 inches | Lower boundary: | 126 inches |
| c. If no, at what depth was impervious material observed? | Upper boundary: | _____ inches | Lower boundary: | _____ inches |

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis

Signature of Soil Evaluator

March 16, 2021
Date

Alan W. Loomis, Soil Evaluator #1405
Typed or Printed Name of Soil Evaluator / License #

June 30, 2022
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

**Note:** In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

## Field Diagrams: Use this area for field diagrams:

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## A. Facility Information

River Marsh, LLC
Owner Name

293R Washington Street
Street Address

Map E-17, Lot 0 & Map E-17A, Lot 274
Map/Lot #

Norwell
City

MA
State

02061
Zip Code

## B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes: Web Soil Survey (Source) 200A & 221B (Soil Map Unit)

Squamscott fine sand loam & Eldridge fine s.l.
Soil Name

Seasonal high watertables / slow permeability
Soil Limitations

Sandy eolian deposits/sandy glaciofluvial deposits
Landform

Lake terraces, Lake Plains

3. Surficial Geological Report Available? ☒ Yes ☐ No If yes: 2018 (Year Published/Source) Thin till (Map Unit)

Till deposits less than 10 - 15 ft. thick
Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer: (Wetland Type)

7. Current Water Resource Conditions (USGS): March 16, 2021 (Month/Day/ Year) Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area*)

**Deep Observation Hole Number:** SW-3 (Hole #) | 3/16/21 (Date) | 12:25 PM (Time) | Sunny 34 degrees (Weather) | 42 6' 28.7" (Latitude) | 70 46' 58.6" (Longitude:)

1. Land Use: Woodland (e.g., woodland, agricultural field, vacant lot, etc.) | Pine, oak, maple (Vegetation) | Common, some large boulder (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | 1-3% (Slope (%))

Description of Location:

2. Soil Parent Material: Eolian deposits/glaciofluvial deposits | Lake terraces/plains (Landform) | (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body >100 feet | Drainage Way >100 feet | Wetlands >100 feet | Property Line 225+/- feet | Drinking Water Well >100 feet | Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 55" Depth Weeping from Pit _____ Depth Standing Water in Hole

**Soil Log**

| Depth (in) | Soil Horizon /Layer | Soil Texture (USDA | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features | | | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Depth | Color | Percent | Gravel | Cobbles & Stones | | | |
| 0"-9" | Ap | Sandy loam | 10YR3/3 | | | | <5% | <5% | Massive | Friable | |
| 9"-27" | Bw | Loamy sand | 10YR4/6 | | | | <5% | <5% | Granular | Friable | |
| 27"-51" | C1 | Loamy sand | 10YR4/3 | 32" | 2.5Y6/3 10YR4/6 | 15% | <5% | <5% | Single grain | Very friable | Medium |
| 51"-71" | C2 | Sandy loam | 2.5Y4/4 | 51" | | 40% | <5% | <5% | Blocky | Moderately firm | |
| 71"-104" | C3 | Sand/loamy sand | 10YR4/4 | | | | <5% | <5% | Single grain | Very friable | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

Additional Notes:

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## C. On-Site Review *(minimum of two holes required at every proposed primary and reserve disposal area)*

**Deep Observation Hole Number:** _____ Hole # _____ Date _____ Time _____ Weather _____ Latitude _____ Longitude:

1. Land Use: _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

Description of Location: _____

2. Soil Parent Material: _____ _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

4. Unsuitable Materials Present: ☐ Yes ☐ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

**Soil Log**

| Depth (in) | Soil Horizon /Layer | Soil Texture (USDA) | Soil Matrix: Color-Moist (Munsell) | Redoximorphic Features | | | Coarse Fragments % by Volume | | Soil Structure | Soil Consistence (Moist) | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Depth | Color | Percent | Gravel | Cobbles & Stones | | | |
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Additional Notes: _____

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## D. Determination of High Groundwater Elevation

1. Method Used:

| | Obs. Hole #SW-3 | Obs. Hole #_____ |
|---|---|---|
| ☐ Depth observed standing water in observation hole | _____ inches | _____ inches |
| ☐ Depth weeping from side of observation hole | _____ inches | _____ inches |
| ☐ Depth to soil redoximorphic features (mottles) | 32 inches | _____ inches |
| ☐ Depth to adjusted seasonal high groundwater ($S_h$) (USGS methodology) | _____ inches | _____ inches |

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ $S_c$ _____ $S_r$ _____ $OW_c$ _____ $OW_{max}$ _____ $OW_r$ _____ $S_h$ _____

2. Estimated Depth to High Groundwater: _____ inches

## E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☐ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: _____ inches Lower boundary: _____ inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

**Commonwealth of Massachusetts**
**City/Town of** Pembroke

# Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

## F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Alan W. Loomis
Signature of Soil Evaluator

March 16, 2021
Date

Alan W. Loomis, Soil Evaluator #1405
Typed or Printed Name of Soil Evaluator / License #

June 30, 2022
Expiration Date of License

Name of Approving Authority Witness

Approving Authority

**Note:** In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

**Field Diagrams:** Use this area for field diagrams:

# A P P E N D I X F

## Best Management Practices
## Operation and Maintenance Plans

# CONSTRUCTION PHASE POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN (BEST MANAGEMENT PRACTICES OPERATION AND MAINTENANCE PLAN)

**for**

## River Marsh Village

**In**

**Pembroke, Massachusetts**
**(Assessor's Map E-17, Lot 0 & E-17A, Lot 274)**

**Submitted to:**

## TOWN OF PEMBROKE

**Prepared for:**

## River Marsh, LLC
**239R Washington Street**
**Norwell, Massachusetts 02061**

**Prepared by:**

MCKENZIE ENGINEERING GROUP

**Professional Civil Engineering • Project Management • Land Planning**
**150 Longwater Drive, Suite 101, Norwell, Massachusetts 02061**
**Tel.: (781) 792-3900 Facsimile: (781) 792-0333**
**www.mckeng.com**

**April 5, 2021**

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## Construction Phase Pollution Prevention & Erosion and Sedimentation Control Plan

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with plans entitled "River Marsh Village Comprehensive Permit Plan, Assessor's Map E-17, Lot 0 & E-17A, Lot 274) Water Street, Pembroke, MA dated September 22, 2016 as revised and approved, prepared by McKenzie Engineering Group, Inc., hereinafter referred to as the Site Plans.

