

Arbella at Ashland

Off Memorial Drive (f/k/a MBTA Road)

Ashland, MA 01721

Issued for:

- Comprehensive Permit (40B)



Applicant/Owner:

UA Senior Manager, LLC
Rensselaer Technology Park
300 Jordan Road
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Prepared by:



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A&M PROJECT #2604-01
December 4, 2020 rev March 25, 2021

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TRAFFIC ENGINEER

Not Applicable

The information presented herein this report has been a collaborative effort from the various members/personnel of the Project Team.

RECORD OWNER

PARCEL ID 13-154-00-000 (0 Memorial Drive (aka MBTA Access Road))

Ashland RTD Apartments LLC
12 Standish Lane
Winchester, MA 01890

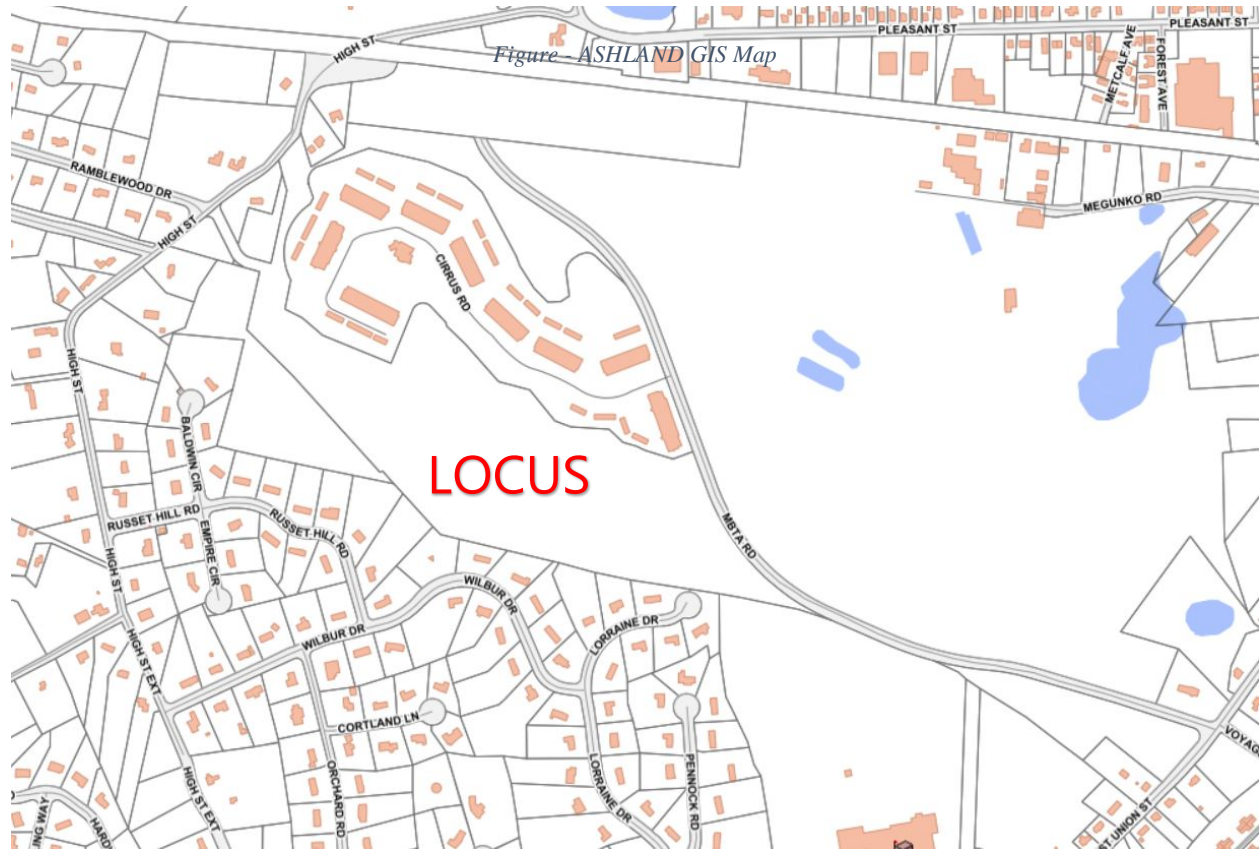


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1.0 – PROJECT SUMMARY

The applicant, UA Senior Manager, LLC, is submitting a comprehensive permit (40B) for a senior housing development located off Memorial Drive (f/k/a MBTA Access Road) in the Town of Ashland, Massachusetts consisting of a total of 180 units. The proposed project will include the construction of two (2) 4/5-story apartment style buildings, four (4) townhouse buildings with six (6) unit each, a clubhouse, four (4) detached parking garages, an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development.

The purpose of this project narrative and stormwater report is to provide a detailed review of the locus, potential project impacts and stormwater as it pertains to the existing conditions and proposed development. The report will show by means of narrative, calculations and exhibits that appropriate best management practices have been used to mitigate the impacts from the proposed development. The report will demonstrate that the proposed site development reduces the peak stormwater discharge rates and the overall site runoff volume during all storm events at the existing design points. Further, the report will show that the proposed stormwater management system complies with the ten stormwater standards as presented in the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Regulations and MA MS4 General Permit regulations.

2.0 – EXISTING CONDITIONS

2.1 – SITE LOCATION & DESCRIPTION

The Town of Ashland Assessor's office currently identifies the site on Map 13 as Lot 154 with a total area of approximately 38± acres with access off of Memorial Drive (f/k/a/ MBTA Access Road). The property is bounded by said roadway to the east, the Cirrus Apartments development to the north, and residential, single family properties to the south and High Street to the west. The property has a connection to High Street along the rear of the property. The proposed development area will be concentrated in approximately 17.98 acres and will be located between the Cirrus Apartment development and the newly created Approval Not Required (ANR) lot. Approximately 20 acres will be conveyed to the Town.

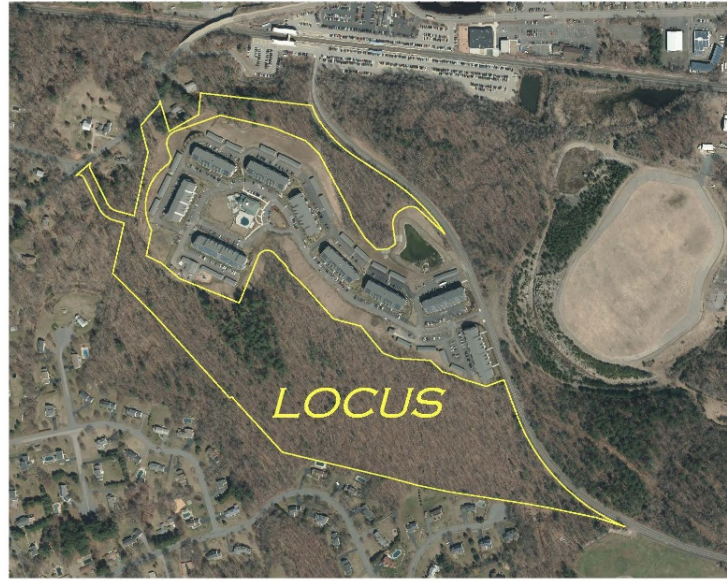


Figure 1 – MassGIS Aerial

An abandoned 50 foot wide Shell Oil easement traverses portions of the northern property. The functional use of the easement has been vacated but has not been extinguished. Development in and around the easement is permissible. The property is located in the Rail Transit District (RTD) as shown on the current Zoning Map. Refer to the site plans for the location of the various sub districts within the RTD.

Memorial Drive provides access to the property with a twenty four (24) foot wide travel way, one (1) foot shoulders, and curbed edges. A fourteen (14) foot wide multi-modal bike path travels along one side of the roadway. The bike path, as well as upgraded roadway lighting, was included as part of a comprehensive rebuild of the roadway as a harbinger to residential development along the corridor. Roadway construction was facilitated through a MassWorks Infrastructure Grant as it achieved a goal of the Commonwealth of Massachusetts to increase the residential population in defined segments of the communities served. In this case, age restricted and rental units that provide reasonable access to transit facilities. Memorial Drive meets at a signalized intersection with West Union Street (MassDOT Route 137) approximately 0.5 mile from the subject site. This intersection provides for dedicated left and right turn movements under signal protected control. Similarly, 0.4 miles northerly along Memorial Drive is the Ashland Commuter rail station. This station provides daily commute access between metro Boston and Worcester station. The property is currently undeveloped and is comprised of New England forest with a variety of tree species onsite. The topography ranges from a low elevation of 255 at the roadway to 391 at the peak of the site. The property is marked by steep slopes and a terraced plateau at approximate crest elevation 391. Some cart paths are spread throughout the property but is largely in its natural state. The infrastructure for this anticipated developed has been installed along Memorial Drive and connection stubs have been provided and stubbed at the right of way/property line.

The underlying soils have been mapped by the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS) and consist of the following:

- 71B – Ridgebury fine sandy loam, 3-8% slopes Hydrologic Soil Group "D"
- 307B – Paxton fine sandy loam, 0-8% slopes Hydrologic Soil Group "C"

- | | |
|--|---------------------------|
| • 307D – Paxton fine sandy loam, 15-25% slopes | Hydrologic Soil Group “C” |
| • 312B – Woodbridge fine sandy loam, 0-8% slopes | Hydrologic Soil Group “C” |
| • 416B – Narragansett silt loam, 3-8% slopes | Hydrologic Soil Group “A” |
| • 416C – Narragansett silt loam, 8-15% slopes | Hydrologic Soil Group “A” |



Figure 2 - Soil's Map

No new on-site soil investigations were done as part of this filing. Drainage infiltration basins have been located in soils categorized as Hydrologic Soil Group A which are known to have soils that are well draining and suitable for infiltration.

2.2 – EXISTING STORMWATER PATTERNS

In order to compare the difference between pre and post-development peak flows and run-off volumes, existing and proposed watersheds were developed. The design points for existing watersheds were picked based on the extent of development to ensure proper analysis from pre and post-development conditions. All flow paths represent the longest time of concentration for stormwater runoff. The site topography is well defined and runoff is either directed towards the easterly wetland, to the westerly wetland, to the northerly property line or towards the existing apartment complex. Please note that a very detailed study was conducted in 2007 for the entire RTD district, therefore this report is only concentrating on the alterations associated with this proposed development. A total of four (4) watersheds have been defined for the site and are as follows:

- Watershed 1W is located on the southeast portion of the site and is 6.318 acres in size. Watershed 1W consists mostly of woodlands, with good groundcover and a small portions of grass with good groundcover. Stormwater currently drains by overland flow to the southeast corner of the parcel and eventually drains to the wetlands located on the easterly side of Memorial Drive;
- Watershed 2W is located on the northeast portion of the site and is 5.335 acres in size. Watershed 2W consists mostly of woodlands, with good groundcover and small portions of grass with good groundcover. Stormwater currently drains by overland flow onto Memorial

Drive into the existing municipal drainage system and eventually into the wetlands on the easterly side of Memorial Drive;

- Watershed 3W is also located on the northerly portion of the site and is 10.509 acres in size. Watershed 3W consists mostly of woodlands, with good groundcover and grass with good groundcover. Stormwater currently drains by overland flow off-site towards the existing apartment complex;
- Watershed 4W is located on the westerly portion of the site and is 8.873 acres in size. Watershed 4W consists mostly of woodlands, with good groundcover, a small portion of grass with good groundcover and a small portion of the existing parking lot located off-site. Stormwater currently drains by overland flow to the westerly wetlands.

See the rear of this report for a copy of the Existing Watershed Plan (EWS-1).

2.3 – SITE UTILITIES

SANITARY SEWER

Municipal sewer is currently installed within Memorial Drive. The sewer consist of an eight (8) inch PVC main and flows southerly via gravity to West Union Street. An eight (8) inch sewer service has been provided and is stubbed at the right-of-way at approximately the midpoint of the street frontage.

STORMWATER

The site topography indicates the site is moderately sloped with the high point being located in the center of the lot. The ridge runs in a north-south direction, therefore stormwater currently flows in an east to west direction. Stormwater flowing easterly drains towards Memorial Drive and eventually to the existing wetlands. Stormwater flowing westerly drains towards the westerly wetlands.

Stormwater in this portion of Town currently drains to Cold Spring Brook crossing Metropolitan Avenue. The Town's stormwater system is regulated by the EPA under the NPDES permitting program. The Town is currently under the NPDES MS4 General Permit (No. MAR041086). As required by the permit, the Town reports annually to the EPA and the MassDEP regarding the status of implementing the permit requirements. The General Permit is more stringent and requires additional treatment as follows:

1. Stormwater management systems on new development sites shall be designed to:
 - a. Retain the volume of runoff equivalent to, or greater than, one (1) inch over the total post-development impervious surface area on the site; AND/OR
 - b. Remove 90% of the annual load of Total Suspended Solids (TSS) generated from the post-construction impervious area on the site and 60% average annual load of Total Phosphorus (TP) generated from the total post-construction impervious surface area on site.
2. Stormwater management systems on redevelopment sites shall be designed to:
 - a. Retain the volume of runoff equivalent to, or greater than, 0.8 inches over the total post-development impervious surface area on the site; AND/OR
 - b. Remove 80% of the annual load of Total Suspended Solids (TSS) generated from the post-construction impervious area on the site and 50% average annual load of Total Phosphorus (TP) generated from the total post-construction impervious surface area on site.

WATER

Municipal water is currently installed within Memorial Drive. The water main consists of a twelve (12) inch ductile iron pipe connecting to a twelve (12) inch main in West Union Street. An eight (8) inch water service has been provided and is stubbed at the right-of-way at approximately the midpoint of the street frontage. A hydrant flow test was recently conducted on October 29, 2020 and witnessed by the Town of Ashland's DPW. The first hydrant flow test was performed with the pumps on and Woodridge valve closed and the second test was done with the pumps off and Woodridge valve open. The results showed a slight drop in the static and residual pressures. Hydrant reports are included in the appendix

OTHER UTILITIES

Underground utilities are currently installed within Memorial Drive. Electrical service is provided by Eversource Electric and is located on the easterly side of Memorial Drive.

Natural gas is provided via a four (4) inch main by Eversource Gas and is also located on the easterly side of Memorial Drive.

Telephone and Cable are available to the site through Comcast and/or Verizon. Comcast and/or Verizon provides digital cable television, state-of-the-art telephone services, and high-speed broadband internet services.

2.4 – OTHER CHARACTERISTICS

WETLAND RESOURCE AREAS

Review of the National Wetland Inventory Map (NWI) and the MassDEP Wetland Map demonstrates that the Site does contain areas subject to jurisdiction under the Wetlands Protection Act. The wetland resource areas was evaluated by a professional wetland scientist from Goddard Consulting in 2019. Bordering Vegetated Wetlands were field delineated, located by an on-the-ground survey and are as shown on the attached plan. Within the proposed development area, there are no wetland resource areas present and the entirety of the proposed work area is greater than 100 feet from the resource area that establishes Wetlands Protection Act jurisdiction. The Conservation Commission has reviewed the resource area via a Request for Determination of Applicability (RDA) in September/October 2020 and have concluded that the proposed work area is located outside their jurisdiction.

FLOOD PLAIN

The Flood Insurance Rate Map (FIRM) (Map Number 25017C0513F) for the Town of Ashland dated July 7, 2014, indicates that the parcel lies within the FEMA Zone X. The FEMA Zone X in this area is defined as "areas determined to be outside the 0.2% annual chance floodplain". The entire subject property is outside of the 500-year Floodplain.

WILDLIFE HABITAT

According to MassGIS and the 14th Edition of the Massachusetts Natural Heritage Atlas dated August 1, 2017, there are no Priority Habitats of Rare Species, no Estimated Habitats of Rare Wildlife, no Certified Vernal Pools and no Potential Vernal Pools on the property.

MEPA PERMIT THRESHOLDS

The review thresholds identify categories of Projects or aspects thereof of a nature, size or location that are likely, directly or indirectly, to cause damage to the environment. MEPA review is required when one (1) or more review thresholds are met or exceeded and the subject matter of at least one review threshold is within MEPA jurisdiction. A review threshold that is met or exceeded specifies whether MEPA review shall consist of an Environmental Notification Form (ENF) and a mandatory Environmental Impact Report (EIR) or an ENF and other MEPA review if the Secretary so requires. The subject matter of a review threshold is within MEPA jurisdiction when there is full-scope jurisdiction (i.e., the Project is undertaken by an Agency or involves Financial Assistance) or when the subject matter of the review threshold is conceptually or physically related to the subject matter of one or more required Permits (provided that the review thresholds for Land and Areas of Critical Environmental Concern shall be considered to be related to the subject matter of any required Permit) or the area subject to a Land Transfer. These thresholds are not triggered by this application.

3.0 – PROPOSED CONDITIONS

3.1 – PROPOSED OVERVIEW

The applicant, UA Senior Manager, LLC, is submitting a comprehensive permit (40B) for a senior housing development located off Memorial Drive (aka MBTA Access Road) in the Town of Ashland, Massachusetts consisting of a total of 180 units. The proposed project will include the construction of two (2) 4/5-story apartment style buildings, four (4) townhouse buildings with six (6) unit each, a clubhouse, four (4) detached parking garages, an access road, parking areas, amenities and all supporting site features and infrastructure required to support the proposed development.

The clubhouse will be centrally located on the site and is approximately 11,500 sf. Building 1 will be located northeast of the clubhouse and will have a footprint of approximately 17,865 sf and will provide 76 residential units. Building 2 will be located northerly of the clubhouse and westerly of Building 1, with a footprint of approximately 20,515 sf with 80 residential units. Buildings 1 and 2 are the residential apartments which will consist of various sized 1-bedroom, 2-bedroom and 3-bedroom units mixed throughout the complex. The four (4) townhouse type buildings will be located along the southerly portion of the proposed development and will have a footprint of approximately 9,020 sf each and contain six (6) residential units each for a total of twenty four (24) units. Four (4) residential garages will be located along the northerly portion of the development and will vary in sizes. Three (3) of the garages will have twelve (12) spaces and the one (1) garage will have eight (8) spaces.