Property Owner:

River Marsh, LLC
293R Washington Street
Norwell, MA 02061

Developer Contact Information:

River marsh, LLC
293R Washington Street
Norwell, MA 02061

Town of Pembroke Contact Information:

Pembroke Department of Public Works
Eugene Fulmine, Jr., Director
100 Center Street
Pembroke, MA 02359
Phone: 781-293-5620
Fax: 781-293-2964

Pembroke Conservation Commission
Robert Clarke, Agent
100 Center Street
Pembroke, MA 02359
Phone: 781-293-4674

Pembroke Building Department
George Verry, Inspector of Buildings & Zoning Officer
100 Center Street
Pembroke, MA 02359
Phone: 781-293-3864
Fax: 781-293-9250

Pembroke Zoning Board of Appeals
Matthew Heins, Administrative Assistant
100 Center Street
Pembroke, MA 02359
Phone: 781-294-4425
Fax: 781-709-1453

**Erosion and Sedimentation Control Practices:**

**Structural Practices:**

1) **Compost Filter Tube Sock Barrier Controls** – A compost filter tube barrier will be constructed along downward slopes at the limit of work in locations shown on the plans. This control will be installed prior to major soil disturbance on the site. The sediment silt sock should be installed as shown on the Erosion Control Detail Plan.

   Compost Filter Tube Design/Installation Requirements

   a) Locate the compost filter tube identified on the plans.
   b) The compost filter tube line should be nearly level through most of its length to impound a broad, temporary pool. The last 10 to 20 feet at each end of the silt sock should be swung slightly uphill (approximately 0.5 feet in elevation) to provide storage capacity.
   c) The compost filter tube shall be staked every 8 linear feet with 1-inch by 1-inch stakes.
   d) Compost filter tubes should be removed when they have served their useful purpose, but not before the upslope area has been permanently stabilized through one growing season. Retained sediment must be removed and properly disposed of or mulched and seeded.

   Compost Filter Tube Inspection/Maintenance

   a) Compost filter tubes should be inspected immediately after each rainfall event of 1-inch or greater, and at least daily during prolonged rainfall. Inspect the depth of sediment, fabric tears, and to see that the stakes are firmly in the ground. Repair or replace as necessary.
   b) Remove sediment deposits promptly after storm events to provide adequate storage volume for the next rain and to reduce pressure on the sock. Sediment will be removed from behind the silt sock when it becomes about ½ foot deep at the silt sock. Take care to avoid undermining the sock during cleanout.
   c) If the fabric tears, decomposes, or in any way becomes ineffective, replace it immediately.
   d) Remove all compost filter tube materials only after the contributing drainage areas have been properly stabilized. Sediment deposits and silt sock materials remaining after stakes have been removed should be graded to conform to the existing topography and vegetated.

2) **Stabilized Construction Entrance** – A stabilized construction entrances will be placed at the proposed entrances on Water Street. The stabilized construction entrances will be installed immediately after the clearing and grubbing of the site entrance and associated roadway cut/fill to maintain access to the site are completed. The stormwater runoff from the entrance will be diverted to temporary sedimentation basins alongside the proposed driveway. The construction entrance will keep mud and sediment from being tracked off the construction site onto Water Street by vehicles leaving the site. The stabilized construction entrances shall be constructed as shown on the Erosion Control Detail Plan.

Construction Entrance Design/Construction Requirements *

a) Grade foundation for positive drainage towards the temporary sedimentation basin along the side of the roadway.

b) Stone for a stabilized construction entrance shall consist of 1 to 3-inch stone placed on a stable foundation.

c) Pad dimensions: The minimum length of the gravel pad should be 50 feet. The pad should extend the full width of the proposed roadway, or wide enough so that the largest construction vehicle will fit in the entrance with room to spare; whichever is greater. If a large amount of traffic is expected at the entrance, then the stabilized construction entrance should be wide enough to fit two vehicles across with room to spare.

d) A geotextile filter fabric shall be placed between the stone fill and the earth surface below the pad to reduce the migration of soil particles from the underlying soil into the stone and vice versa. The filter fabric should be Amoco woven polypropylene 1198 or equivalent.

e) Washing: If the site conditions are such that the majority of mud is not removed from the vehicle tires by the gravel pad, then the tires should be washed before the vehicle enters the street. The wash area should be a level area with 3-inch washed stone minimum, or a commercial rack.

f) Water employed in the washing process shall be directed to a sediment trap or approved sediment-trapping device prior to discharge to a temporary sedimentation basin along side the site entrance drives. Sediment should be prevented from entering any watercourses.

Construction Entrance Inspection/Maintenance *

a) The entrance should be maintained in a condition that will prevent tracking or flowing of sediment onto Water Street. This may require periodic topdressing with additional stone.

b) The construction entrance and sediment disposal area shall be inspected weekly and after heavy rains or heavy use.

c) Mud and sediment tracked or washed onto public road shall be immediately removed by sweeping.

d) Once mud and soil particles clog the voids in the gravel and the effectiveness of the gravel pad is no longer satisfactory, the pad must be topdressed with new stone. Replacement of the entire pad may be necessary when the pad becomes completely clogged.

e) If washing facilities are used, the sediment traps should be cleaned out as often as necessary to assure that adequate trapping efficiency and storage volume is available.

f) The pad shall be reshaped as needed for drainage and runoff control.

g) Broken road pavement on Water Street shall be repaired immediately.

h) All temporary erosion and sediment control measures shall be removed within 30 days after final site stabilization is achieved or after the temporary practices are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal shall be permanently stabilized.

3) **Inlet Protection** – Inlet Protection will be utilized around the catch basin grates. The inlet protection will allow the storm drain inlets to be used before final stabilization. This structural practice will allow early use of the drainage system if the detention basin is already stabilized. Siltsack or equivalent will be utilized for the inlet protection. Siltsack is manufactured by ACF Environmental. The telephone number is 1-800-437-6746. Regular flow siltsack will be utilized, and if it does not allow enough storm water flow, hi-flow siltsack will be utilized.

Silt Sack (or equivalent) Inlet Protection Inspection/Maintenance Requirements *

a) All trapping devices and the structures they protect should be inspected after every rainstorm and repairs made as necessary.

b) Sediment should be removed from the trapping devices after the sediment has reached a maximum depth of one-half the depth of the trap.

c) Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. Sediment removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

d) The silt sack must be replaced if it is ripped or torn in any way.

e) Temporary traps should be removed and the area repaired as soon as the contributing drainage area to the inlet has been completely stabilized.

**Stabilization Practices:**

Stabilization measures shall be implemented as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased, with the following exceptions.

- Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

- The contractor shall provide erosion control measures around all soil stockpiles.

1) **Temporary Seeding** – Temporary seeding will allow a short-term vegetative cover on disturbed site areas that may be in danger of erosion. Temporary seeding will be done at stock piles and disturbed portions of the site where construction activity will temporarily cease for at least 21 days. The temporary seedings will stabilize cleared and unvegetated areas that will not be brought into final grade for several weeks or months.

Temporary Seeding Planting Procedures *

a) Planting should preferably be done between April 1st and June 30th, and September 1st through September 31st. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1st and March 31st, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

b) Before seeding, install structural practice controls. Utilize Amoco supergro or equivalent.

c) The seedbed should be firm with a fairly fine surface. Perform all cultural operations across or at right angles to the slope. A minimum of 2 to 4-inches of tilled topsoil is required. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content.

d) Apply uniformly 2 tons of ground limestone per acre (100 lbs. Per 1,000 sq.ft.) or according to soil test. Apply uniformly 10-10-10 analysis fertilizer at the rate of 400 lbs. per acre (14 lbs. per 1,000 sq.ft.) or as indicated by soil test. Forty percent of the nitrogen should be in organic form. Work in lime and fertilizer to a depth of 4-inches using any suitable equipment.

e) Select the appropriate seed species for temporary cover from the following table.

| Species | Seeding Rate (lbs/1,000 sq.ft.) | Seeding Rate (lbs/acre) | Recommended Seeding Dates | Seed Cover required |
|---|---|---|---|---|
| Annual Ryegrass | 1 | 40 | April 1st to June 1st<br>August 15th to Sept. 15th | ¼ inch |
| Foxtail Millet | 0.7 | 30 | May 1st to June 30th | ½ to ¾ inch |
| Oats | 2 | 80 | April 1st to July 1st<br>August 15th to Sept. 15th | 1 to 1-½ inch |
| Winter Rye | 3 | 120 | August 15th to Oct. 15th | 1 to 1-½ inch |

Apply the seed uniformly by hydroseeding, broadcasting, or by hand.

f) Use an effective mulch, such as clean grain straw; tacked and/or tied with netting to protect seedbed and encourage plant growth.

Temporary Seeding Inspection/Maintenance *

a) Inspect within 6 weeks of planting to see if stands are adequate. Check for damage within 24 hours of the end to a heavy rainfall, defined as a 2-year storm event (i.e., 3.2 inches of rainfall within a twenty-four hour period). Stands should

be uniform and dense. Fertilize, reseed, and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

b) Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather. Water application rates should be controlled to prevent runoff.

2) **Geotextiles** - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

| Practice | Manufacturer | Product | Remarks |
|---|---|---|---|
| Sediment Fence | Amoco | Woven polypropylene 1198 or equivalent | 0.425 mm opening |
| Construction Entrance | Amoco | Woven polypropylene 2002 or equivalent | 0.300 mm opening |
| Outlet Protection | Amoco | Nonwoven polypropylene 4551 or equivalent | 0.150 mm opening |

Amoco may be reached at (800) 445-7732

Geotextile Installation

a) Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Geotextile Inspection/Maintenance *

a) In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.

3) **Mulching and Netting** – Mulching will provide immediate protection to exposed soils during the period of short construction delays, or over winter months through the application of plant residues, or other suitable materials, to exposed soil areas. In areas, which have been seeded either for temporary or permanent cover, mulching should immediately follow seeding. On steep slopes, mulch must be supplemented with netting. The preferred mulching material is straw.

Mulch Maintenance *

a) Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting.

b) Grass mulches that blow or wash away should be repaired promptly.

c) If plastic netting is used to anchor mulch, care should be taken during initial mowing's to keep the mower height high. Otherwise, the netting can wrap up on the mower blade shafts. After a period of time, the netting degrades and becomes less of a problem.

d) Continue inspections until vegetation is well established.

4) **Land Grading** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

Land Grading Design/Installation Requirements

a) Areas to be graded should be cleared and grubbed of all timber, logs, brush, rubbish, and vegetated matter that will interfere with the grading operation. All brush, tree limbs, tree trunk and stump disposal shall take place off site and within 30 days of cutting. All disposal shall be in accordance with federal, state and local regulations. Any temporary stockpiling of brush, tree limbs, tree trunks or stumps shall be surrounded with an erosion control barrier. Topsoil should be stripped and stockpiled for use on critical disturbed areas for establishment of vegetation. Cut slopes to be topsoiled should be thoroughly scarified to a minimum depth of 3-inches prior to placement of topsoil.

b) Fill materials should be generally free of brush, rubbish, rocks, and stumps. Frozen materials or soft and easily compressible materials should not be used in fills intended to support buildings, parking lots, roads, conduits, or other structures.

c) Earth fill intended to support structural measures should be compacted to a minimum of 90 percent of Standard Proctor Test density with proper moisture control, or as otherwise specified by the engineer responsible for the design. Compaction of other fills should be to the density required to control sloughing, erosion or excessive moisture content. Maximum thickness of fill layers prior to compaction should not exceed 9 inches.

d) The uppermost one foot of fill slopes should be compacted to at least 85 percent of the maximum unit weight (based on the modified AASHTO compaction test). This is usually accomplished by running heavy equipment over the fill.

e) Fill should consist of material from borrow areas and excess cut will be stockpiled in areas shown on the Site Plans. All disturbed areas should be free draining, left with a neat and finished appearance, and should be protected from erosion.

Land Grading Stabilization Inspection/Maintenance *

a) All slopes should be checked periodically to see that vegetation is in good condition. Any rills or damage from erosion and animal burrowing should be repaired immediately to avoid further damage.

b) If seeps develop on the slopes, the area should be evaluated to determine if the seep will cause an unstable condition. Subsurface drains or a gravel mulch may be required to solve seep problems. However, no seeps are anticipated.

c) Areas requiring revegetation should be repaired immediately. Slopes should be limed and fertilized as necessary to keep vegetation healthy. Control undesirable vegetation such as weeds and woody growth to avoid bank stability problems in the future.

5) **Topsoiling *** – Topsoiling will help establish vegetation on all disturbed areas throughout the site during the seeding process. The soil texture of the topsoil to be used will be a sandy loam to a silt loam texture with 15% to 20% organic content.

Topsoiling Placement

a) Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed seeding.

b) Do not place topsoil on slopes steeper than 2.5:1, as it will tend to erode.

c) If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method is to actually work the topsoil into the layer below for a depth of at least 6 inches.