The site will be accessed off of Memorial Drive with a thirty two (32) foot wide drive. The drive will split at the top of the development, providing access to all the residential units as well as the clubhouse. Parking spaces will dispersed throughout the site and within reasonable distances to the buildings. A total of 243 parking spaces are being provided of which 67 parking stalls are located within garages. A total of 13 spaces in compliance with the Americans with Disabilities Act (ADA) are provided site wide located at main entry points to each building and/or amenity spaces. All points of the site have been designed in compliance with ADA grading tolerances.

Other site improvements include landscape areas, underground utilities, municipal water and sewer and a new stormwater management systems. Three (3) dedicated trash and recycling centers have been strategically located throughout the site. The proposed stormwater management plan calls for the use of appropriate best management practices, including swales, deep sump hooded catch basins,

several CDS hydrodynamic separator, a subsurface infiltration systems and a infiltration basin. The system has been designed with infiltration and an outlet control structure. The outlet control structure has been designed to match pre-development conditions for peak discharge rates and runoff volumes. The combination of these BMP's will remove greater than 80% of Total Suspended Solids, from the anticipated stormwater runoff. The stormwater design seeks to use off road swales to control drainage to prevent high sheet flow velocities developed along steep roadways. This condition allows limits water paths of travel that help minimize icing potential during winter months.

3.2 – PROPOSED STORMWATER PATTERNS

The drainage patterns under proposed conditions will maintain the same design points and designations under existing conditions. Some of the existing watershed areas have been modified due to grading of the proposed development. The study concluded that the proposed rates of runoff and runoff volumes at the property line is less than the existing conditions analysis. A total of six (6) watersheds have been defined for the site and are as follows:

- Watershed P-1 is associated with a majority of the proposed development and is 8.471 acres in size. The area will consist of impervious surface areas and landscape areas. Stormwater will be directed into several deep sump hooded catch basins, routed through a water quality structure and through the infiltration basin system. The access road has been graded to drain into the grass swales equipped with catch basins, equally spaced along the bottom. The infiltration basin will be located at the intersection of Memorial Drive and the access drive. An outlet pipe will direct treated stormwater towards the existing design point, the southeast corner.
- Watershed P-2 is also associated with the proposed development and is 5.263 acres in size. The area will consist mostly of roof area, impervious surface areas and landscape areas. Clean roof runoff will be piped directly into the subsurface infiltration system. Stormwater from the access road and landscape areas will be directed into a set of deep sump hooded catch basins, routed through a water quality structure and through the subsurface infiltration system. An outlet pipe will direct treated stormwater towards the proposed infiltration basin at the front of the site.
- Watershed P-3 is located along the southeasterly portion of the site and is 7.626 acres in size. The area will consist of landscape slope area and the existing woodlands. Runoff from this watershed will continue to flow by overland to the southeast corner.
- Watershed P-4 is located along the southwesterly portion of the site and is 7.265 acres in size. The area will consist mostly of landscape slope area, existing woodlands, the rear portion of the roof and patio associated with buildings 6 and 7. Runoff from this watershed will continue to flow by overland to the westerly wetlands.
- Watershed P-5 is located along the northerly portion of the development and is 2.41 acres in size. The area will consist mostly of landscape slope area and the existing woodlands. Runoff from this watershed will continue to flow by overland to the northerly property line.

See the rear of this report for a copy of the Proposed Watershed Plan (PWS-1).

The following tables show comparison of the existing vs proposed peak flow rate of runoff and runoff volume at the three (3) design points.

Table 3.2.A – Design Point 1 Existing vs Proposed peak rate of runoff at the Southeast Corner

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	0.68	0.33	-0.35 (51.4%)
10-year	3.14	2.52	-0.62 (19.7%)
25-year	6.42	5.19	-1.23 (19.1%)
100-year	11.85	9.42	-2.43 (20.5%)

Table 3.2.B – Design Point 1 Existing vs Proposed runoff volume at the Southeast Corner

Design Storm	Existing (ac-ft)	Proposed (ac-ft)	Difference (ac-ft)
2-year	0.123	0.115	-0.008 (6.5%)
10-year	0.444	0.408	-0.036 (8.1%)
25-year	0.774	0.712	-0.062 (8.0%)
100-year	1.286	1.765	0.479 (37.2%)

Table 3.2.C – Design Point 2 Existing vs Proposed peak rate of runoff at the Northerly Property

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	6.26	1.21	-5.05 (80.7%)
10-year	14.63	3.24	-11.38 (77.8%)
25-year	21.30	5.00	-16.3 (76.5%)
100-year	30.29	7.37	-22.92 (75.7%)

Table 3.2.D – Design Point 2 Existing vs Proposed runoff volume at the Northerly Property

Design Storm	Existing (ac-ft)	Proposed (ac-ft)	Difference (ac-ft)
2-year	0.61	0.120	-0.49 (80.3%)
10-year	1.305	0.273	-1.032 (79.1%)
25-year	1.869	0.400	-1.469 (78.6%)
100-year	2.641	0.576	-2.065 (78.2%)

Table 3.2.E – Design Point 3 Existing vs Proposed peak rate of runoff at the Westerly Wetlands

Design Storm	Existing (cfs)	Proposed (cfs)	Difference (cfs)
2-year	5.97	5.67	-0.30 (5.0%)
10-year	13.05	12.07	-0.98 (7.5%)
25-year	18.62	17.07	-1.55 (8.3%)
100-year	26.06	23.71	-2.35 (9.0%)

Table 3.2.F – Design Point 3 Existing vs Proposed runoff volume at the Westerly Wetlands

Design Storm	Existing (ac-ft)	Proposed (ac-ft)	Difference (ac-ft)
2-year	0.585	0.561	-0.024 (4.1%)
10-year	1.207	1.121	-0.086 (7.1%)
25-year	1.704	1.564	-0.14 (8.2%)
100-year	2.379	2.159	-0.22 (9.2%)

3.2.1 – METHODOLOGY

The peak rate of runoff was determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
2. HydroCAD[®] Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.18. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration systems, to perform drainage routing and to combine the results of the runoff hydrographs.
3. Soil Survey of Middlesex County, Massachusetts by United States Department of Agriculture, National Resource Conservation Service. Soil types and boundaries were obtained from this reference.
4. Rainfall Data for each of the storm events was based on the data from the National Weather Service Technical Paper 40 (TP-40) 24-hour rainfall maps as published in the TR-55 book. The total rainfall for each event is shown in the following table:

Table 3.2.1 – Rainfall (TP-40)

	2-year	10-year	25-year	100-year
	3.2 inches	4.55 inches	5.50 inches	6.7 inches

3.2.2 – CLOSED DRAINAGE SYSTEM COMPUTATIONAL METHODS

The closed drainage system calculations determine the rate of runoff, the time of concentration and the rainfall intensity for the drainage basin. The calculations were performed for a 25-year storm event. The closed drainage system has also been analyzed for the 100-year event. The following standards were used:

1. The Rational Formula ($Q = CIA$) was used to determine the flow to each structure.
 - Q = Flow cubic feet per second (CFS)
 - C = Runoff coefficients
 - I = Rainfall Intensity (inches per hour)
 - A = Drainage Area (acres)
2. The runoff coefficients used are as follows:
 - Impervious (pavement and roofs) = 0.9
 - Grassed = 0.30
 - Bare Ground and gravel = 0.50
 - Landscape = 0.3
 - Wooded = 0.2
3. The intensity for each area was determined by the Steel Formula for a 25-year frequency storm. The Steel Formula is:
 - $I = k/(t+b)$
 - I = Intensity
 - k = 230 (25 yr)
 - t = Time of Concentration
 - b = 30 (25 yr)

4. The times of concentration were calculated using a nomograph provided in "Design, Volume 1," by Seelye, 1960. A minimum time of concentration of six (6) minutes was utilized.
5. The Manning's formula was utilized to calculate the capacity of the individual pipes in the closed drainage system. The Manning's formula is:
$$Q = (A_p) (1.486/n) (s^{1/2}) (h^{2/3})$$

Q = Flow in CFS
A_p = Cross-sectional area of the pipe (square feet)
n = Roughness coefficient
s = slope of the pipe (ft/ft)
h = hydraulic radius

The closed drainage system, as designed, is capable of handling the design flow as calculated, as well as maintaining a design velocity of between 2.0 feet per second (fps) (cleansing velocity at pipe half full conditions) and 12.0 fps.

3.2.3 – EROSION AND SEDIMENT CONTROL

The site will be enclosed with a straw wattle and/or fiber roll barrier to prevent incidental conveyance of sediment from disturbed areas off-site or into the existing drainage system. Intermediate erosion control devices will be installed on exposed slopes to minimize erosion. All existing drainage inlets adjacent to the site that are to remain shall have silt sacks installed prior to any construction activities. Stabilized construction entrances shall be installed as part of the construction and will be maintained until site tracking potential has been eliminated. The erosion control measures will remain in place until all construction activities are complete and all disturbed areas have been stabilized. The contractor will be required to inspect all controls regularly to ensure that they are working properly and to see if they need to be cleaned and/or replaced on an as-needed basis. The proposed project will disturb greater than one (1) acre of land, therefore the project will require the filing of a National Pollutant Discharge Elimination System (NPDES) Stormwater Construction General Permit. A stormwater Pollution Prevention Plan (SWPPP) will be prepared prior to any construction activity. The SWPPP will prescribe in detail the performance standards to which the contractor for the project will be responsible for. The SWPPP will be maintained at the construction trailer on-site throughout the duration of the project. The SWPPP shall outline acceptable temporary stabilization measures to prevent incidental transport of sediment to off-site areas.

3.3 – SITE UTILITIES

SANITARY SEWER

The proposed project is proposing a new eight (8) inch sewer service and will be connected to the existing sewer manhole, located opposite the new site driveway. The existing sewer stub is located down gradient and will be abandoned in-place. The proposed development is anticipated to have 98 one-bedroom units and 164 two-bedroom units; totaling 262 total bedrooms. The proposed sewer flows are estimated to be 29,728 gallons per day (0.05 cfs) based on 314 CMR 7.00 and 310 CMR 15.00. The sewage flows were calculated as follows.

Table 3.3.1 - Proposed Sewage Flows per the State Environmental Code, Title V

Type of Establishment	Min. Flow		Size		Calculated Flow		Design Flow	
Residential	110	gpd/bedroom	262	bedrooms	28820	gpd	28820	gpd
Office	75	gpd/1000 sf (200 gpd min)	12098	sf	907.35	gpd	908	gpd
						Total	29728	gpd
							0.05	cfs

STORMWATER

The stormwater management design incorporates Best Management Practices (BMP's) to protect down gradient points and measures to reduce peak rates and runoff volumes from the site between existing and proposed conditions. The stormwater design incorporates deep sump hooded catch basins, several CDS hydrodynamic separators, grass swales, an infiltration basin and a subsurface infiltration systems consisting of StormTrap concrete chambers. An outlet control structure is being proposed to control the release of stormwater to less than predevelopment conditions. The proposed layout, grading and the drainage system will reduce the total site runoff rate, volume and total suspended solids discharging off-site. The developed site will meet and exceed the criteria set forth in the MassDEP Stormwater Technical handbook as well as the MA MS4 General Permit. Proposed BMP's include grass channels, deep sump hooded catch basin, CDS unit, infiltration basin and subsurface infiltration chambers. The combination of these BMP's will remove greater than 80% of TSS from the anticipated stormwater runoff.

WATER

The proposed project is proposing a new eight (8) inch water service connection to the existing twelve (12) inch main in Memorial Drive. The existing eight (8) inch stub is located further southerly, therefore will be abandoned in-place. The proposed eight (8) inch water main will connect to a new booster pump located in one of the garages. The water main servicing the buildings will be pressurized and looped throughout the development. Fire hydrants will be strategically located around the site at locations coordinated at a pre-submission meeting held with the Town of Ashland Fire Chief and Fire Prevention Captain. Each building will have a separate domestic service and a fire protection service off the pressurized eight (8) inch main. In lieu of a peak water demand calculation based on a plumbing fixture unit count, the daily water usage for the project is estimated at 32,700 gpd (22.7 gpm) which is 110% of the anticipated sewer flows. Assuming a peak factor of three (3) the adjusted water usage is 98,100 gpd (68.1 gpm). A more accurate estimate of domestic water demand will be provided by the owner as the building design progresses. The applicant will coordinate with the DPW – Water Division on the opportunity for irrigation water usage.

In order to meet NFPA, the proposed system will be required/capable of moving 750 GPM at 85 psi. This is the worst case scenario for sprinkler flow. At the same time, domestic flow requires 78 psi discharge pressure. A hydrant flow test was conducted on the source line at the entry point to the site. At the lowest operating pressure, the Town can deliver 960 gpm with a flow psi of 33 off of a 12 inch main at a rough grade elevation of 251. The booster pump will be located roughly at elevation 363. The booster system will be installed and maintained as part of the private development.

Specifications will be developed as part of the construction document phase of the project and shall be provided to DPW for review prior to fabrication and installation.

OTHER UTILITIES

The premises will be serviced by new underground utilities and will be coordinated with the various utility providers in the area. Transformer pads will be located throughout the site meeting Eversource design standards for location and vehicular protection. Final locations will be determined and coordinated with Eversource Electric.

A new gas connection will be provided off the existing four (4) main on Memorial Drive. The gas main will feed the gas meter banks located along the buildings. Final location to be determined and coordinated with Eversource Gas.

3.4 – OTHER CHARACTERISTICS

WETLAND RESOURCE AREAS

In October 2020, the Town of Ashland Conservation Commission issued a negative determination (WPA Form 2 – Determination of Applicability) that the proposed project will not have any impact to the wetland resource areas adjacent to the site.

FLOOD PLAIN

The project site is located in a Zone X. Therefore, no impacts to flood plains are anticipated.

WILDLIFE HABITAT

No impacts on wildlife habitat, since there are no Priority Habitats of Rare Species, Estimated Habitats of Rare Wildlife, Certified Vernal Pools nor Potential Vernal Pools are located on the project site. Therefore, no impacts to flood plains are anticipated.

MEPA PERMIT THRESHOLDS

The proposed project will not meet or exceed any of the thresholds established, and is therefore not applicable.

4.0 – TRANSPORTATION

In order to estimate the number of vehicle trips associated with the proposed development, A&M relied upon the Institute of Transportation Engineer's (ITE) *Trip Generation Manual, 10th Edition*. The ITE is a national research organization of transportation professions and the *Trip Generation Manual, 10th Edition* provides traffic generation information for various land uses compiled from studies conducted by members nationwide for similar facilities. Vehicle trip estimates for the proposed project were determined using ITE Land Use Code (LUC) 252 – Senior Adult Housing – Attached.

LUC 252, Senior Adult housing consists of attached independent living developments, including retirement communities, age-restricted housing, and active adult communities. These developments may include limited social or recreational services. The ITE classification lacks centralized dining and onsite medical facilities. Residents in these communities live independently, are typically active (requiring little to no medical supervision) and may or may not be retired. This analysis approach is an over-conservative estimation based on the anticipated population of the Arbella at Ashland. The United Group's residential basis is often based on limited mobility residents that will seek to engage

in communal based activities supported by the facility operator. These activities include coordinated shuttle bus services to nearby locations inclusive of medical appointments, basic service needs, and the like. The Arbella at Ashland will also maintain an onsite clubhouse that will provide recreational opportunities that may otherwise be sought off property.

A continuing care retirement community (CCRC) is a land use that provides multiple elements of senior adult living. CCRCs combine aspects of independent living with increased care, as lifestyle needs change with time. Housing options may include various combinations of senior adult (detached), senior adult (attached), congregate care, assisted living, and skilled nursing care—aimed at allowing the residents to live in one community as their medical needs change. The communities may also contain special services such as medical, dining, recreational, and some limited, supporting retail facilities. CCRCs are usually self-contained villages.

Arbella at Ashland Vehicular Trip Generation

Weekday, AM Peak hour	180 units	56 – 59 vehicle trips per day
Weekday, PM Peak hour	180 units	56 – 60 vehicle trips per day.

Under the analysis method, approximately 1/3 of the occupied units would make a round trip in any given day during the peak hours of analysis.

For comparative value, on June 11, 2019, preliminary traffic data was recorded using automatic data recorders to determine the flow of traffic at the intersection of West Union Street and the MBTA Driveway. At the time of study, the Ashland Commuter Rail station was in full operation and the 288 residential units at Cirrus Apartments were occupied.

During the 7:00 – 9:00 am reporting period, approximately 402 vehicle trips were recorded as vehicles traveling along the MBTA Roadway. Approximately 2,902 vehicles were recorded traveling east/west along West Union Street. The 60 (rounded) Arbella at Ashland trips per day would represent approximately 29% trips during a one hour period along the MBTA roadway, and 4% of the West Union Street volume.

Similarly during the 4:00 – 6:00 pm reporting period, approximately 420 vehicle trips were reported along the MBTA Roadway and 2,879 along West Union Street, or 29% and 4% respectively.

During the 7:00 – 9:00 am reporting period, on a normal weekday operating calendar, the Framingham/Worcester has three inbound stops (7:27, 7:54, and 8:34) that are traffic attractors and three outbound stops (7:01, 7:59, and 8:21) that contribute departing traffic to the MBTA roadway. During the 4:00 – 6:00 pm reporting period, three inbound stops (4:20, 5:50, and 6:35) and three outbound stops (4:29, 5:09, and 5:48) are noted.

The data presented above is preliminary and is subject to final review, modification, and evaluation based on growth projections, timing and gap models, and seasonal variations.

5.0 – STORMWATER MANAGEMENT

STANDARD 1

No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The proposed project is proposing an infiltration basin and two (2) subsurface infiltration systems with an outlet control structure. All discharges from the roadway and parking areas will be treated and directed into one of the proposed infiltration systems prior to discharging.

STANDARD 2

Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

Calculations have been provided to show that the proposed development will not cause an increase in peak discharge rates. Refer to the HydroCAD calculations provided within Appendix A and Appendix B of this report for detailed breakdowns.

STANDARD 3

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The USDA Soil Survey of Middlesex County was used to determine soil types on site.