6) **Permanent Seeding** – Permanent Seeding should be done immediately after the final design grades are achieved. Native species of plants should be used to establish perennial vegetative cover on disturbed areas. The revegetation should be done early enough in the fall so that a good cover is established before cold weather comes and growth stops until the spring. A good cover is defined as vegetation covering 75 percent or more of the ground surface.

Permanent Seeding Seedbed Preparation

a) In infertile or coarse-textured subsoil, it is best to stockpile topsoil and respread it over the finished slope at a minimum 2 to 6-inch depth and roll it to provide a
b) firm seedbed. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.

c) Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.

d) Areas not to receive topsoil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above.

Permanent Seeding Grass Selection/Application

a) Select an appropriate cool or warm season grass based on site conditions and seeding date. Apply the seed uniformly by hydroseeding, broadcasting, or by hand. Uniform seed distribution is essential. On steep slopes, hydroseeding may be the most effective seeding method. Surface roughening is particularly important when preparing slopes for hydroseeding.

b) Lime and fertilize. Organic fertilizer shall be utilized in areas within the 100 foot buffer zone to a wetland resource area.

c) Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas. Amoco supergro or equivalent should be utilized.

Permanent Seeding Inspection/Maintenance *

a) Frequently inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

b) If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

c) If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

d) Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

**Dust Control *:**

Dust control will be utilized throughout the entire construction process of the site. For example, keeping disturbed surfaces moist during windy periods will be an effective control measure, especially for construction haul roads. The use of dust control will prevent the movement of soil to offsite areas. However, care must be taken to not create runoff from excessive use of water to control dust. The following are methods of Dust Control that may be used on-site:

- Vegetative Cover – The most practical method for disturbed areas not subject to traffic.
- Calcium Chloride – Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage.
- Sprinkling – The site may be sprinkled until the surface is wet. Sprinkling will be effective for dust control on haul roads and other traffic routes.
- Stone – Stone will be used to stabilize construction roads; will also be effective for dust control.

**Non-Stormwater Discharges:**

During construction activities at the site, some water from the site will be suitable for discharge to the detention areas and/or temporary sediment basin areas. Non-stormwater discharges will be directed to recharge groundwater and to replenish wetland resource areas.

The construction de-watering and all non-stormwater discharges will be directed into a sediment dirt bag (or equivalent inlet protection) or a sediment basin. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges.

**Soil Stockpiling *:**

Topsoil and subsoil from the driveway and parking area grading will be stockpiled in locations shown on the plans.

Stockpile Material Construction Procedure

1) Topsoil and subsoil that are stripped will be stockpiled for later distribution on disturbed areas.

2) The stockpiles will be located as shown on the plans. These locations will allow them to not interfere with work on the site.

3) Seed the stockpiles with a temporary erosion control mix if the stockpile is to remain undisturbed for more than 30 days. The stockpiles must be stable and the side slopes should not exceed 2:1.

4) Sediment silt sock or hay bale barrier erosion control measure should be placed surrounding each stockpile.

5) As needed, the stockpiled topsoil and subsoil are redistributed throughout the site.

**Pollution Prevention:**

**Fueling and Maintenance of Equipment or Vehicles**

**Refueling/maintenance Rules** – The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. This document shall include language that shall permit the maintenance of vehicles only in designated locations on the job site. In the event of mechanical failure of a vehicle, the vehicle shall be moved to the designated maintenance area on the site to perform maintenance. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. Refueling for vehicles or equipment shall occur either within the designated washout area or shall utilize temporary drip protection measures at the location of fueling. The site supervisor or their representative shall be present at the time of any fueling procedure. The site supervisor shall have a fuel spill plan and measures on site to initiate containment and clean-up in the event a fuel spill occurs.

1. Fueling operations shall take place in designated area(s) as shown on site maps. Provide temporary drip protection during fueling operations which take place outside of designated area(s). Materials necessary to address a spill shall be made readily available in a location known to the site supervisor or his/her designee.
2. Fueling operation procedures shall be in effect throughout the project duration.

Maintenance Requirements

1. All emergency response equipment listed in the Emergency Response Equipment Inventory shall be made readily available and kept in a designated

location known to the site supervisor or his/her designee. All such materials shall be replenished as necessary to the listed amounts.

## Washing of Equipment and Vehicles

**Vehicle Washing Rules** - The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall include language that shall not permit vehicle washing on the job site. Concrete trucks shall be exempt from this rule. Concrete truck cleaning shall be confined within the work area and conducted in a manner to prevent water drainage beyond the specified area of work.
Concrete truck washout shall be conducted in designated areas and shall not be discharged in areas which would allow wash water to leave the site or enter protected areas.

Maintenance Requirements

1. The site supervisor shall maintain a log of individuals receiving these instructions.

## Storage, Handling, and Disposal of Construction Products, Materials, and Wastes

**Building Products -** Building products are not anticipated during this phase of construction.

## Pesticides, Herbicides, Insecticides, Fertilizers, and Landscape Materials

The use of pesticides and herbicides is not currently anticipated for this site. Fertilizers and landscape materials will be used to stabilize slopes and other disturbed areas.

1. Store all fertilizers and landscape materials in designated locations. Store all weather sensitive materials in closed containers in accordance with manufacturer's recommendations.

Maintenance Requirements

1. The site supervisor shall regularly inspect the designated storage areas as well as any portions of the site under construction to ensure that all materials are properly stored. The site supervisor shall immediately address any issues and instruct personnel to secure and properly store all materials.

## Diesel Fuel, Oil, Hydraulic Fluids, Other Petroleum Products, and Other Chemicals

Refueling and maintenance for vehicles or equipment shall occur either within the designated washout area or shall utilize temporary drip protection measures at the location of fueling. The site supervisor or their representative shall be present at the time of any fueling procedure. The site supervisor shall have a fuel spill plan and measures on site to initiate containment and clean-up in the event a fuel spill occurs.

Refueling and maintenance of equipment shall take place in designated areas whenever possible. Refueling or maintenance of equipment in locations other than those designated for such activity shall be performed under the supervision of the site supervisor or his/her designee and shall employ drip pans or other suitable means of preventing fuel, hydraulic fluid, etc. from spilling or being otherwise carried offsite or into protected areas.

Maintenance Requirements

1. All emergency response equipment listed in the Emergency Response Equipment Inventory shall be made readily available and kept in a designated location known to the site supervisor or his/her designee. All such materials shall be replenished as necessary to the listed amounts.