The required recharge rates for each soil classification are as follows:

Table 5.1 – Recharge Volume per Hydrologic Soil Group (HSG)

	HSG A	HSG B	HSG C	HSG D
Required Recharge	0.60 inches	0.35 inches	0.25 inches	0.10 inches

Table 5.2 – Proposed Impervious Surface

Site	Total Area	HSG A	HSG B	HSG C	HSG D
Building Roof	99,970 sf	-	-	99,970 sf	-
Pavement/sidewalk	183,388 sf	28,314 sf	-	155,074 sf	-
Total Impervious Area	283,358 sf	28,314 sf	-	255,044 sf	-

The project is considered a new development project under proposed conditions, the project will have 283,358 sf of impervious surface area. Per the Massachusetts Stormwater Handbook, the project is required to recharge the increase in impervious surface. All runoff that flows from impervious areas

will be collected by the proposed closed drainage system and directed into an underground infiltration system. The required recharge volume is given by the following equation

$$R_v = F \times IA \text{ (Equation 1 Stormwater Handbook Volume 3)}$$

where R_v = Required Recharge Volume, ft³
 F = Target Depth factor
 IA = Impervious drainage area
 R_v = $F \times IA$
 = (0.6 inches)(1foot/12 inches)(28,314 sf) + (0.25 inches)(1foot/12 inches)(255,044 sf)
 = 6,729 cubic feet

The volume within the infiltration basin and the subsurface infiltration system, below the lowest orifice in the outlet control structure is approximately 68,355 cubic feet which exceeds the required volume of 6,729 cubic feet.

MA MS4 General Permit requires the project to retain and infiltrate the volume of one (1) inch over the post-developed impervious surface, therefore the required $V = (1'')(1'/12'')(255,044 \text{ sf}) = 21,254 \text{ cf}$.

The volume within the subsurface infiltration system, below the lowest orifice in the outlet control structure is approximately 68,355 cubic feet which exceeds the required volume of 21,254 cubic feet.

The basin drawdown time is defined as:

$$\text{Time}_{\text{drawdown}} = R_v / (K)(\text{bottom area})$$

where R_v = Required Recharge Volume, ft³
 K = Saturated Hydraulic Conductivity (Rawls Table)
 Bottom area = Bottom area of recharge structure

Table 5.3 – Drawdown Calculation

System	R_v	K	Bottom Area	$\text{Time}_{\text{drawdown}}$
Infiltration Basin	49,080 cf	8.27 in/hr	10,661 sf	6.7 hrs
Stormtrap	19,275 cf	0.27 in/hr	12,000 sf	71.4 hrs

STANDARD 4

Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

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

All runoff that flows through or along any impervious area will be treated in a manner such that 80% (min.) of the total suspended solids are removed with 44% removal achieved prior to infiltration. Parking lot sweeping shall be performed in accordance with the table below in order to remove at least 5% of TSS. Sweeping shall comply with Table 7 for a minimum of 5% removal. Also the site will

employ a proprietary treatment device (CDS), deep sump hooded catch basins and a subsurface infiltration system to achieve and exceed the required 80% TSS removal. Removal rates for the proprietary water quality unit are based on the recommendations of the former Technology Acceptance and Reciprocity Partnership (TARP) and the Massachusetts Strategic Envirotechnology Partnership (STEP) and not wholly on manufacturer’s claims. Refer to the TSS Removal Calculation Worksheet included in Appendix C of this report.

TSS Removal Rate	High Efficiency Vacuum Sweeper – Frequency of Sweeping	Regenerative Air Sweeper – Frequency of Sweeping	Mechanical Sweeper (Rotary Broom)
5%	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Quarterly Average, with sweeping scheduled primarily in spring and fall.	Monthly Average, with sweeping scheduled primarily in spring and fall.
0%	Less than above	Less than above	Less than above

STANDARD 5

For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

The proposed project is not a Land Use with Higher Potential Pollutant Loads and therefore Standard 5 does not apply.

STANDARD 6

Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A “storm water discharge” as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

The project site does not discharge to or near a critical area therefore Standard 6 does not apply.

STANDARD 7

A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

This project is considered a new development, therefore not applicable.

STANDARD 8

A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

An Erosion Control plan has been incorporated with the design plans. Also, the project requires a Stormwater Pollution Prevention Plan (SWPPP). The SWPPP will be prepared and submitted prior to construction. The SWPPP shall also be kept on file as required under the NPDES Construction General Permit program.

STANDARD 9

A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

An operations and maintenance (O&M) plan has been included in this report that outlines the general maintenance for the stormwater systems during and after construction.

STANDARD 10

All illicit discharges to the stormwater management system are prohibited.

No illicit discharges exist on site. The storm water management system proposed shall not be connected to the wastewater management system and shall not be contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease per Massachusetts DEP Storm Water Standard 10. A signed statement shall be provided by the owner in concurrence with issuance of the final site plan.

6.0 – STORMWATER MANAGEMENT SYSTEM MAINTENANCE

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. (A&M) has prepared the following Operation and Maintenance plan for the proposed stormwater management system for the proposed project.

This plan focuses on post construction maintenance of the on-site drainage system. Operation and Maintenance (O&M) practices discussed below are recommendations made by the Design Engineer based on available reference material on Best Management Practices (BMP's) and experience. The property owner is responsible for implementation of the plan, and is encouraged to revise / supplement this plan accordingly based on actual site conditions.

This plan is broken into two (2) major sections. The first section describes construction-related erosion and sedimentation controls. The second section is devoted to a post-development operation and maintenance plan.

Basic Information

Proponent: UA Senior Manager, LLC
Property Address: Off Memorial Drive Ashland, MA
Owner Address: Rensselaer Technology Park 300 Jordon Road
City: Troy, NY 12180

Section 1 Construction Activities

1. Schedule a meeting with the various Town Departments, Design Engineer and Owner at least three (3) days prior to start of construction.
2. Install the wattles, silt fence, construction fencing and silt sacks in the catch basins as shown on the Erosion and Sediment Control Plan.
3. All erosion and sedimentation controls shall be in accordance with MassDEP's Erosion and Sedimentation Control guidelines revised through May 2003 and the USDA SCS Erosion and Sedimentation Control in site development dated September 1983.
4. Site access shall be achieved only from the designated construction entrance.
5. All erosion control measures shall be inspected weekly and after any rainfall event greater than 0.5-inches, and shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, or the Town's Engineer.
6. Sediment accumulation up-gradient of the wattles and silt fence greater than 6-inches in depth shall be removed and disposed of in accordance with all applicable regulations.
7. If it appears that sediment is exiting the site, additional silt sacks shall be installed in all catch basins adjacent to the site as directed by the Engineer. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
8. The contractor shall comply with the General and Erosion Notes as shown on the Site Development Plans & National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan (SWPPP).
9. All disturbed areas shall be stabilized with mulch or seed immediately upon completion of the construction activity that disturbed the soil or at 6 months whichever is less.

10. All slopes greater than 3:1 shall be stabilized with an erosion control blanket.
11. The contractor shall keep on site additional silt fence and wattle to mitigate any emergency condition.
12. All proposed drainage structures (catch basins, manholes, etc.) should be cleaned at the end of construction and any time the sediment within the structures equals 12" deep.
13. All newly installed inlets shall be protected during construction by installing silt sacks.
14. The contractor shall be responsible for preventing any silt or sediment from entering the infiltration systems.
15. No overuse, over-compaction, or storage of materials shall occur within any areas defined as stormwater infiltration to prevent the incidental compaction of soils. The areas are to be constructed as soon as possible and protected from construction traffic. NO CONSTRUCTION WATERS are to be emptied into an infiltration system. An allowance may be accommodated for a temporary excavation of soils within the infiltration basin for collection and handling of construction water, but the entirety of the debris is to be removed in order to achieve the grades as shown on the construction drawings.
16. The entire drainage system, including but not limited to catch basin, manholes, piping, water quality structures and infiltration system should be cleaned prior to turnover to the Owner.

Section 2 Post-Development Activities

1. The entire project area shall be stabilized with vegetation upon completion of construction and prior to removal of the erosion control devices.
2. Salt for de-icing on the paved areas during the winter months shall be limited to the minimum amount practicable. 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.
3. The closed drainage system shall be inspected every six (6) months. If more than 18 inches of sediment is found within the drainage structures, manholes or catch basins the structures shall be cleaned and the sediment removed and disposed of.
4. Deep Sump Hooded Catch Basins shall be inspected two (2) times per year (specifically after foliage and snow season) to ensure that the catch basins are working in their intended fashion and that they are free of debris. Structures will be skimmed of floatable materials (i.e. Snout), check to ensure watertight seal is working. Units shall be cleaned two (2) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert.
5. Drainage channels should be inspected for the first few months after construction in order to ensure proper function and twice a year thereafter. Inspection is recommended to include ensuring slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding, and sediment accumulation are not affecting the efficiency of the channel. For the highest efficiency, grass heights, within drainage channels, should be around three to six inches which is optimal so mowing should be done as necessary and removal of sediment is recommended to be completed once per year. Due to use of road salt and other deicers during the winter months, the need to reseed drainage channels is recommended to be evaluated yearly during the spring months. Other regular maintenance of drainage channels include fertilizing, liming, watering, pruning, weeding, and pest control. Each condition is evaluated on a case by case basis for applicability. Temporary ponding within drainage channels is normal and can develop over time. Each area should be reviewed on a semi-regular

basis and duration of ponding should be noted. Cleaning of drainage channels are subject to site specific review and may not require cleaning in accordance with recommendations if conditions do not permit.

6. It is recommended that check dams be inspected twice per year and after all major storm events. Repair damage to check dams as needed. All accumulated sediment, trash, and debris is to be removed.
7. CDS specific maintenance shall be as follows:
 - A. Inspections shall be performed twice per year (e.g. spring and fall).
 - B. A visual inspection should ascertain that the system components are in working order and there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument.
 - C. Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen.
 - D. Cleaning is required once the sediment depth reaches 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated.
 - E. Cleaning should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.
 - F. The system should be cleaned out immediately in the event of an oil or gasoline spill.
 - G. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oil layer.
 - H. Trash and debris can be netted out to separate it from other pollutants. The screen should be power washed to ensure it is free of trash and debris.
8. Infiltration basins are recommended to be inspected twice per year as well as during and following major storms for the first three (3) months of operation. Inspection is also prompted when there are discharges through the high outlet orifice. Examination of outlet structures for evidence of clogging and velocities of outflow runoff that exceed design should also be conducted twice per year. According to the Massachusetts Stormwater Handbook, potential problems include settlement, erosion, cracking or tree growth on the embankment, sediment accumulation around the outlet, inadequacy of the inlet/outlet channel erosion control measures, the health of the turf, and erosion within the basin and banks. Mowing of the upper-stage, side slopes, embankment, and emergency spillway should be conducted twice per year or as necessary. Removal of sediment, trash, and debris is recommended to be conducted once per year.

9. Due to the location of subsurface structures, inspection and maintenance can be difficult. Inlets of subsurface structures are recommended to be inspected twice per year and any debris present which might cause the structure to clog should be removed. Subsurface Infiltration Structures should be inspected within the first three (3) months after construction and within 72 hours of a half-inch storm event to ensure it is draining properly. Thereafter, the system should be inspected for sediment, trash and debris at least twice per year. Trash, debris, and visible sediment should be removed. The system should also be inspected annually within 72 hours of a half-inch storm event to ensure it is draining properly. Inspection can be accomplished by using the observation well, inspection port, and/or access structure for underground chamber systems. Adjust the inspection interval based on previous observation of sediment accumulation and high water elevations. Conduct jetting and vactoring annually or when inspection shows that maintenance is necessary.
10. It is recommended that outlet structures be inspected for sediment buildup as well as any signs of clogging twice per year. Removal of sediment, trash, and debris should be completed as necessary to ensure proper efficiency of the outlet structures. Outlet control structures should be inspected and maintained to assure proper routing of stormwater. Pipe joints in connection with the outlet structure, trash racks, and covers should also be checked for damage and repaired as necessary. Cleaning of outlet structures are subject to site specific review and may not require cleaning in accordance with recommendations if conditions do not permit.
11. It is recommended that the stone placed at the end of pipes be inspected twice per year and after all major storm events. Inlets and outlets of pipes should also be inspected at the same time to ensure there is no clogging or buildup of sediment impeding flow. All accumulated sediment, trash, and debris from the stone as well as the pipe is to be removed.
12. Mosquito Control Plan – Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance, and treatment with larvicides can minimize this potential. Reference: Massachusetts Stormwater Handbook Volume 2, Chapter 5 (Copy attached herewith). Mosquito control shall be performed if visual evidence supports need. Treatment shall include use of accepted pesticides outlined in the Stormwater policy.
13. Work within any drainage structures shall performed in accordance with the latest OSHA regulations, and only by individuals with appropriate OSHA certification.
14. Maintenance Responsibilities - All post-construction maintenance activities shall be documented and kept on file and made available upon request.

Referenced from the Massachusetts Stormwater Handbook "Chapter 5"

Miscellaneous Stormwater Topics

Mosquito Control in Stormwater Management Practices

Both aboveground and underground stormwater BMPs have the potential to serve as mosquito breeding areas. Good design, proper operation and maintenance and treatment with larvicides can minimize this potential.

EPA recommends that stormwater treatment practices dewater within three (3) days (72 hours) to reduce the number of mosquitoes that mature to adults, since the aquatic stage of many mosquito species is 7 to 10 days. Massachusetts has had a 72-hour dewatering rule in its Stormwater Management Standards since 1996. The 2008 technical specifications for BMPs set forth in Volume 2, Chapter 2 of the Massachusetts Stormwater Handbook also concur with this practice by requiring that all stormwater practices designed to drain do so within 72 hours.

The proposed site plan does not incorporate any permanent stormwater pooling areas except deep sump catch basins. Any temporary ponding areas are located subsurface. Two temporary stormwater basins are proposed in offsite areas. These areas are anticipated to drain within 72 hours in compliance with the Stormwater Handbook and are discussed further below. Please refer to post-construction prevention below. Recommended oversight includes the application of larvicides to affected areas. The Steen operations team only provides mosquito control if an increased population occurs over baseline conditions.

Construction Period Best Management Practices for Mosquito Control

To minimize mosquito breeding during construction, it is essential that the following actions be taken to minimize the creation of standing pools by taking the actions below. The available options are provided directly from the MassDEP handbook to allow for all contingencies during the construction period.

- **Minimize Land Disturbance:** The existing site is denuded and no further clearing is anticipated. Earthwork activity has the potential to create temporary ponding areas onsite. Stilling basins and temporary forebays will be minimized to the extent feasible. The onsite soils recharge water at an accelerated rate.
- **Catch Basin inlets:** Inspect and refresh filter fabric, hay bales, filter socks or stone dams on a regular basis to ensure that any stormwater ponded at the inlet drains within 8 hours after precipitation stops. Shorter periods may be necessary to avoid hydroplaning in roads caused by water ponded at the catch basin inlet. Treat catch basin sumps with larvicides such as *Bacillus sphaericus* (Bs) using a licensed pesticide applicator.
- **Check Dams:** If temporary check dams are used during the construction period to lag peak rate of runoff or pond runoff for exfiltration, inspect and repair the check dams on a regular basis to ensure that any stormwater ponded behind the check dam drains within 72 hours.
- **Design construction period sediment traps** to dewater within 72 hours after precipitation. Because these traps are subject to high silt loads and tend to clog, treat them with the larvicide Bs after it rains from June through October, until the first frost occurs.

- **Construction period open conveyances:** When temporary manmade ditches are used for channelizing construction period runoff, inspect them on a regular basis to remove any accumulated sediment to restore flow capacity to the temporary ditch.
- **Revegetating Disturbed Surfaces:** Revegetating disturbed surfaces reduces sediment in runoff that will cause construction period controls to clog and retain standing pools of water for greater than 72 hours.
- **Sediment fences/hay bale barriers:** When inspections find standing pools of water beyond the 24-hour period after a storm, take action to restore barrier to its normal function.

Post-Construction Stormwater Treatment Practices

- Mosquito control continues with the selection of structural stormwater BMPs that are unlikely to become breeding grounds for mosquitoes, such as:
 - **Bioretention Areas/Rain Gardens/Sand Filter:** Not site applicable.
 - **Infiltration Trenches:** This practice tends not to result in mosquito breeding. If any level spreaders, weirs, or sediment forebays are used as part of the design, inspect them and correct them as necessary to prevent standing pools of water for more than 72 hours.
- Another mosquito control strategy is to select BMPs that can become habitats for mosquito predators, such as:
 - **Constructed Stormwater Wetlands:** Not site applicable.
 - **Wet Basins:** Not site applicable.

Effective mosquito controls require proponents to design structural BMPs to prevent ponding and facilitate maintenance and, if necessary, the application of larvicides. Examples of such design practices include the following:

- **Basins:** Provide perimeter access around wet basins, extended dry detention basins and dry detention basins for both larviciding and routine maintenance. Control vegetation to ensure that access pathways stay open. The open air temporary basins shall be seeded upon completion and allowed to grow naturally. Given the location within the site, rapid growth of vegetation is not anticipated and routine cutting shall be performed on a schedule as determined based on field conditions. Mosquito dunks are an effective treatment device if standing water is encountered.
- **BMPs without a permanent pool of water:** All structural BMPs that do not rely on a permanent pool of water must drain and completely dewater within 72 hours after precipitation. This includes dry detention basins, extended dry detention basins, infiltration basins, and dry water quality swales. Use underdrains at extended dry detention basins to drain the small pools that form due to accumulation of silts. Site development drawings utilize subsurface handling of stormwater. An emergency overflow basin is proposed that, by design, is not anticipated to receive any stormwater flow up to and including the 100 year event.
- **Energy Dissipators and Flow Spreaders:** Not site applicable.
- **Rain Barrels and Cisterns:** Not site applicable.
- **Subsurface Structures, Deep Sump Catch Basins, Oil Grit Separators, and Leaching Catch Basins:** All manhole covers shall be inspected to ensure they are closed and reduce the likelihood of mosquitoes laying eggs in standing water. Upon routine inspection, if these systems increase the mosquito breeding potential, the covers can be seal and mosquito netting installed over the outlets.