**Hazardous or Toxic Waste**

(Note: Examples include paints, solvents, petroleum-based products, wood preservatives, additives, curing compounds, acids.)

Hazardous or toxic waste associated with paints, solvents, petroleum-based products, wood preservatives, additives, curing compounds, acids shall be collected in approved containers and disposed of in accordance with municipal, state and federal regulations.

Hazardous or toxic waste shall be collected in approved containers and disposed of in accordance with municipal, state and federal regulations. Hazardous and toxic waste shall not be disposed of in solid waste containers intended for non-hazardous construction debris.

Maintenance Requirements

1. The site supervisor shall regularly inspect all portions of the project under construction and ensure that all hazardous or toxic materials are disposed of in accordance with the practices detailed above and shall immediately correct any improper disposal practices.

**Construction and Domestic Waste**

(Note: Examples include packaging materials, scrap construction materials, masonry products, timber, pipe and electrical cuttings, plastics, styrofoam, concrete, and other trash or building materials.)

Construction and domestic waste shall be disposed of in a trash receptacle (dumpster) which shall be removed and disposed of at an approved land fill.

Recyclable waste material shall be stored in an appropriate container or in a designated location on site until it can be removed.

1. Trash receptacles (dumpsters) and recyclable waste material containers shall be located as needed throughout the site.

Maintenance Requirements

1. The site supervisor shall inspect all trash receptacles and containers to confirm that construction and domestic waste is properly contained, and shall also ascertain that waste is being picked up in a timely manner to ensure that no receptacles are overflowing. Pick-up schedules shall be modified or the number of receptacles shall be increased as needed.

**Sanitary Waste**

During the construction process, portable toilets will be provided in an appropriate location during the construction process.

Maintenance Requirements

1. The site supervisor shall execute a contract with a vendor to supply and maintain portable toilets throughout the site for the project duration. The site supervisor shall determine if a sufficient number of toilets are present to meet staffing levels and shall ensure that the toilets are regularly and properly maintained.

**Washing of Applicators and Containers used for Paint, Concrete or Other Materials**

Concrete washout shall be restricted to designated areas. Paints, form release oils, curing compounds, etc. shall be recycled and/or disposed of utilizing appropriate containers in accordance with manufacturer's recommendations and EPA guidelines.

1. Install straw bale and plastic liner washout pit at the designated location on site. Concrete trucks shall wash out only at washout pit or other similar acceptable facility such as a portable roll-off washout pit.
2. Provide suitable containers for recycling or disposal for cleanup of paints, form release oils, curing compounds, etc.

Maintenance Requirements

1. The site supervisor shall inspect concrete washout pits (or other acceptable facility) to ensure that they are properly maintained. If necessary, wash water in a concrete washout pit shall be vacuumed off and the hardened concrete broken up and recycled. Wash water and broken up concrete shall be properly disposed of at a suitable facility. If necessary the wash out pit shall be repaired and relined with plastic prior to continued use.
2. Containers for waste paint, form release oil, curing compounds, etc. shall be sealed and removed from the site and properly disposed of at a suitable facility. Empty containers shall replace those being removed for disposal.

**Fertilizers**

Fertilizers shall be used only as necessary to establish vegetative stabilized slopes and disturbed areas. Apply at recommended rates. Use only slow release fertilizers to minimize discharge of nitrogen or phosphorous.

1. Store all fertilizers in designated locations. Store all weather sensitive materials in closed containers in accordance with manufacturer's recommendations.
2. To prevent accidental release of fertilizers, the site supervisor shall attempt to coordinate delivery of fertilizers to coincide with application and reduce the need to warehouse large quantities on-site.

Maintenance Requirements

1. Site supervisor shall make regular inspections to ensure that fertilizer is being applied at proper rates and that all perimeter controls are in place and properly maintained to control runoff which may contain fertilizer. Stored fertilizer shall be properly covered or enclosed in a designated location to prevent introduction into stormwater runoff.

**Spill Prevention and Response**

The site supervisor or their representative shall be present on the job site at all times during the course of work and shall be present during the delivery, removal of any liquid/chemical materials to or from the job site. They will also be present during any refueling practices. All subcontractors will be notified of their responsibilities in writing. In the event a spill occurs, the site supervisor shall be notified immediately.
The site supervisor shall have in place a spill prevention plan and resources to contain and clean up any potential spills in a timely manner. Refer to the following Spill Containment & Management Plan, including Spill Report, Emergency Response Equipment Inventory, and Emergency Notification and phone numbers.

**Inspection/Maintenance:**

Operator personnel must inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of ½-inch or greater. The applicant shall be responsible to secure the services of a licensed engineer or similar professional (inspector) on an on-going basis throughout all phases of the project. Refer to the Inspection/Maintenance Requirements presented earlier in the "Structural and Stabilization Practices." The inspector should review the erosion and sediment controls with respect to the following:

- Whether or not the measure was installed/performed correctly.
- Whether or not there has been damage to the measure since it was installed or performed.
- What should be done to correct any problems with the measure.

The inspector should complete the Stormwater Management Construction Phase BMP Inspection Schedule and Evaluation Checklist, as attached, for documenting the findings and should request the required maintenance or repair for the pollution prevention measures when the inspector finds that it is necessary for the measure to be effective. The inspector should notify the appropriate person to make the changes and submit copies of the form to the Pembroke Conservation Commission upon request.

It is essential that the inspector document the inspection of the pollution prevention measures. These records will be used to request maintenance and repair and to prove that the inspection and maintenance were performed. The forms list each of the measures to be inspected on the site, the inspector's name, the date of the inspection, the condition of the measure/area inspected, maintenance or repair performed and any changes which should be made to the Pollution Prevention & Erosion and Sedimentation Control Plan to control or eliminate unforeseen pollution of storm water.

**Project Location: River Marsh Village 0 Water Street, Pembroke, MA** **Date:**

**Stormwater Management – Construction Phase**
**Best Management Practices – Inspection Schedule and Evaluation Checklist**

## Construction Practices

| Best Management Practice | Inspection Frequency | Date Inspected | Inspector | Minimum Maintenance and Key Items to Check | Cleaning/Repair Needed: (List Items) | Date of Cleaning/ Repair | Performed by |
|---|---|---|---|---|---|---|---|
| Siltsock Erosion Control Barrier | After heavy rainfall events (minimum weekly) | | | 1. Sediment level<br>2. Material tears or repairs | ☐yes ☐no | | |
| Stabilized Construction Entrance | After heavy rainfall events (minimum weekly) | | | 1. Sediment build-up or clogging | ☐yes ☐no | | |
| Inlet Protection | After heavy rainfall events (minimum weekly) | | | 1. Sediment level<br>2. Sack tears or damage | ☐yes ☐no | | |
| Temporary Seeding | After heavy rainfall events (minimum weekly) | | | | ☐yes ☐no | | |
| Geotextiles | After heavy rainfall events (minimum weekly) | | | | ☐yes ☐no | | |
| Mulching & Netting | After heavy rainfall events (minimum weekly) | | | | ☐yes ☐no | | |
| Land Grading | After heavy rainfall events (minimum weekly) | | | | ☐yes ☐no | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Topsoiling | After heavy rainfall events (minimum weekly) | | | | ☐**yes** ☐**no** | | |
| Permanent Seeding | After heavy rainfall events (minimum weekly) | | | | ☐**yes** ☐**no** | | |
| Dust Control | After heavy rainfall events (minimum weekly) | | | | ☐**yes** ☐**no** | | |

**(1) Refer to the Massachusetts Stormwater Handbook issued January 2, 2008.**

**Notes (Include deviations from : Site Plan Approval or Order of Conditions, Construction Sequence and Approved Plan):**

**Stormwater Control Manager** _____

# Spill Containment and Management Plan

**Initial Notification**

In the event of a spill, the facility manager will be notified immediately.

Facility Managers (name) _____

_____

Facility Manager (phone) _____

**Assessment - Initial Containment**

The supervisor will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. The supervisor will first contact the Fire Department and then notify the Police Department, Department of Public Works, Board of Health and Conservation Commission. The fire department is ultimately responsible for matters of public health and safety and should be notified immediately.

| Contact: | Phone Number: |
|---|---|
| Fire Department: | 911 |
| Police Department: | 911 |
| Department of Public Works: | (781) 293 5620 |
| Board of Health Phone: | (781) 293 2718 |
| Conservation Commission Phone: | (781) 293 4674 |

**Further Notification**

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the facility office and readily accessible to all employees.

**HAZARDOUS WASTE / OIL SPILL REPORT**

Date____/_____/_____ Time_____ AM / PM

Exact location (Transformer #)_____

Type of equipment_____Make_____Size_____

S / N_____Weather Conditions_____

On or near water ☐ Yes If yes, name of body of water_____
☐ No

Type of chemical / oil spilled_____

Amount of chemical / oil spilled_____

Cause of spill_____

_____

_____

Measures taken to contain or clean up spill_____

_____

_____

Amount of chemical / oil recovered_____Method_____

Material collected as a result of clean up

_____drums containing_____

_____drums containing_____

_____drums containing_____

Location and method of debris disposal_____

_____

Name and address of any person, firm, or corporation suffering damages_____

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring____

_____

Spill reported to General Office by_____Time_____AM / PM

Spill reported to DEP / National Response Center by_____

DEP Date____/_____/_____ Time_____ AM / PM Inspector_____

NRC Date____/_____/_____ Time_____ AM / PM Inspector_____

Additional comments_____

_____

_____

**EMERGENCY RESPONSE EQUIPMENT**
**INVENTORY**

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

| | | |
|---|---|---|
| -- | SORBENT PADS | 1 BALE |
| -- | SAND BAGS (empty) | 5 |
| -- | SPEEDI-DRI ABSORBENT | 1 – 40LB BAGS |
| -- | SQUARE END SHOVELS | 1 |
| -- | PRY BAR | 1 |

**EMERGENCY NOTIFICATION PHONE NUMBERS**

1. FACILITY MANAGER
   NAME: _____ BEEPER: _____
   PHONE: _____ CELL PHONE: _____

   ALTERNATE:
   NAME: _____ BEEPER: N/A _____
   PHONE: _____ CEL PHONE: _____

2. FIRE DEPARTMENT
   EMERGENCY: 911
   BUSINESS: (781) 293 2300

   POLICE DEPARTMENT
   EMERGENCY: 911
   BUSINESS: (781) 293 6363

   DEPARTMENT OF PUBLIC WORKS
   BUSINESS: (781) 293 5620

3. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
   EMERGENCY: (617) 556-1133
   SOUTHEAST REGION - LAKEVILLE OFFICE: (508) 946-2700

4. NATIONAL RESPONSE CENTER
   PHONE: (800) 424-8802

   ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY
   EMERGENCY: (617) 223-7265
   BUSINESS: (617) 860-4300

5. DEPARTMENT OF PUBLIC WORKS
   CONTACT: Director of Public Works, Eugene Fulmine, Jr.
   PHONE: (781) 293 5620

   CONSERVATION COMMISSION
   CONTACT: Conservation Agent, Robert Clarke
   PHONE: (781) 293 4674

   BOARD OF HEALTH
   CONTACT: Health Agent, Lisa Cullity
   PHONE: (781) 293 2718

# POST-DEVELOPMENT BEST MANAGEMENT PRACTICE
# OPERATION AND MAINTENANCE PLAN & LONG-TERM POLLUTION PREVENTION PLAN

**for**

## River Marsh Village

**In**

**Pembroke, Massachusetts**
**(Assessor's Map E-17, Lot 0 & E-17A, Lot 274)**

**Submitted to:**

## TOWN OF PEMBROKE

**Prepared for:**

## River Marsh, LLC
**239R Washington Street**
**Norwell, Massachusetts 02061**

**Prepared by:**

MCKENZIE ENGINEERING GROUP

**Professional Civil Engineering • Project Management • Land Planning**
**150 Longwater Drive, Suite 101, Norwell, Massachusetts 02061**
**Tel.: (781) 792-3900 Facsimile: (781) 792-0333**
**www.mckeng.com**

**April 5, 2021**

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**Post-Development Best Management Practice**
**Operation and Maintenance Plan &**
**Long-Term Pollution Prevention Plan**

## Post-Development Best Management Practices (BMPs) Operation and Maintenance Plan

Responsible Party/Property Owner/Developer contact information:
Property Owner:

River March, LLC
293R Washington Street
Norwell, MA 02061

Developer Contact Information:

River Marsh, LLC
293R Washington Street
Norwell, MA 02061

Town of Pembroke Contact Information:

Pembroke Department of Public Works
Eugene Fulmine, Jr., Director
100 Center Street
Pembroke, MA 02359
Phone: 781-293-5620
Fax: 781-293-2964

Pembroke Conservation Commission
Robert Clarke, Agent
100 Center Street
Pembroke, MA 02359
Phone: 781-293-4674

Pembroke Building Department
George Verry, Inspector of Buildings & Zoning Officer
100 Center Street
Pembroke, MA 02359
Phone: 781-293-3864
Fax: 781-293-9250

## Long-Term Operations and Maintenance General Conditions

1. The property owner shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's as illustrated on the design plans and detailed in the following long-term operations and maintenance plan.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Operations and Maintenance Plan.
3. The owner shall:

a. Maintain an Operation and Maintenance Log (see Attachment A) for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);

b. Make the log available to the Pembroke Department of Public Works and Planning Board upon request;

c. Allow members and agents of the Pembroke Department of Public Works to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.