- **Check dams:** Not site applicable.
- **Cisterns:** Not site applicable.
- **Water quality swales:** Not site applicable.
- **Larvicide Treatment: See LTPP for larvicides treatment.**

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- Wallace, John R., Stormwater Management and Mosquito Ecology, Stormwater Magazine, March/April 2007, http://www.gradingandexcavation.com/sw_0703_management.html

7.0 – LONG-TERM POLLUTION PREVENTION

As required under stormwater Standard 4, the project requires the “development and implementation of suitable practices for source control and pollution prevention. These measures must be identified in a long term pollution prevention plan. The plan shall include the proper procedures for the following:

- good housekeeping;
- storing materials and waste products inside or under cover;
- vehicle washing;
- routine inspections and maintenance of stormwater BMPs;
- spill prevention and response;
- maintenance of lawns, gardens, and other landscaped areas;
- storage and use of fertilizers, herbicides, and pesticides;
- pet waste management;
- operation and management of septic systems (where applicable); and
- proper management of deicing chemicals and snow.

The proposed project consists of a residential development and associated infrastructure to support the development. Upon completion of the projects the maintenance and pollution prevention activities will be the responsibility of the property owner. The Pollution prevention items noted herein shall be followed post construction. Additional constraints shall be followed per the Stormwater Pollution Prevention Plan prepared at the time of construction.

Operator Information

Proponent: UA Senior Manager, LLC
 Property Address: Off Memorial Drive Ashland, MA
 Owner Address: Rensselaer Technology Park 300 Jordon Road
 City: Troy, NY 12180

Good Housekeeping
The following good housekeeping practices will be followed onsite during the construction project: <ul style="list-style-type: none"> • An effort will be made to store only the amount of material required to do the job. • All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure. • Products will be kept in their original containers with the original manufacturer’s label. • Substances will not be mixed with one another unless recommended by the manufacturer. • Whenever possible, all of a product will be used up before disposing of the container. • Manufacturer’s recommendations for proper use and disposal will be followed. • The site superintendent will inspect daily to ensure proper use and disposal of materials onsite.
Hazardous Products
These practices are used to reduce the risks associated with hazardous materials: <ul style="list-style-type: none"> • Products will be kept in the original containers unless they are not re-sealable. • Original labels and material safety data will be retained; they contain important product information. • If surplus product must be disposed of, manufacturers or local and State recommended methods for proper disposal will be followed.
Product Specific Practices
The following product specific practices will be followed onsite:

Petroleum Products
All onsite vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers that are clearly labeled. Any asphalt substances used onsite will be applied according to the manufacturer's recommendations.
Fertilizers
Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to stormwater. Storage will be in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.
Paints
All containers will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to the manufacturer's instructions or State and local regulations.
Concrete Trucks
Concrete Trucks will not be allowed to wash out or discharge surplus concrete or drum wash water on the site.
Spill Control Practices
In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and clean-up: <ul style="list-style-type: none"> • Manufacturers' recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies. • Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include but not be limited to brooms, dustpans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose. • All spills will be cleaned up immediately upon discovery. • The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance. • Spills of toxic or hazardous substances will be reported to the appropriate State or local government agency, regardless of the size. • The spill prevention plan will be adjusted to include measure to prevent this type of spill from reoccurring and how to clean up the spill if there should be another. A description of the spill, what caused it, and the cleanup measure will also be included. • The Site Superintendent responsible for the day-to-day site operation will be the spill prevention and cleanup coordinator.
Waste Disposal
All trash and construction debris from the site will be deposited in the dumpster. The dumpster will meet all local and State solid waste management regulations. All trash and construction debris from the site will be deposited in the dumpster. No construction waste materials will be buried onsite. All personnel will be instructed regarding the correct procedure for waste disposal. Notices stating these practices will be posted in the office trailer and the individual who manages day-to-day site operations, will be responsible for seeing that these practices are followed.
Hazardous Waste
All hazardous waste materials will be disposed of in the manner specified by local or State regulation or by the manufacturer. Site personnel will be instructed in these practices and the individual whom manages day-to-day site operations, will be responsible for seeing that these practices are followed.
Sanitary Waste
All sanitary waste will be collected from the portable units a minimum of once per week by a licensed sanitary waste management contractor, as required by the local or State regulation.
Pet Waste
The Owner shall implement a cleanup program where pet owners must put the pet waste into bags and dispose of the waste in the trash.
Sanitary Waste (septic)
There is no septic component to this project that will require long term maintenance.
Landscaping
1) 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 (Hay or Straw) Materials and Installation

- a) Straw has been found to be one of the most effective organic mulch materials. The specifications for straw are described below, but other material may be appropriate. The straw should be air-dried; free of undesirable seeds & coarse materials. The application rate per 1,000 sq. ft. is 90-100 lbs. (2-3 bales) and the application rate per acre is 2 tons (100-120 bales). The application should cover about 90% of the surface. The use of straw mulch is appropriate where mulch is maintained for more than three months. Straw mulch is subject to wind blowing unless anchored, is the most commonly used mulching material, and has the best microenvironment for germinating seeds.

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) Straw or 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 mowings 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.

Vehicle Washing & Construction Access

A stabilized construction entrance has been provided to help reduce vehicle tracking of sediments. Any paved streets adjacent to the site entrance will be swept daily to remove any excess mud, dirt or rock tracked from the site. Dump trucks hauling material from the construction site will be covered with a tarpaulin.

- 1) **Stabilized Construction Entrance** – An existing stabilized construction entrance shall be used for the duration of construction activity for this project.

Construction Entrance Inspection/Maintenance

- a) The entrance should be maintained in a condition that will prevent tracking or flowing of sediment onto adjacent properties. 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.
 - 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 adjacent access roadways 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.
- 2) **Construction Road Stabilization** – Existing internal construction roads shall be used for the duration of construction activity for this project. Additional construction road shall be constructed as required with the following requirements:

The proposed stabilization of existing gravel and/or paved roadways will provide a means for construction vehicles to move around the site without causing significant erosion. The road stabilization will significantly speed up on-site work and generally improve site efficiency and working conditions during adverse weather. The construction roads will be stabilized at the beginning of construction and maintained throughout construction. The stabilized construction road will not be located in a cut or fill area until after grading has been performed. Some of the stone used will remain in place for use as part of the final base course of the road. The permanent roadway and cul-de-sac will be paved as soon as possible.

Construction Road Stabilization Design/Construction Requirements

- a) A 6-inch course of 2 to 4-inch crushed rock, gravel base, or crushed surfacing base course should be applied immediately after grading or the completion of utility installation. The temporary roads should follow the contour of the natural terrain to the maximum extent possible and/or the existing gravel and/or paved roadways. Slope should not exceed 15 percent. Roadways should be carefully graded to drain to the edge of the road, forcing storm water to travel the shortest route. Provide drainage swales on each side of the roadway in the case of a crowned section, or one side in the case of a super-elevated section.
- b) Drain inlets should be protected to prevent sediment-laden water entering.
- c) Areas adjacent to culvert crossings and steep slopes should be seeded and mulched.
- d) Dust control should be used when necessary. (Please refer to page 15 of 19)

Construction Road Stabilization Inspection/Maintenance

- a) Inspect stabilized areas regularly, especially after large storm events. Add 2 to 4-inch crushed rock if necessary and restabilize any areas found to be eroding.
- b) All temporary erosion and sediment control measures should be removed with 30 days after final site stabilization is achieved or after the temporary practices are no longer needed.
- c) Trapped sediment should be removed or stabilized on site. Disturbed soil areas resulting from removal should be permanently stabilized.

Structural BMP Maintenance

- 1) **Temporary Diversion** – Temporary Diversion channels will be constructed alongside the proposed roadway until it is paved. The temporary diversion channels will route storm water to temporary sediment basins to remove sediment-laden storm water, before the storm water is allowed to discharge to the permanent detention basin. Check dams need to be utilized along the diversion channels. The maximum spacing of temporary diversion channels should be no greater than the following:

Land Slope (%)	Spacing (feet)
1% or less	300 ft
2%	200 ft
3% to 5%	150 ft
5% or greater	100 ft

Temporary Diversion Design/Construction Requirements

- a) The temporary diversion channel cross-section should have a top width between two and four feet, a minimum height of 1.5 ft, and side slopes between 2:1 and 4:1.
- b) The grade may be variable depending on the topography and must have a positive grade to the outlet. The maximum channel grade should be limited to 1.0 %.
- c) The diverted runoff will outlet through check dams and then to a temporary sediment basin.
- d) Diversions that are to serve longer than 30 working days should be seeded and mulched as soon as they are constructed, in order to preserve dike height and reduce maintenance.
- e) Once the temporary diversion channels are no longer needed, they should be brought to the design grade and permanently stabilized.

Temporary Diversion Inspection/Maintenance

- a) Inspect temporary diversion channels once a week and after every rainfall.
 - b) Damage caused by construction traffic or other activity should be repaired before the end of each working day.
 - c) Immediately remove sediment from the flow area and repair the diversion ridge.
 - d) Check outlets carefully and make timely repairs as needed.
 - e) When the area protected has been permanently stabilized, remove the ridge and the channel to blend with the natural ground level, and appropriately stabilize it.
- 2) **Check Dam** – Temporary check dams should be installed along the temporary diversion channels alongside the proposed roadway until it is paved. The check dams will lower the velocities of concentrated flows, thereby reducing erosion in the channel and promoting the settlement of sediments.

Check Dam Design/Construction Requirements

- a) Check dams can be constructed of stone, sand bags filled with pea-gravel, or logs. Provide a sump immediately upstream.
- b) The maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.
- c) The stone must be placed by hand or mechanical placement (do not dump rock to form dam) to achieve complete coverage of the ditch or swale and to ensure that the center of the dam is lower than the edges. The stone used should be 2 to 4-inch size.
- d) Log check dams should be constructed of 4 to 6-inch diameter logs embedded into the soil at least 18 inches.

Check Dam Inspection/Maintenance

- a) Inspect after each rainfall event.

Erosion and Sediment Control Inspection and Maintenance Practices

The following are the inspection and maintenance practices that will be used to maintain erosion and sediment controls:

- All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater.
- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report.
- Built up sediment will be removed from hay bales when it has reached a depth of 6-inches.
- Hay bales will be inspected to ensure secured posts, continuous coverage and proper alignment.
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts and to ensure healthy growth.
- A maintenance inspection report will be made after each inspection. A copy of the report form to be completed by the inspector is attached.
- The Site Superintendent will be responsible for inspection, maintenance and repair activities and reports.
- Personnel selected to aid the Site Superintendent in the above responsibilities will be knowledgeable in all of the inspection and maintenance practices necessary for keeping the erosion and sediment controls used onsite in good working order.

Non-Storm Water Discharges			
<p>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 as follows:</p> <ol style="list-style-type: none"> 1) Water from line flushing will be recharged if in compliance with MA Surface and Ground Water Quality Regulations. 2) Uncontaminated groundwater from de-watering excavations will also be recharged. <p>The construction de-watering and all non-stormwater discharges will be directed into a storm drain inlet equipped with a siltsack (or equivalent) inlet protection or a sediment basin. The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges, (N.P.D.E.S., Section 402 and 40 C.F.R. 122.26(b)(14)(x)).</p>			
INVENTORY FOR POLLUTION PREVENTION PLAN			
<p>The materials and substances listed below are expected to be present on site during construction:</p> <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Concrete • Detergents • Paints (enamel and latex) • Concrete • Tar </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> • Fertilizers • Petroleum Based Products • Cleaning Solvents • Wood • Masonry Block • Roofing Shingles </td> </tr> </table>		<ul style="list-style-type: none"> • Concrete • Detergents • Paints (enamel and latex) • Concrete • Tar 	<ul style="list-style-type: none"> • Fertilizers • Petroleum Based Products • Cleaning Solvents • Wood • Masonry Block • Roofing Shingles
<ul style="list-style-type: none"> • Concrete • Detergents • Paints (enamel and latex) • Concrete • Tar 	<ul style="list-style-type: none"> • Fertilizers • Petroleum Based Products • Cleaning Solvents • Wood • Masonry Block • Roofing Shingles 		
SPILL PREVENTION			
Material Management Practices			
<p>The following are the material management practices that will be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.</p>			
Paints			
<p>All containers will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to the manufacturer's instructions or State and local regulations.</p>			
Concrete Trucks			
<p>Concrete Trucks will be allowed to wash out on-site to a designated area as directed by the Site Superintendent. Concrete waste will be disposed of in accordance with Federal, State and Local regulations.</p>			
Spill Control Practices			
<p>In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and clean-up:</p> <ul style="list-style-type: none"> • Manufacturers' recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies. • Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include but not be limited to brooms, dustpans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose. • All spills will be cleaned up immediately upon discovery. • The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance. • Spills of toxic or hazardous substances will be reported to the appropriate State or local government agency, regardless of the size. • The spill prevention plan will be adjusted to include measure to prevent this type of spill from reoccurring and how to clean up the spill if there should be another. A description of the spill, what caused it, and the cleanup measure will also be included. • The Site Superintendent responsible for the day-to-day site operation will be the spill prevention and cleanup coordinator. 			

Deicing and Snow Removal
Relative to the agricultural area that surrounds the project, environmentally appropriate deicing tools will be used. Standard snow removal plowing techniques shall be used.

8.0 – REQUESTED WAIVERS

The Comprehensive Permit program allows a Project to combine local permitting efforts under the auspices of the Zoning Board of Appeals with process input sought from all Town departments. The streamlined process allows an applicant to waiver other local permit processes and zoning criteria if design conditions are satisfactorily addressed within the permit application. A full summary of anticipated waivers can be found in Appendix E.

9.0 – CONCLUSION

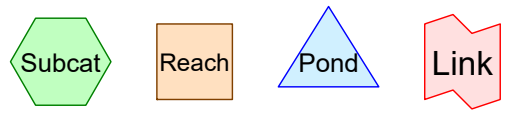
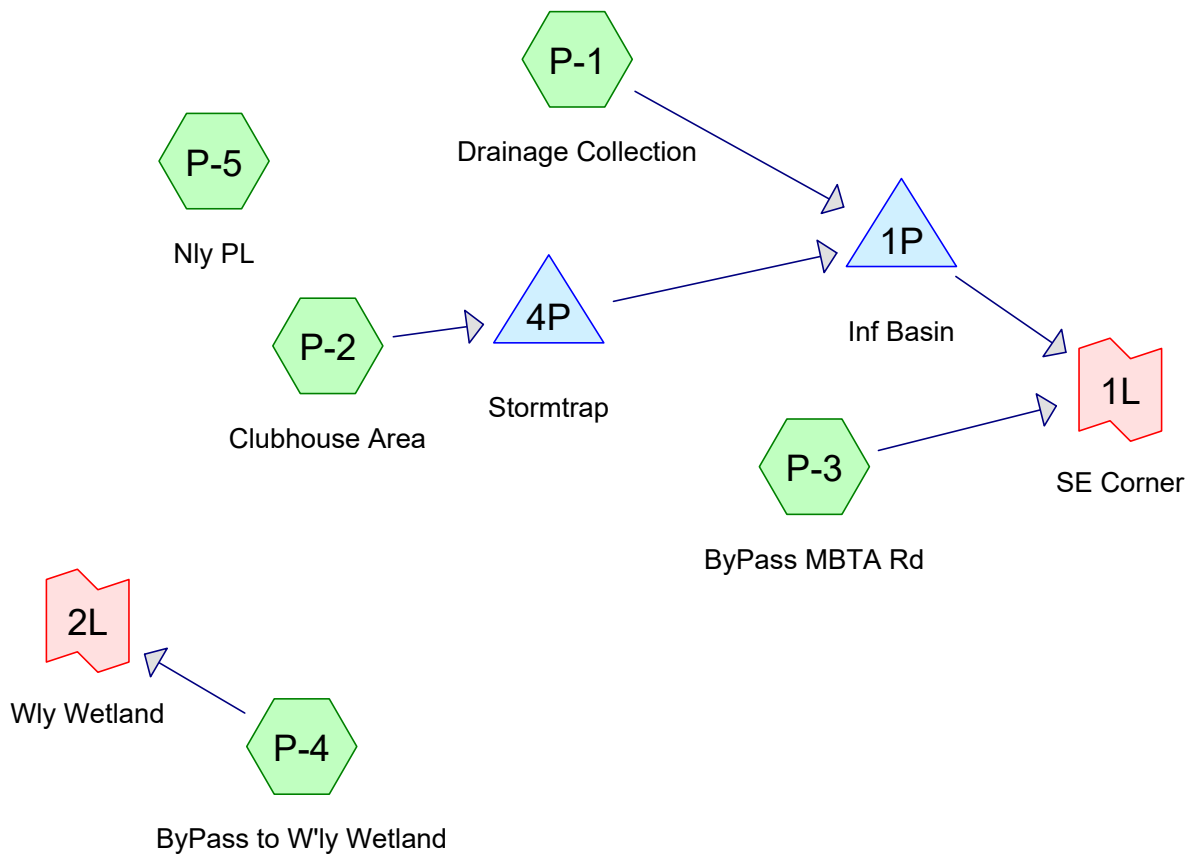
As demonstrated throughout this report by means of narrative, calculations and exhibits that appropriate best management practices and strategic site planning have been used to mitigate the impacts from the proposed development on adjacent properties and on the Town of Ashland’s resources. The proposed project has been designed to minimize and prevent indirect disturbance to neighboring parcels. Strategic site design measures and accepted erosion control practices has been employed to mitigate adverse impacts to the surrounding area both during construction and after. The plan is based on a multi-dimensional approach to site layout and stormwater management , which recognizes the need for proper site planning. It relies on the applicant’s well-established track record of thoughtful residential design as illustrated throughout Massachusetts and beyond. Source control of potential contaminants and implementation of stormwater runoff treatment methods serve to ensure the protection of the groundwater. The proposed stormwater system includes a number of Best Management Practices to provide improved water quality and stormwater mitigation.