4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule should be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule should be determined based on the level of service for this site.

**Best Management Practices Operations and Maintenance**

***1.*** **Paved Areas** –Sweepers shall sweep paved areas periodically during dry weather to remove excess sediments and to reduce the amount of sediments that the drainage system shall have to remove from the runoff. The sweeping shall be conducted primarily between March 15th and November 15th. Special attention should be made to sweeping paved surfaces in March and April before spring rains wash residual sand into the drainage system.

The frequency of sweeping shall average:

- Monthly if by a high-efficiency vacuum sweeper
- Bi-weekly if by a regenerative air sweeper
- Weekly if by a mechanical sweeper

Salt used for de-icing on the parking lot during winter months shall be limited as much as possible as this will reduce the need for removal and treatment. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

Cost: The property owner should consult local sweeping contractors for detailed cost estimates.

***2.*** **Catch Basins -** Catch basin grates shall be checked quarterly and following heavy rainfalls to verify that the inlet openings are not clogged by debris. Debris shall be removed from the grates and disposed of properly. Deep sump catch basins shall be inspected and cleaned bi-annually of all accumulated sediments. Catch basins with hoods shall be inspected annually to check oil build-up and outlet obstructions. Material shall be removed from catch basins and disposed of in accordance with all applicable regulations.

Cost: Estimated $50 - $100 per cleaning as needed. The property owner should consult local vacuum cleaning contractors for detailed cost estimates.

3. **Sediment Forebay Areas –** The sediment forebay areas shall be checked for sediment and debris accumulation on a monthly basis and cleaned quarterly. Additional inspections should be scheduled during the first few months to make sure that the vegetation becomes adequately established. Trash, leaves, branches, etc. shall be removed from facility. Silt, sand and sediment, if significant accumulation occurs, shall be removed by hand annually. Material removed from the areas shall be disposed of in accordance with all applicable local, state, and federal regulations. Where applicable by design, mow grassed areas 2 to 12 times per year as necessary. Any slope erosion within the facilities shall be stabilized and repaired as soon as practical.

   Do not store snow in the sediment forebay areas. Care must be taken during plowing operations to prevent snow from being plowed into the sediment forebay area.

   Cost*:* Estimated $100 - $200 per cleaning as needed. The Owner should consult local landscape contractors for a detailed cost estimate.

4. **Infiltration Basin -** The infiltration basins, inlets and vehicular access shall be checked for debris accumulation on a quarterly basis. Additional inspections should be scheduled during the first few months to make sure that the vegetation becomes adequately established in the infiltration basin and that the facility is functioning as intended. Trash, leaves, branches, etc. shall be removed from facility. Silt, sand and sediment, if significant accumulation occurs, shall be removed by rubber-tired excavator annually. Material removed from the basin shall be disposed of in accordance with all applicable local, state, and federal regulations. The infiltration basins and vehicular access shall be kept free of woody vegetation by mowing at least twice per year. Reseeding, weed control, and invasive species removal may need to be performed periodically to maintain healthy vegetation and maintain the pollutant removal efficiency of the facilities. In the case that water remains in the infiltration facilities for greater than three (3) days after a storm event, an inspection is warranted and necessary maintenance or repairs to the outlet control structure or bottom of the basin may be necessary. Any slope erosion within the facility shall be stabilized and repaired as soon as practical.

   *Cost:* $500-$1000 per cleaning if excavator is necessary to remove sediment. The Owner should consult local landscape contractors for a detailed cost estimate.

5. **Pesticides, Herbicides, and Fertilizers -** Pesticides and herbicides shall be used sparingly. Fertilizers should be restricted to the use of organic fertilizers only.

   All structural BMP's as identified on the site plans will be owned and maintained by the homeowner's association of the development and shall run with the title of the property.

   Cost: Included in the routine landscaping maintenance schedule. The Owner should consult local landscaping contractors for details.

6. **Snow Removal -** Snow accumulations removed from driveway and parking areas should be placed in upland areas only, where sand and other debris will remain after snowmelt for later removal. Excess snow should be removed from the site and properly disposed of in an approved snow disposal facility. Care must be exercised not to deposit snow in the following areas: in the rain gardens, bioswales, and where sand and debris can get into the watercourse.

   Cost: The owner should consult local snow removal contractors for a detailed cost estimate.

**Maintenance Responsibilities**

All post construction maintenance activities should be documented and kept on file and made available to the Pembroke DPW, in addition to the Planning Board upon request.
To develop and implement an operation and maintenance program with the goal of preventing or reducing pollutant runoff by keeping potential pollutants from coming into contact with stormwater or being transported off site without treatment, the following efforts will be made:

- Property Management awareness and training on how to incorporate pollution prevention techniques into maintenance operations.
- Follow appropriate best management practices (BMPs) by proper maintenance and inspection procedures.

**Long-Term Pollution Prevention Plan**
**Good Housekeeping:**

**Storage and Disposal of Waste and Toxics:**

Failure to properly store hazardous materials dramatically increases the probability that they will end up in local waterways. Practices such as covering hazardous materials or even storing them properly, can have dramatic impacts.

The exterior storage of hazardous materials on site shall be prohibited.

The following is a list of management considerations for hazardous materials as outlined by the EPA:

- Ensuring sufficient aisle space to provide access for inspections and to improve the ease of material transport;
- Storing materials well away from high-traffic areas to reduce the likelihood of accidents that might cause spills or damage to drums, bags, or containers.
- Stacking containers in accordance with the manufacturers' directions to avoid damaging the container or the product itself;
- Storing containers on pallets or equivalent structures. This facilitates inspection for leaks and prevents the containers from coming into contact with wet floors, which can cause corrosion. This consideration also reduces the incidence of damage by pests.