Appendix B

HYDRO-CAD POST-DEVELOPMENT DRAINAGE ANALYSIS

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B



Routing Diagram for 2604-01 - Proposed Conditions Revisions
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Rainfall Events Listing (selected events)

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	3.20	2
2	10 Yr	Type III 24-hr		Default	24.00	1	4.55	2
3	25 Yr	Type III 24-hr		Default	24.00	1	5.50	2
4	100 Yr	Type III 24-hr		Default	24.00	1	6.70	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.630	39	>75% Grass cover, Good, HSG A (P-1, P-3, P-5)
8.148	74	>75% Grass cover, Good, HSG C (P-1, P-2, P-3, P-4, P-5)
0.339	98	Paved parking, HSG A (P-1)
3.792	98	Paved parking, HSG C (P-1, P-2, P-4, P-5)
0.311	98	Paved roads w/curbs & sewers, HSG A (P-3)
2.082	98	Roofs, HSG C (P-1, P-2)
0.023	98	Unconnected pavement, HSG C (P-4)
0.210	98	Unconnected roofs, HSG C (P-4)
3.490	30	Woods, Good, HSG A (P-1, P-3, P-5)
9.580	70	Woods, Good, HSG C (P-1, P-3, P-4, P-5)
0.430	77	Woods, Good, HSG D (P-4)
31.035	70	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.770	HSG A	P-1, P-3, P-5
0.000	HSG B	
23.835	HSG C	P-1, P-2, P-3, P-4, P-5
0.430	HSG D	P-4
0.000	Other	
31.035		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
2.630	0.000	8.148	0.000	0.000	10.778	>75% Grass cover, Good	P-1, P-2, P-3, P-4, P-5
0.339	0.000	3.792	0.000	0.000	4.131	Paved parking	P-1, P-2, P-4, P-5
0.311	0.000	0.000	0.000	0.000	0.311	Paved roads w/curbs & sewers	P-3
0.000	0.000	2.082	0.000	0.000	2.082	Roofs	P-1, P-2
0.000	0.000	0.023	0.000	0.000	0.023	Unconnected pavement	P-4
0.000	0.000	0.210	0.000	0.000	0.210	Unconnected roofs	P-4
3.490	0.000	9.580	0.430	0.000	13.500	Woods, Good	P-1, P-3, P-4, P-5
6.770	0.000	23.835	0.430	0.000	31.035	TOTAL AREA	

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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	280.91	277.45	119.0	0.0291	0.012	0.0	24.0	0.0
2	4P	350.00	348.52	74.0	0.0200	0.012	0.0	24.0	0.0

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Type III 24-hr 2 Yr Rainfall=3.20"

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 P-1: Drainage Collection Runoff Area=8.041 ac 30.37% Impervious Runoff Depth>1.09"
Flow Length=345' Tc=14.0 min CN=75 Runoff=7.58 cfs 0.731 af

Subcatchment P-2: Clubhouse Area Runoff Area=5.263 ac 70.70% Impervious Runoff Depth>2.25"
Flow Length=305' Tc=12.5 min CN=91 Runoff=11.06 cfs 0.989 af

Subcatchment P-3: ByPass MBTA Rd Runoff Area=8.056 ac 3.86% Impervious Runoff Depth>0.17"
Flow Length=1,801' Tc=19.5 min CN=52 Runoff=0.33 cfs 0.115 af

Subcatchment P-4: ByPass to W'ly Wetland Runoff Area=7.265 ac 3.48% Impervious Runoff Depth>0.93"
Flow Length=258' Tc=13.6 min CN=72 Runoff=5.67 cfs 0.561 af

Subcatchment P-5: Nly PL Runoff Area=2.410 ac 1.24% Impervious Runoff Depth>0.60"
Flow Length=77' Tc=8.0 min CN=65 Runoff=1.21 cfs 0.120 af

Pond 1P: Inf Basin Peak Elev=284.12' Storage=7,263 cf Inflow=7.58 cfs 1.036 af
Discarded=2.41 cfs 1.034 af Primary=0.00 cfs 0.000 af Outflow=2.41 cfs 1.034 af

Pond 4P: Stormtrap Peak Elev=356.18' Storage=0.643 af Inflow=11.06 cfs 0.989 af
Discarded=0.07 cfs 0.090 af Primary=0.71 cfs 0.306 af Outflow=0.78 cfs 0.396 af

Link 1L: SE Corner Inflow=0.33 cfs 0.115 af
Primary=0.33 cfs 0.115 af

Link 2L: Wly Wetland Inflow=5.67 cfs 0.561 af
Primary=5.67 cfs 0.561 af

Total Runoff Area = 31.035 ac Runoff Volume = 2.515 af Average Runoff Depth = 0.97"
78.23% Pervious = 24.278 ac 21.77% Impervious = 6.757 ac

2604-01 - Proposed Conditions Revisions

Type III 24-hr 2 Yr Rainfall=3.20"

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Summary for Subcatchment P-1: Drainage Collection

Runoff = 7.58 cfs @ 12.21 hrs, Volume= 0.731 af, Depth> 1.09"

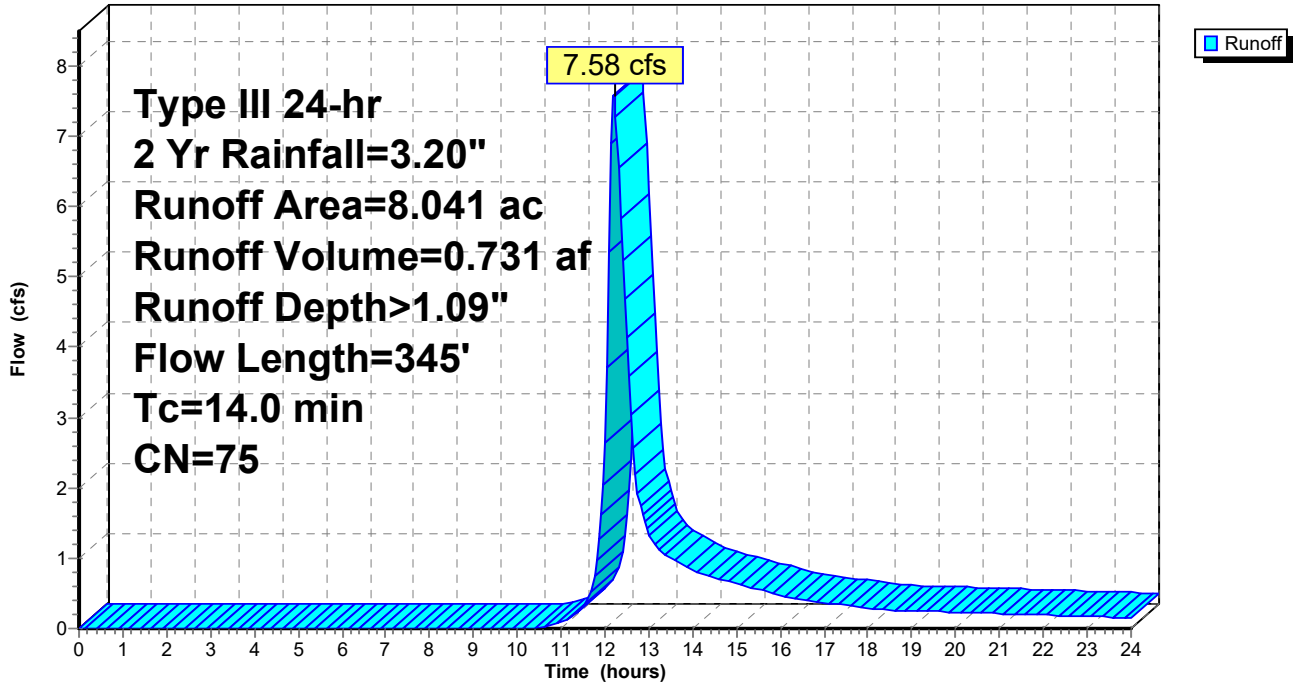
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Yr Rainfall=3.20"

Area (ac)	CN	Description
0.080	30	Woods, Good, HSG A
1.391	39	>75% Grass cover, Good, HSG A
0.339	98	Paved parking, HSG A
0.294	70	Woods, Good, HSG C
3.834	74	>75% Grass cover, Good, HSG C
1.412	98	Paved parking, HSG C
0.691	98	Roofs, HSG C
8.041	75	Weighted Average
5.599		69.63% Pervious Area
2.442		30.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	145	0.0470	3.49		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.1	62	0.3300	9.25		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
0.9	88	0.0100	1.61		Shallow Concentrated Flow, D-E Unpaved Kv= 16.1 fps
14.0	345	Total			

Subcatchment P-1: Drainage Collection

Hydrograph



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Type III 24-hr 2 Yr Rainfall=3.20"

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Summary for Subcatchment P-2: Clubhouse Area

Runoff = 11.06 cfs @ 12.17 hrs, Volume= 0.989 af, Depth> 2.25"

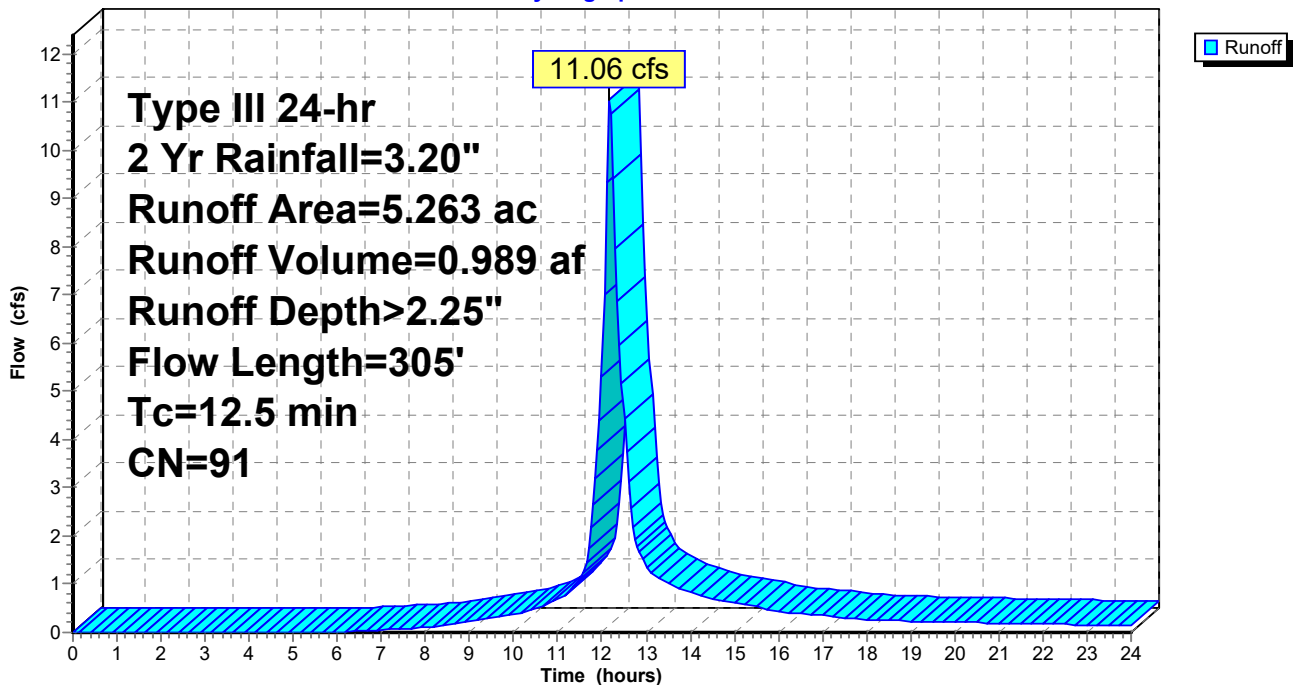
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Yr Rainfall=3.20"

Area (ac)	CN	Description
1.542	74	>75% Grass cover, Good, HSG C
2.330	98	Paved parking, HSG C
1.391	98	Roofs, HSG C
5.263	91	Weighted Average
1.542		29.30% Pervious Area
3.721		70.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20"
0.7	89	0.0200	2.28		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.0	166	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.5	305	Total			

Subcatchment P-2: Clubhouse Area

Hydrograph



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Type III 24-hr 2 Yr Rainfall=3.20"

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Summary for Subcatchment P-3: ByPass MBTA Rd

Runoff = 0.33 cfs @ 12.62 hrs, Volume= 0.115 af, Depth> 0.17"

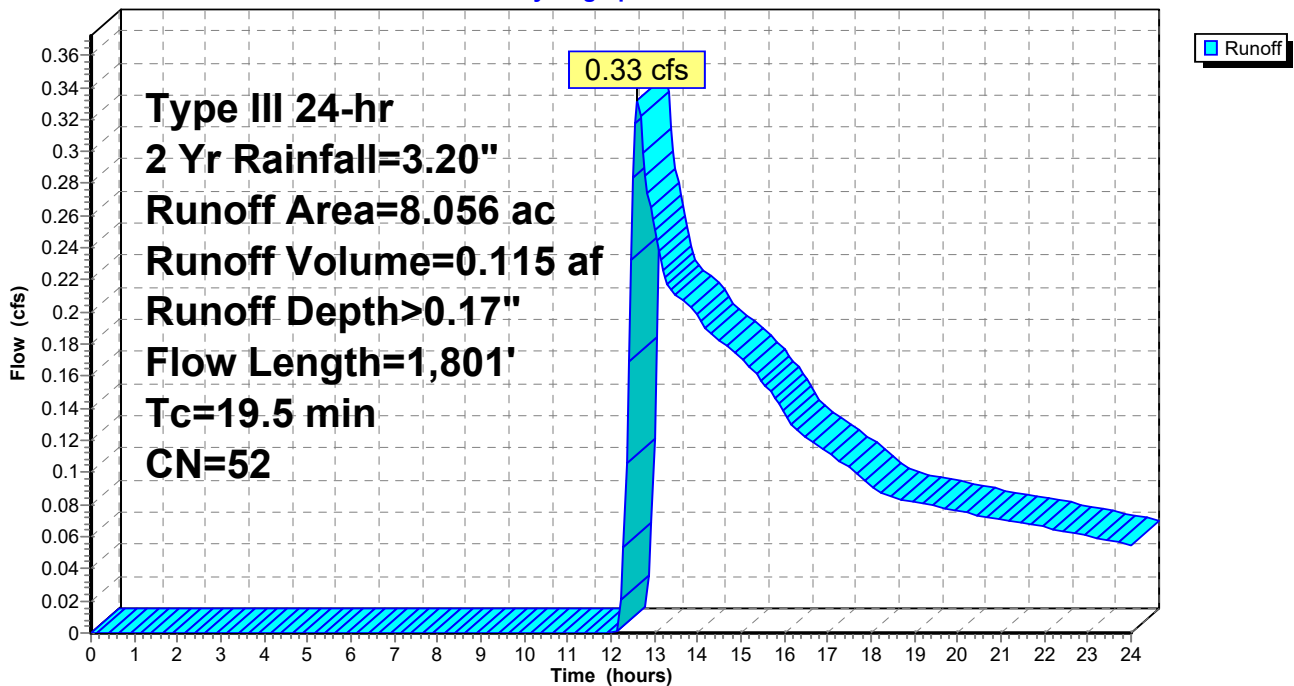
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Yr Rainfall=3.20"

Area (ac)	CN	Description
3.340	30	Woods, Good, HSG A
0.600	39	>75% Grass cover, Good, HSG A
3.306	70	Woods, Good, HSG C
0.380	74	>75% Grass cover, Good, HSG C
0.311	98	Paved roads w/curbs & sewers, HSG A
0.119	39	>75% Grass cover, Good, HSG A
8.056	52	Weighted Average
7.745		96.14% Pervious Area
0.311		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	50	0.0180	0.06		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
6.6	1,751	0.0760	4.44		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
19.5	1,801	Total			

Subcatchment P-3: ByPass MBTA Rd

Hydrograph



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Type III 24-hr 2 Yr Rainfall=3.20"

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Summary for Subcatchment P-4: ByPass to W'ly Wetland

Runoff = 5.67 cfs @ 12.21 hrs, Volume= 0.561 af, Depth> 0.93"

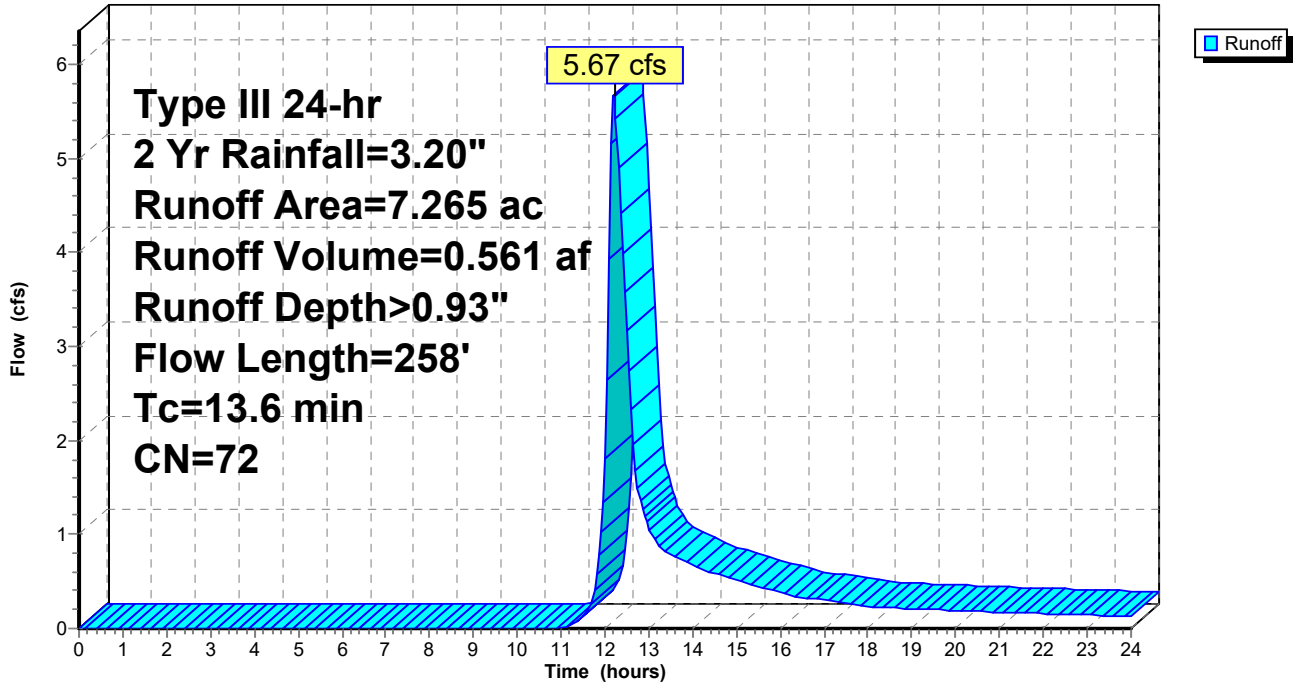
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Yr Rainfall=3.20"

Area (ac)	CN	Description
5.540	70	Woods, Good, HSG C
0.830	74	>75% Grass cover, Good, HSG C
0.020	98	Paved parking, HSG C
0.430	77	Woods, Good, HSG D
0.212	74	>75% Grass cover, Good, HSG C
0.210	98	Unconnected roofs, HSG C
0.023	98	Unconnected pavement, HSG C
7.265	72	Weighted Average
7.012		96.52% Pervious Area
0.253		3.48% Impervious Area
0.233		92.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	208	0.0270	2.65		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
13.6	258	Total			

Subcatchment P-4: ByPass to W'ly Wetland

Hydrograph



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Type III 24-hr 2 Yr Rainfall=3.20"

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Summary for Subcatchment P-5: Nly PL

Runoff = 1.21 cfs @ 12.15 hrs, Volume= 0.120 af, Depth> 0.60"

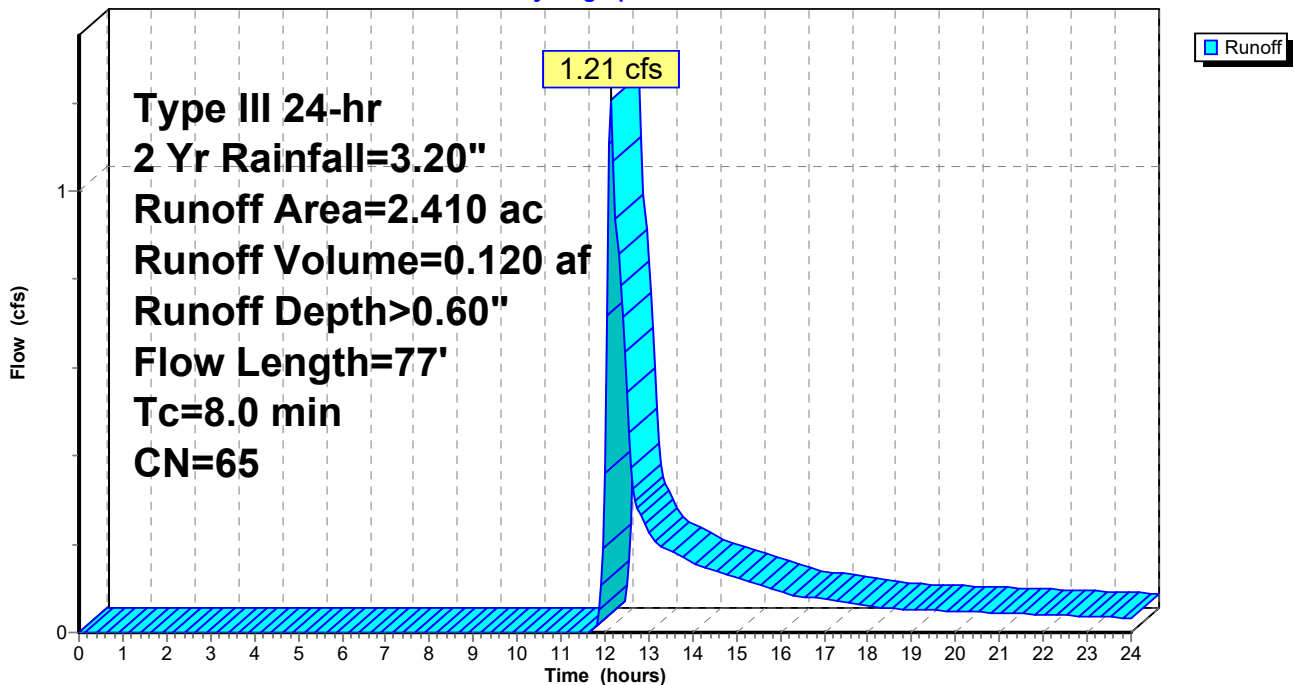
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Yr Rainfall=3.20"

Area (ac)	CN	Description
0.070	30	Woods, Good, HSG A
0.520	39	>75% Grass cover, Good, HSG A
0.440	70	Woods, Good, HSG C
1.350	74	>75% Grass cover, Good, HSG C
0.030	98	Paved parking, HSG C
2.410	65	Weighted Average
2.380		98.76% Pervious Area
0.030		1.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	27	0.0700	4.26		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
8.0	77	Total			

Subcatchment P-5: Nly PL

Hydrograph



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Summary for Pond 1P: Inf Basin

Inflow Area = 13.304 ac, 46.32% Impervious, Inflow Depth > 0.93" for 2 Yr event
 Inflow = 7.58 cfs @ 12.21 hrs, Volume= 1.036 af
 Outflow = 2.41 cfs @ 12.67 hrs, Volume= 1.034 af, Atten= 68%, Lag= 27.8 min
 Discarded = 2.41 cfs @ 12.67 hrs, Volume= 1.034 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 284.12' @ 12.67 hrs Surf.Area= 12,569 sf Storage= 7,263 cf

Plug-Flow detention time= 20.3 min calculated for 1.032 af (100% of inflow)
 Center-of-Mass det. time= 19.2 min (922.4 - 903.2)

Volume	Invert	Avail.Storage	Storage Description
#1	283.50'	112,982 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.50	10,661	0	0
284.00	12,357	5,755	5,755
285.00	14,108	13,233	18,987
286.00	15,917	15,013	34,000
287.00	17,782	16,850	50,849
288.00	19,703	18,743	69,592
289.00	21,681	20,692	90,284
290.00	23,716	22,699	112,982

Device	Routing	Invert	Outlet Devices
#1	Discarded	283.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	280.91'	24.0" Round Culvert L= 119.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 280.91' / 277.45' S= 0.0291 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	286.90'	2.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	287.25'	6.0" Vert. Orifice/Grate X 3.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	288.50'	16.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=2.41 cfs @ 12.67 hrs HW=284.12' (Free Discharge)

↑1=Exfiltration (Exfiltration Controls 2.41 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=283.50' (Free Discharge)

↑2=Culvert (Passes 0.00 cfs of 19.07 cfs potential flow)

↑3=Orifice/Grate (Controls 0.00 cfs)

↑4=Orifice/Grate (Controls 0.00 cfs)

↑5=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

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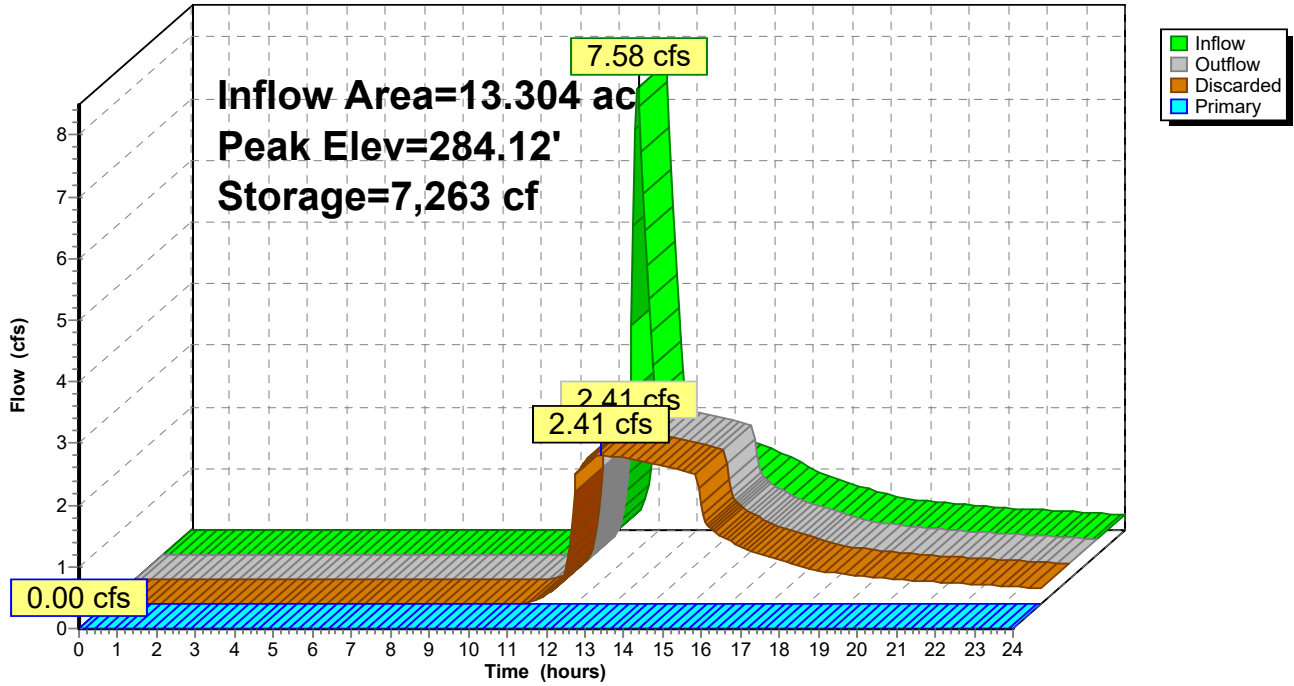
Type III 24-hr 2 Yr Rainfall=3.20"

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Pond 1P: Inf Basin

Hydrograph



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Summary for Pond 4P: Stormtrap

Inflow Area = 5.263 ac, 70.70% Impervious, Inflow Depth > 2.25" for 2 Yr event
 Inflow = 11.06 cfs @ 12.17 hrs, Volume= 0.989 af
 Outflow = 0.78 cfs @ 14.15 hrs, Volume= 0.396 af, Atten= 93%, Lag= 119.0 min
 Discarded = 0.07 cfs @ 8.15 hrs, Volume= 0.090 af
 Primary = 0.71 cfs @ 14.15 hrs, Volume= 0.306 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 356.18' @ 14.15 hrs Surf.Area= 0.239 ac Storage= 0.643 af

Plug-Flow detention time= 297.6 min calculated for 0.396 af (40% of inflow)
 Center-of-Mass det. time= 175.4 min (982.7 - 807.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	352.50'	0.125 af	32.27'W x 323.23'L x 5.50'H Field A 1.317 af Overall - 1.005 af Embedded = 0.312 af x 40.0% Voids
#2A	353.50'	0.789 af	StormTrap ST2 SingleTrap 4-0 x 40 Inside #1 Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf 40 Chambers in 2 Rows 16.96' x 307.92' Core + 6.66' Border = 30.27' x 321.23' System
		0.914 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	352.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	350.00'	24.0" Round Culvert L= 74.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 350.00' / 348.52' S= 0.0200 1/ S= 0.0200 1/ Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	355.20'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	355.85'	4.0" Vert. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	356.50'	7.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.07 cfs @ 8.15 hrs HW=352.56' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=0.71 cfs @ 14.15 hrs HW=356.18' (Free Discharge)

↑ **2=Culvert** (Passes 0.71 cfs of 34.44 cfs potential flow)
 ↑ **3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 4.68 fps)
 ↑ **4=Orifice/Grate** (Orifice Controls 0.69 cfs @ 1.97 fps)
 ↑ **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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Type III 24-hr 2 Yr Rainfall=3.20"

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Pond 4P: Stormtrap - Chamber Wizard Field A

Chamber Model = StormTrap ST2 SingleTrap 4-0 (StormTrap ST2 SingleTrap® Type II+IV)

Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf

Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf

20 Chambers/Row x 15.40' Long = 307.92' Row Length +79.9" Border x 2 +12.0" End Stone x 2 = 323.23' Base Length

2 Rows x 101.7" Wide + 79.9" Side Border x 2 + 12.0" Side Stone x 2 = 32.27' Base Width

12.0" Stone Base + 54.0" Chamber Height = 5.50' Field Height

40 Chambers x 470.3 cf + 15,569.7 cf Border = 34,380.5 cf Chamber Storage

40 Chambers x 587.4 cf + 20,259.5 cf Border = 43,757.4 cf Displacement

57,369.8 cf Field - 43,757.4 cf Chambers = 13,612.4 cf Stone x 40.0% Voids = 5,444.9 cf Stone Storage

Chamber Storage + Stone Storage = 39,825.5 cf = 0.914 af

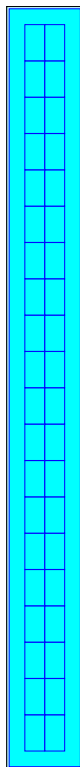
Overall Storage Efficiency = 69.4%

Overall System Size = 323.23' x 32.27' x 5.50'

40 Chambers (plus border)

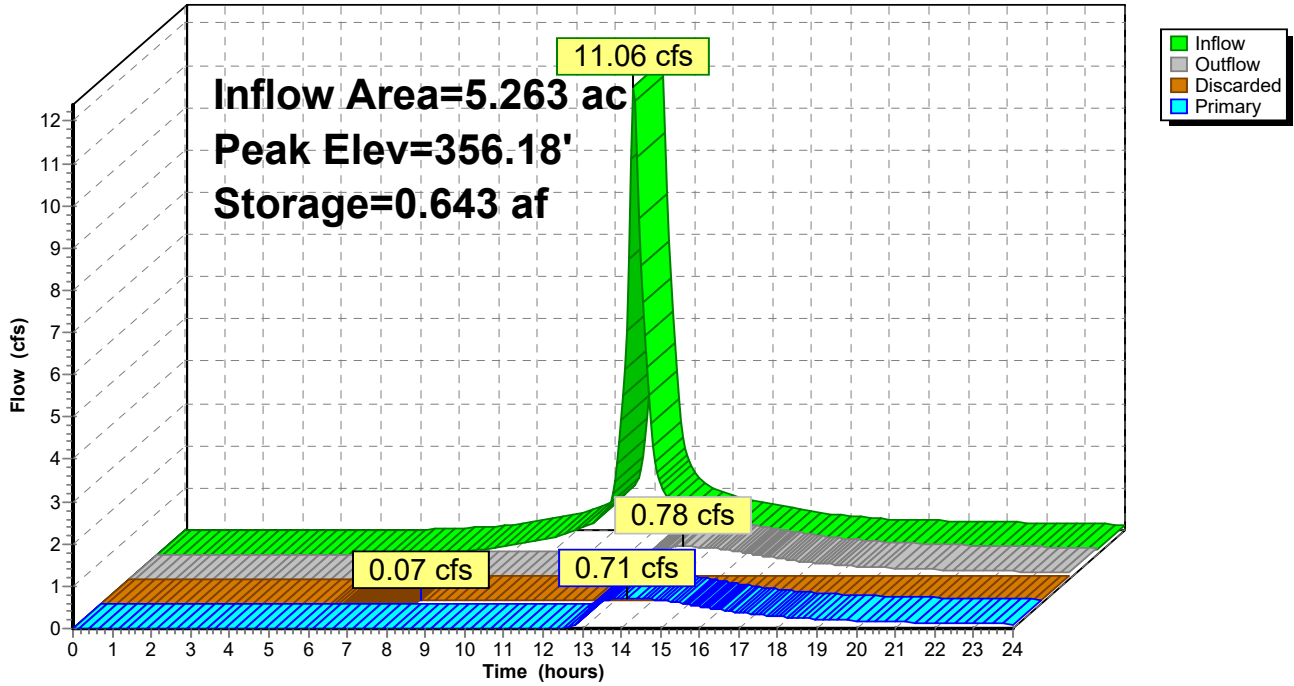
2,124.8 cy Field

504.2 cy Stone



Pond 4P: Stormtrap

Hydrograph



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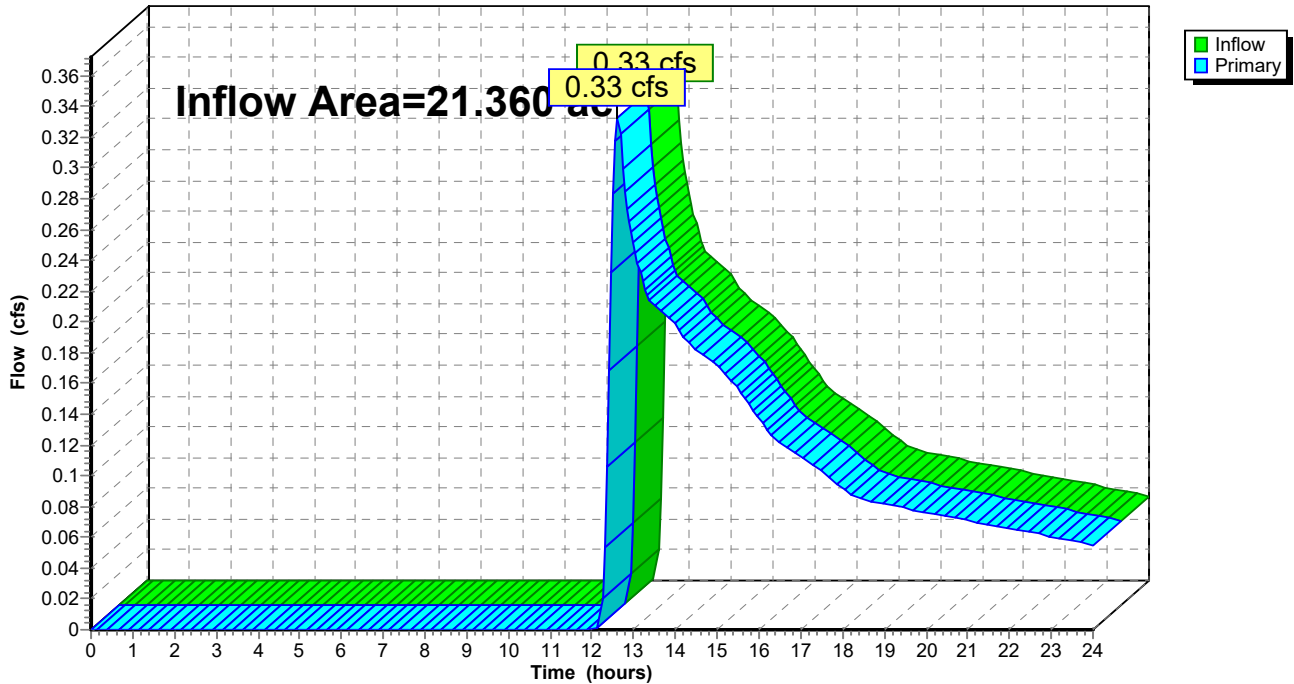
Summary for Link 1L: SE Corner