**Landscape Maintenance:**

Using proper landscaping techniques can effectively increase the value of a property while benefiting the environment. These practices can benefit the environment by reducing water use; decreasing energy use (because less water pumping and treatment is required); minimizing runoff of storm and irrigation water that transports soils, fertilizers, and pesticides; and creating additional habitat for plants and wildlife. The following lawn and landscaping management practices will be encouraged:

- Mow lawn areas at the highest recommended height.
- Minimize lawn size and maintain existing native vegetation.
- Abide by water restrictions and other conservation measures implemented by the Town of Pembroke.
- Water only when necessary.
- Use automatic irrigation systems to reduce water use.

**Integrated Pest Management (IPM):**

This management measure seeks to limit the adverse impacts of insecticides and herbicides by providing information on alternative pest control techniques other than chemicals or explaining how to determine the correct dosages needed to manage pests.

The presence of pesticides in stormwater runoff has a direct impact on the health of aquatic organisms and can present a threat to humans through contamination of drinking water supplies. The pesticides of greatest concern are insecticides, such as diazinon and chloropyrifos, which even at very low levels can be harmful to aquatic life.

The following IPM practices will be encouraged:

- Pesticides and herbicides shall be used sparingly. Fertilizers should be restricted to the use of organic fertilizers only.
- Lawn care and landscaping management programs including appropriate pesticide use management as part of program.

**Illicit Discharges:**

Illicit discharges are non-stormwater discharges to the storm drain system which typically contain bacteria and other pollutants. All illicit discharges are prohibited. Any illicit discharges should be reported to MassDOT and/or the DPW as applicable to be addressed in accordance with their respective policies.

The following is a list of EPA allowed non-stormwater discharges. If the non-stormwater discharge is not listed, it is prohibited.

1. Water line flushing,
2. Landscape irrigation,
3. Diverted stream flows,
4. Rising ground waters,
5. Uncontaminated ground water infiltration (as defined at 40 CFR 35.2005(20)),
6. Uncontaminated pumped ground water,
7. Discharge from potable water sources,
8. Foundation drains,
9. Air conditioning condensation,
10. Irrigation water, springs,
11. Water from crawl space pumps,
12. Footing drains,
13. Lawn watering,
14. Flows from riparian habitats and wetlands,
15. Street wash water,
16. Discharges or flows from fire fighting activities occur during emergency conditions.

# Spill Containment and Management Plan

**Initial Notification**

In the event of a spill, the facility manager will be notified immediately.

Facility Managers (name) _____

_____

Facility Manager (phone) _____

**Assessment - Initial Containment**

The supervisor will assess the incident and initiate containment control measures with the appropriate spill containment equipment included in the spill kit kept on-site. The supervisor will first contact the Fire Department and then notify the Police Department, Department of Public Works, Board of Health and Conservation Commission. The fire department is ultimately responsible for matters of public health and safety and should be notified immediately.

| Contact: | Phone Number: |
|---|---|
| Fire Department: | 911 |
| Police Department: | 911 |
| Department of Public Works: | (781) 293 5620 |
| Board of Health Phone: | (781) 293 2718 |
| Conservation Commission Phone: | (781) 293 4674 |

**Further Notification**

Based on the assessment from the Fire Chief, additional notification to a cleanup contractor may be made. The Massachusetts Department of Environmental Protection (DEP) and the EPA may be notified depending upon the nature and severity of the spill. The Fire Chief will be responsible for determining the level of cleanup and notification required. The attached list of emergency phone numbers shall be posted in the facility office and readily accessible to all employees.

**HAZARDOUS WASTE / OIL SPILL REPORT**

Date____/_____/_____ Time_____ AM / PM

Exact location (Transformer #)_____

Type of equipment_____Make_____Size_____

S / N_____Weather Conditions_____

On or near water ☐ Yes If yes, name of body of water_____
☐ No

Type of chemical / oil spilled_____

Amount of chemical / oil spilled_____

Cause of spill_____

_____

_____

Measures taken to contain or clean up spill_____

_____

_____

Amount of chemical / oil recovered_____Method_____

Material collected as a result of clean up

_____drums containing_____

_____drums containing_____

_____drums containing_____

Location and method of debris disposal_____

_____

Name and address of any person, firm, or corporation suffering damages_____

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring____

_____

Spill reported to General Office by_____Time_____AM / PM

Spill reported to DEP / National Response Center by_____

DEP Date____/_____/_____ Time_____ AM / PM Inspector_____

NRC Date____/_____/_____ Time_____ AM / PM Inspector_____

Additional comments_____

_____

_____

**EMERGENCY RESPONSE EQUIPMENT**
**INVENTORY**

The following equipment and materials shall be maintained at all times and stored in a secure area for long-term emergency response need.

| | | |
|---|---|---|
| -- | SORBENT PADS | 1 BALE |
| -- | SAND BAGS (empty) | 5 |
| -- | SPEEDI-DRI ABSORBENT | 1 – 40LB BAGS |
| -- | SQUARE END SHOVELS | 1 |
| -- | PRY BAR | 1 |

**EMERGENCY NOTIFICATION PHONE NUMBERS**

1. FACILITY MANAGER
   NAME: _____ BEEPER: _____
   PHONE: _____ CELL PHONE: _____

   ALTERNATE:
   NAME: _____ BEEPER: N/A _____
   PHONE: _____ CEL PHONE: _____

2. FIRE DEPARTMENT
   EMERGENCY: 911
   BUSINESS: (781) 293 2300

   POLICE DEPARTMENT
   EMERGENCY: 911
   BUSINESS: (781) 293 6363

   DEPARTMENT OF PUBLIC WORKS
   BUSINESS: (781) 293 5620

3. MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION
   EMERGENCY: (617) 556-1133
   SOUTHEAST REGION - LAKEVILLE OFFICE: (508) 946-2700

4. NATIONAL RESPONSE CENTER
   PHONE: (800) 424-8802

   ALTERNATE: U.S. ENVIRONMENTAL PROTECTION AGENCY
   EMERGENCY: (617) 223-7265
   BUSINESS: (617) 860-4300

5. DEPARTMENT OF PUBLIC WORKS
   CONTACT: Director of Public Works, Eugene Fulmine, Jr.
   PHONE: (781) 293 5620

   CONSERVATION COMMISSION
   CONTACT: Conservation Agent, Robert Clarke
   PHONE: (781) 293 4674

   BOARD OF HEALTH
   CONTACT: Health Agent, Lisa Cullity
   PHONE: (781) 293 2718