Inflow Area = 21.360 ac, 30.31% Impervious, Inflow Depth > 0.06" for 2 Yr event
Inflow = 0.33 cfs @ 12.62 hrs, Volume= 0.115 af
Primary = 0.33 cfs @ 12.62 hrs, Volume= 0.115 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: SE Corner

Hydrograph



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Type III 24-hr 2 Yr Rainfall=3.20"

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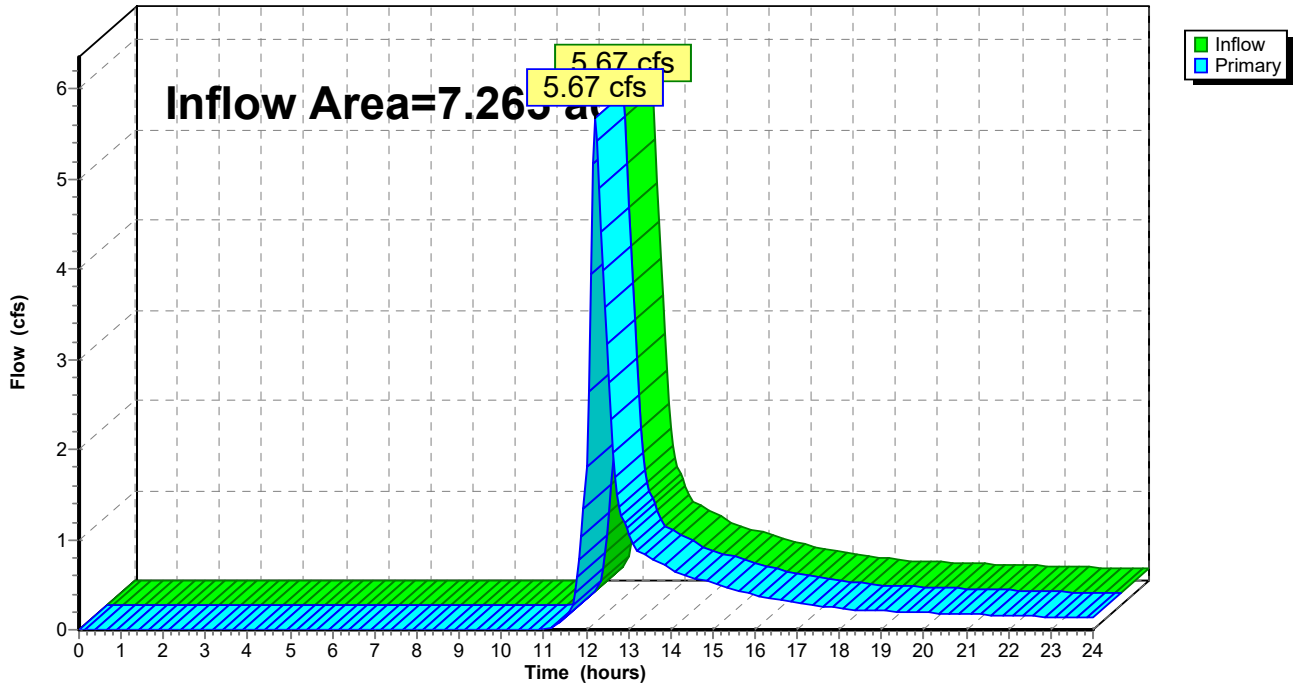
Summary for Link 2L: Wly Wetland

Inflow Area = 7.265 ac, 3.48% Impervious, Inflow Depth > 0.93" for 2 Yr event
Inflow = 5.67 cfs @ 12.21 hrs, Volume= 0.561 af
Primary = 5.67 cfs @ 12.21 hrs, Volume= 0.561 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Wly Wetland

Hydrograph



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Type III 24-hr 10 Yr Rainfall=4.55"

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 P-1: Drainage Collection Runoff Area=8.041 ac 30.37% Impervious Runoff Depth>2.08"
Flow Length=345' Tc=14.0 min CN=75 Runoff=15.07 cfs 1.396 af

Subcatchment P-2: Clubhouse Area Runoff Area=5.263 ac 70.70% Impervious Runoff Depth>3.54"
Flow Length=305' Tc=12.5 min CN=91 Runoff=17.04 cfs 1.553 af

Subcatchment P-3: ByPass MBTA Rd Runoff Area=8.056 ac 3.86% Impervious Runoff Depth>0.61"
Flow Length=1,801' Tc=19.5 min CN=52 Runoff=2.52 cfs 0.408 af

Subcatchment P-4: ByPass to W'ly Wetland Runoff Area=7.265 ac 3.48% Impervious Runoff Depth>1.85"
Flow Length=258' Tc=13.6 min CN=72 Runoff=12.07 cfs 1.121 af

Subcatchment P-5: Nly PL Runoff Area=2.410 ac 1.24% Impervious Runoff Depth>1.36"
Flow Length=77' Tc=8.0 min CN=65 Runoff=3.25 cfs 0.273 af

Pond 1P: Inf Basin Peak Elev=285.97' Storage=33,469 cf Inflow=15.34 cfs 2.250 af
Discarded=3.04 cfs 2.247 af Primary=0.00 cfs 0.000 af Outflow=3.04 cfs 2.247 af

Pond 4P: Stormtrap Peak Elev=356.88' Storage=0.784 af Inflow=17.04 cfs 1.553 af
Discarded=0.07 cfs 0.099 af Primary=6.63 cfs 0.854 af Outflow=6.70 cfs 0.953 af

Link 1L: SE Corner Inflow=2.52 cfs 0.408 af
Primary=2.52 cfs 0.408 af

Link 2L: Wly Wetland Inflow=12.07 cfs 1.121 af
Primary=12.07 cfs 1.121 af

Total Runoff Area = 31.035 ac Runoff Volume = 4.751 af Average Runoff Depth = 1.84"
78.23% Pervious = 24.278 ac 21.77% Impervious = 6.757 ac

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Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Subcatchment P-1: Drainage Collection

Runoff = 15.07 cfs @ 12.20 hrs, Volume= 1.396 af, Depth> 2.08"

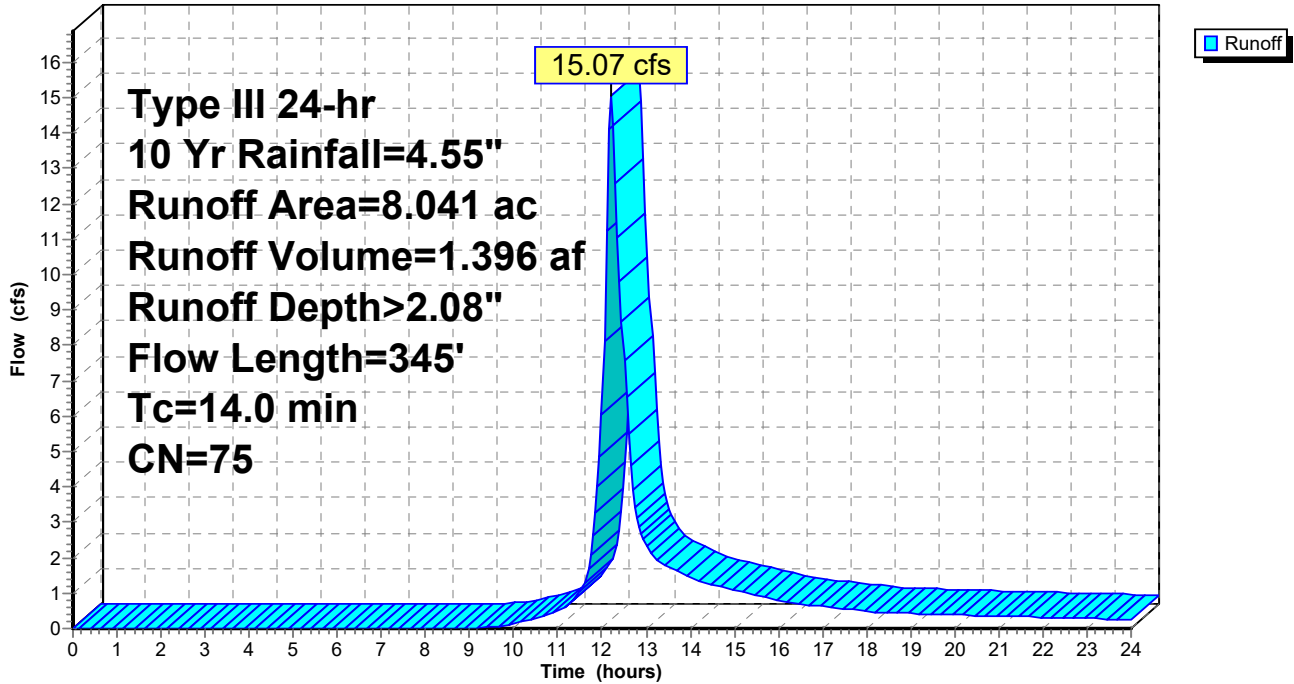
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Yr Rainfall=4.55"

Area (ac)	CN	Description
0.080	30	Woods, Good, HSG A
1.391	39	>75% Grass cover, Good, HSG A
0.339	98	Paved parking, HSG A
0.294	70	Woods, Good, HSG C
3.834	74	>75% Grass cover, Good, HSG C
1.412	98	Paved parking, HSG C
0.691	98	Roofs, HSG C
8.041	75	Weighted Average
5.599		69.63% Pervious Area
2.442		30.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	145	0.0470	3.49		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.1	62	0.3300	9.25		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
0.9	88	0.0100	1.61		Shallow Concentrated Flow, D-E Unpaved Kv= 16.1 fps
14.0	345	Total			

Subcatchment P-1: Drainage Collection

Hydrograph



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Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Subcatchment P-2: Clubhouse Area

Runoff = 17.04 cfs @ 12.17 hrs, Volume= 1.553 af, Depth> 3.54"

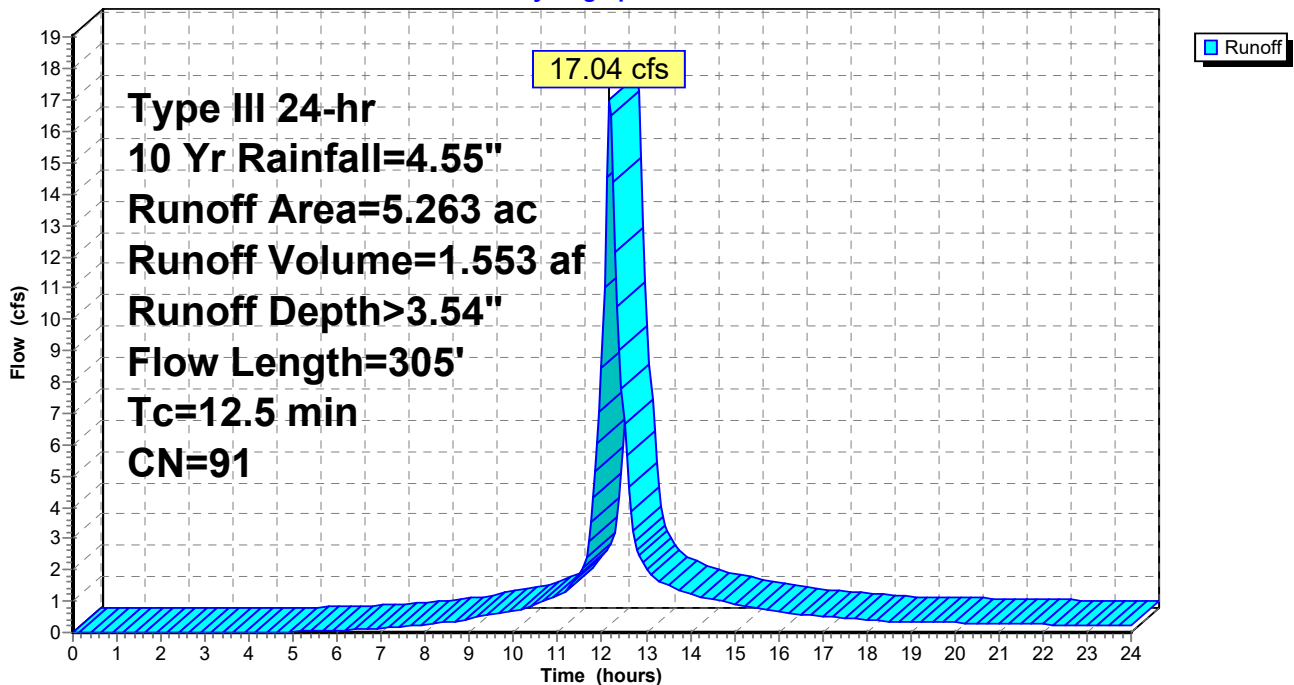
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Yr Rainfall=4.55"

Area (ac)	CN	Description
1.542	74	>75% Grass cover, Good, HSG C
2.330	98	Paved parking, HSG C
1.391	98	Roofs, HSG C
5.263	91	Weighted Average
1.542		29.30% Pervious Area
3.721		70.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20"
0.7	89	0.0200	2.28		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.0	166	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.5	305	Total			

Subcatchment P-2: Clubhouse Area

Hydrograph



2604-01 - Proposed Conditions Revisions

Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Subcatchment P-3: ByPass MBTA Rd

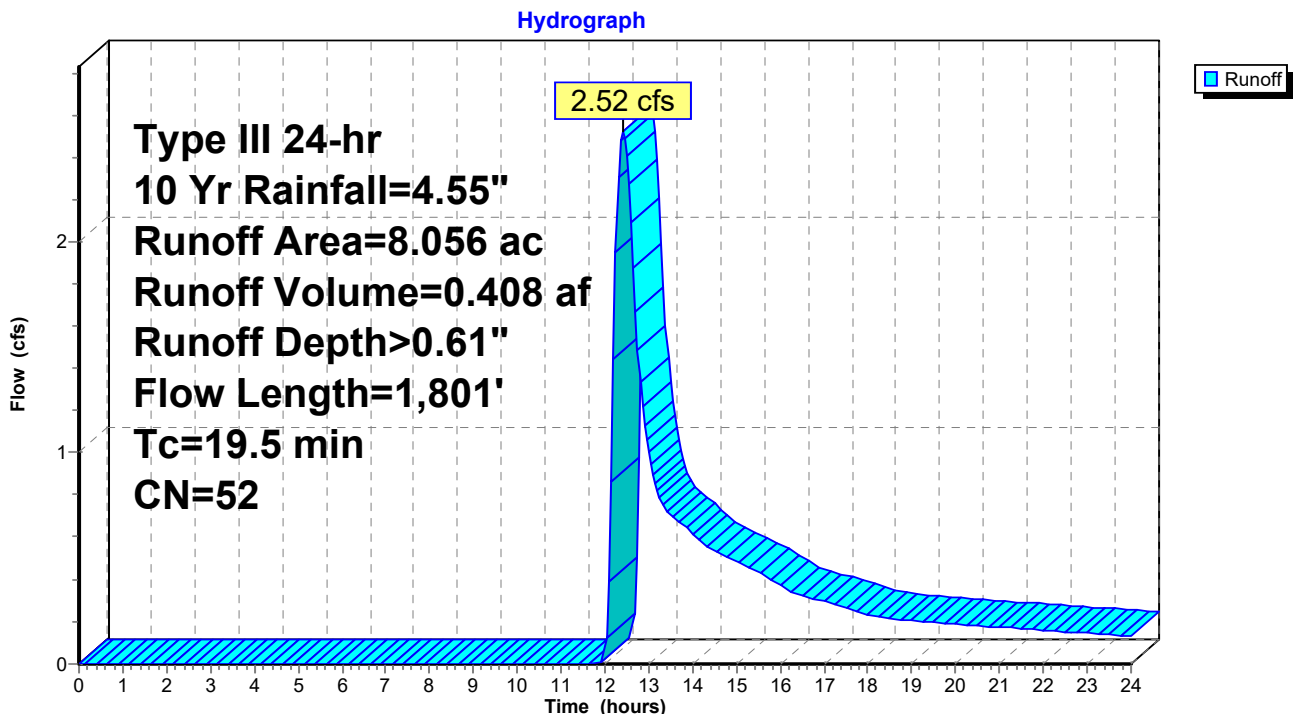
Runoff = 2.52 cfs @ 12.40 hrs, Volume= 0.408 af, Depth> 0.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Yr Rainfall=4.55"

Area (ac)	CN	Description
3.340	30	Woods, Good, HSG A
0.600	39	>75% Grass cover, Good, HSG A
3.306	70	Woods, Good, HSG C
0.380	74	>75% Grass cover, Good, HSG C
0.311	98	Paved roads w/curbs & sewers, HSG A
0.119	39	>75% Grass cover, Good, HSG A
8.056	52	Weighted Average
7.745		96.14% Pervious Area
0.311		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	50	0.0180	0.06		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
6.6	1,751	0.0760	4.44		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
19.5	1,801	Total			

Subcatchment P-3: ByPass MBTA Rd



2604-01 - Proposed Conditions Revisions

Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Subcatchment P-4: ByPass to W'ly Wetland

Runoff = 12.07 cfs @ 12.20 hrs, Volume= 1.121 af, Depth> 1.85"

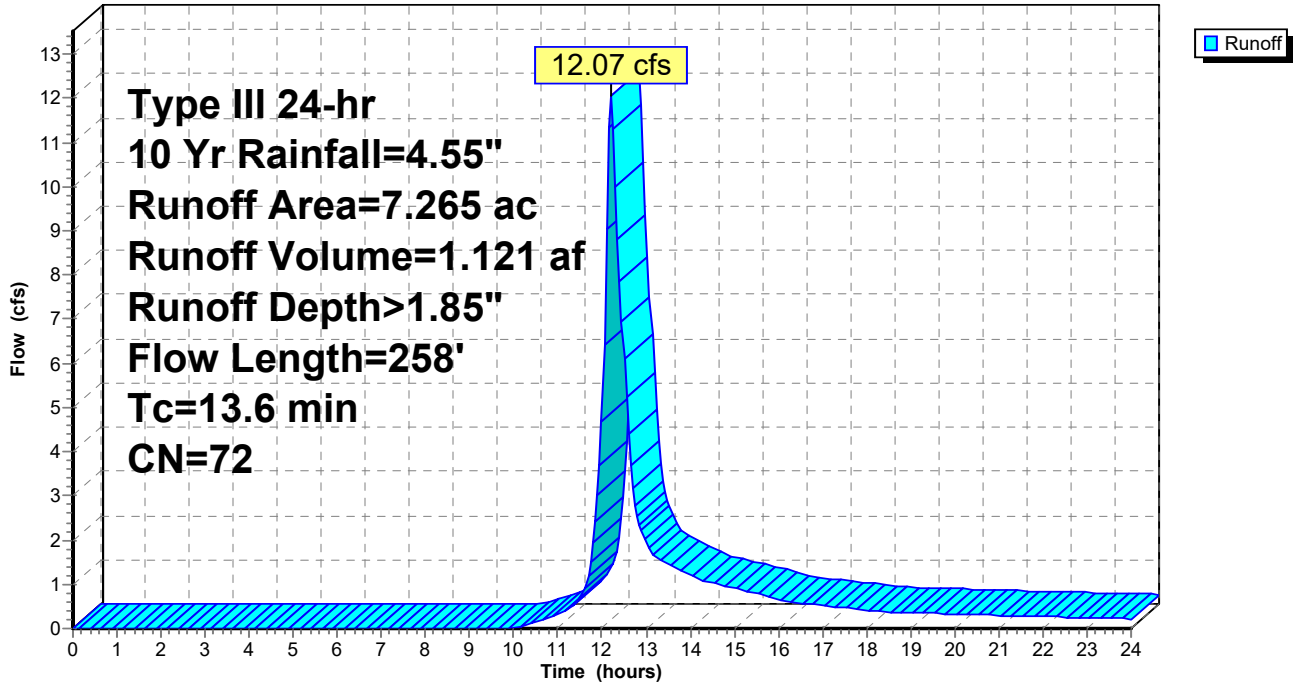
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Yr Rainfall=4.55"

Area (ac)	CN	Description
5.540	70	Woods, Good, HSG C
0.830	74	>75% Grass cover, Good, HSG C
0.020	98	Paved parking, HSG C
0.430	77	Woods, Good, HSG D
0.212	74	>75% Grass cover, Good, HSG C
0.210	98	Unconnected roofs, HSG C
0.023	98	Unconnected pavement, HSG C
7.265	72	Weighted Average
7.012		96.52% Pervious Area
0.253		3.48% Impervious Area
0.233		92.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	208	0.0270	2.65		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
13.6	258	Total			

Subcatchment P-4: ByPass to W'ly Wetland

Hydrograph



2604-01 - Proposed Conditions Revisions

Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Subcatchment P-5: Nly PL

Runoff = 3.25 cfs @ 12.13 hrs, Volume= 0.273 af, Depth> 1.36"

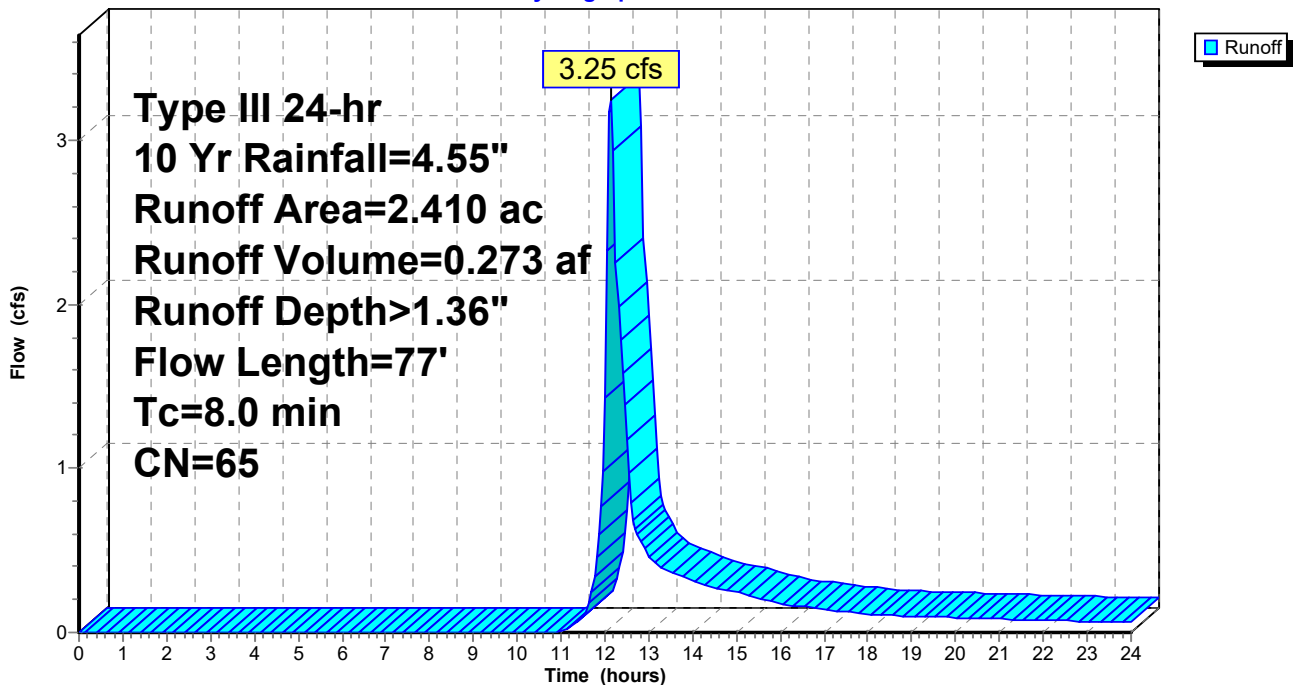
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Yr Rainfall=4.55"

Area (ac)	CN	Description
0.070	30	Woods, Good, HSG A
0.520	39	>75% Grass cover, Good, HSG A
0.440	70	Woods, Good, HSG C
1.350	74	>75% Grass cover, Good, HSG C
0.030	98	Paved parking, HSG C
2.410	65	Weighted Average
2.380		98.76% Pervious Area
0.030		1.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	27	0.0700	4.26		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
8.0	77	Total			

Subcatchment P-5: Nly PL

Hydrograph



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Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Pond 1P: Inf Basin

Inflow Area = 13.304 ac, 46.32% Impervious, Inflow Depth > 2.03" for 10 Yr event
 Inflow = 15.34 cfs @ 12.22 hrs, Volume= 2.250 af
 Outflow = 3.04 cfs @ 13.80 hrs, Volume= 2.247 af, Atten= 80%, Lag= 94.7 min
 Discarded = 3.04 cfs @ 13.80 hrs, Volume= 2.247 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 285.97' @ 13.80 hrs Surf.Area= 15,857 sf Storage= 33,469 cf

Plug-Flow detention time= 113.8 min calculated for 2.247 af (100% of inflow)
 Center-of-Mass det. time= 113.0 min (981.2 - 868.2)

Volume	Invert	Avail.Storage	Storage Description
#1	283.50'	112,982 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.50	10,661	0	0
284.00	12,357	5,755	5,755
285.00	14,108	13,233	18,987
286.00	15,917	15,013	34,000
287.00	17,782	16,850	50,849
288.00	19,703	18,743	69,592
289.00	21,681	20,692	90,284
290.00	23,716	22,699	112,982

Device	Routing	Invert	Outlet Devices
#1	Discarded	283.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	280.91'	24.0" Round Culvert L= 119.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 280.91' / 277.45' S= 0.0291 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	286.90'	2.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	287.25'	6.0" Vert. Orifice/Grate X 3.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	288.50'	16.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=3.04 cfs @ 13.80 hrs HW=285.97' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 3.04 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=283.50' (Free Discharge)

↳ **2=Culvert** (Passes 0.00 cfs of 19.07 cfs potential flow)

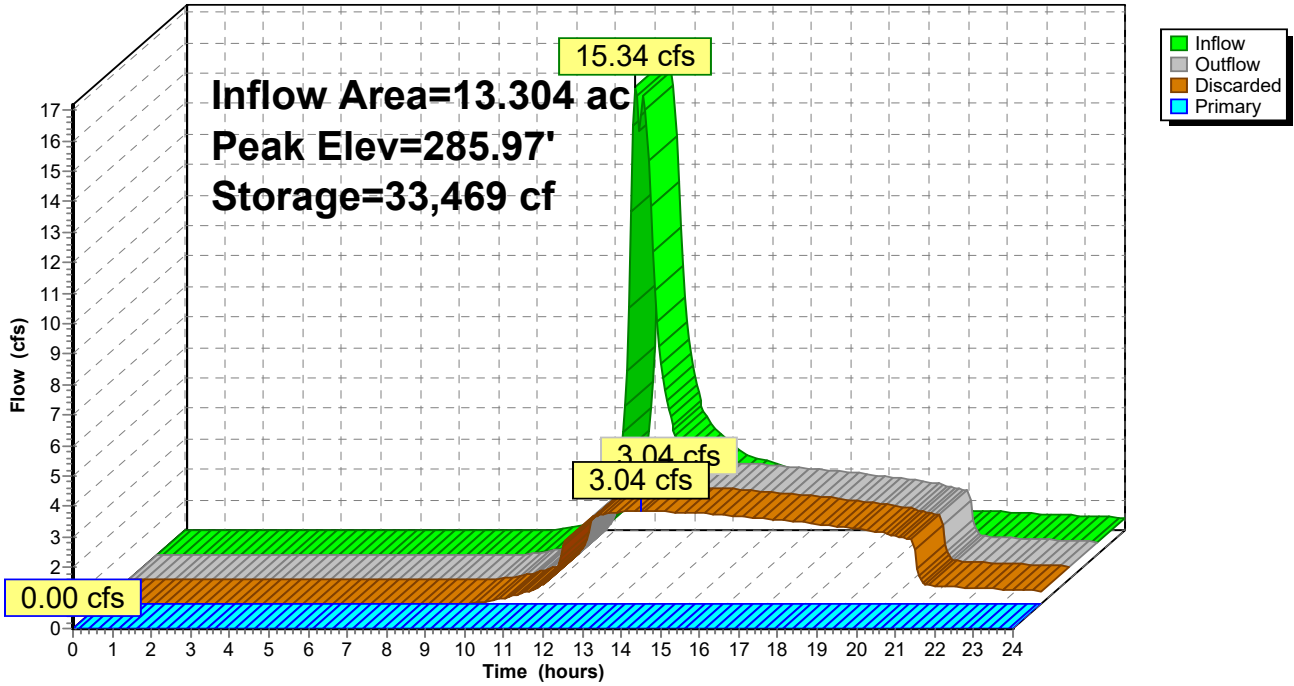
↳ **3=Orifice/Grate** (Controls 0.00 cfs)

↳ **4=Orifice/Grate** (Controls 0.00 cfs)

↳ **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Inf Basin

Hydrograph



2604-01 - Proposed Conditions Revisions

Type III 24-hr 10 Yr Rainfall=4.55"

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Summary for Pond 4P: Stormtrap

Inflow Area = 5.263 ac, 70.70% Impervious, Inflow Depth > 3.54" for 10 Yr event
 Inflow = 17.04 cfs @ 12.17 hrs, Volume= 1.553 af
 Outflow = 6.70 cfs @ 12.51 hrs, Volume= 0.953 af, Atten= 61%, Lag= 20.2 min
 Discarded = 0.07 cfs @ 6.65 hrs, Volume= 0.099 af
 Primary = 6.63 cfs @ 12.51 hrs, Volume= 0.854 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 356.88' @ 12.51 hrs Surf.Area= 0.239 ac Storage= 0.784 af

Plug-Flow detention time= 210.3 min calculated for 0.953 af (61% of inflow)
 Center-of-Mass det. time= 109.5 min (904.3 - 794.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	352.50'	0.125 af	32.27'W x 323.23'L x 5.50'H Field A 1.317 af Overall - 1.005 af Embedded = 0.312 af x 40.0% Voids
#2A	353.50'	0.789 af	StormTrap ST2 SingleTrap 4-0 x 40 Inside #1 Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf 40 Chambers in 2 Rows 16.96' x 307.92' Core + 6.66' Border = 30.27' x 321.23' System
		0.914 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	352.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	350.00'	24.0" Round Culvert L= 74.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 350.00' / 348.52' S= 0.0200 1/ S= 0.0200 1/ Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	355.20'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	355.85'	4.0" Vert. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	356.50'	7.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.07 cfs @ 6.65 hrs HW=352.56' (Free Discharge)↑ **1=Exfiltration** (Exfiltration Controls 0.07 cfs)**Primary OutFlow** Max=6.59 cfs @ 12.51 hrs HW=356.87' (Free Discharge)↑ **2=Culvert** (Passes 6.59 cfs of 36.66 cfs potential flow)↑ **3=Orifice/Grate** (Orifice Controls 0.03 cfs @ 6.15 fps)↑ **4=Orifice/Grate** (Orifice Controls 1.56 cfs @ 4.46 fps)↑ **5=Broad-Crested Rectangular Weir** (Weir Controls 5.00 cfs @ 1.78 fps)

2604-01 - Proposed Conditions Revisions

Type III 24-hr 10 Yr Rainfall=4.55"

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Pond 4P: Stormtrap - Chamber Wizard Field A

Chamber Model = StormTrap ST2 SingleTrap 4-0 (StormTrap ST2 SingleTrap® Type II+IV)

Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf

Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf

20 Chambers/Row x 15.40' Long = 307.92' Row Length +79.9" Border x 2 +12.0" End Stone x 2 = 323.23' Base Length

2 Rows x 101.7" Wide + 79.9" Side Border x 2 + 12.0" Side Stone x 2 = 32.27' Base Width

12.0" Stone Base + 54.0" Chamber Height = 5.50' Field Height

40 Chambers x 470.3 cf + 15,569.7 cf Border = 34,380.5 cf Chamber Storage

40 Chambers x 587.4 cf + 20,259.5 cf Border = 43,757.4 cf Displacement

57,369.8 cf Field - 43,757.4 cf Chambers = 13,612.4 cf Stone x 40.0% Voids = 5,444.9 cf Stone Storage

Chamber Storage + Stone Storage = 39,825.5 cf = 0.914 af

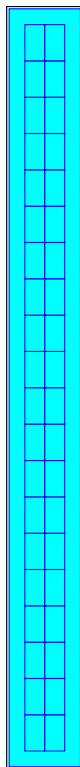
Overall Storage Efficiency = 69.4%

Overall System Size = 323.23' x 32.27' x 5.50'

40 Chambers (plus border)

2,124.8 cy Field

504.2 cy Stone



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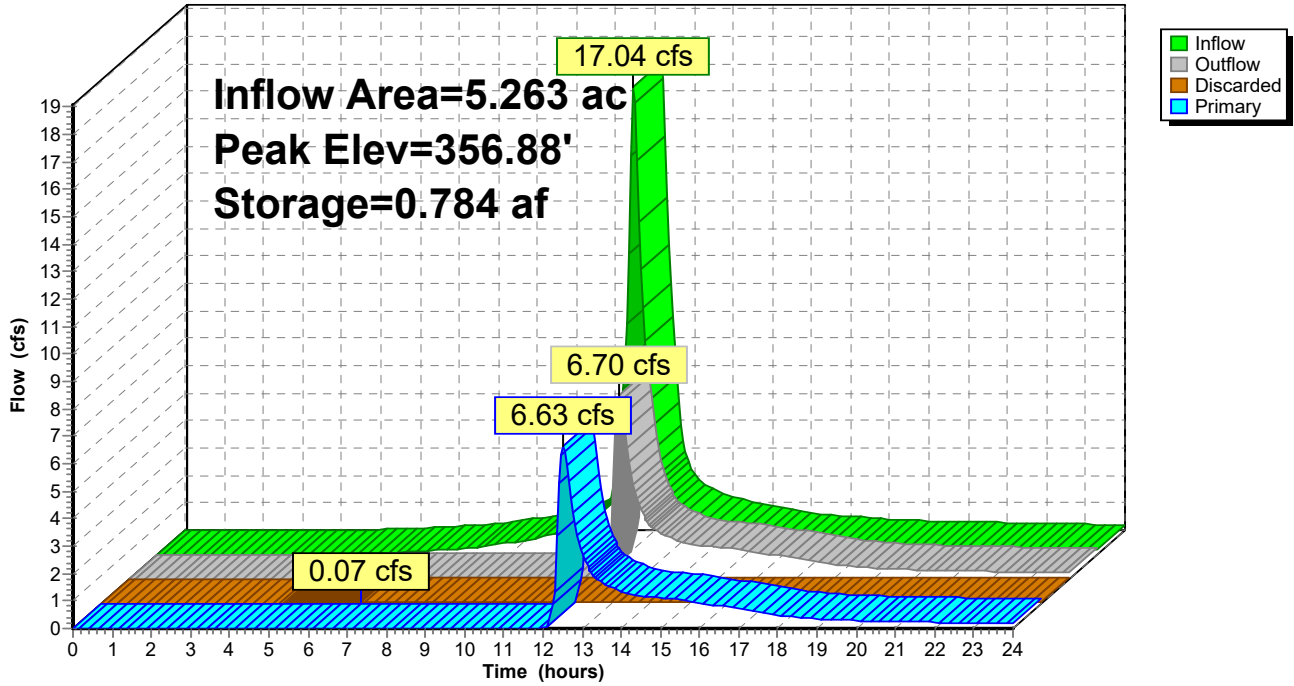
Type III 24-hr 10 Yr Rainfall=4.55"

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Pond 4P: Stormtrap

Hydrograph



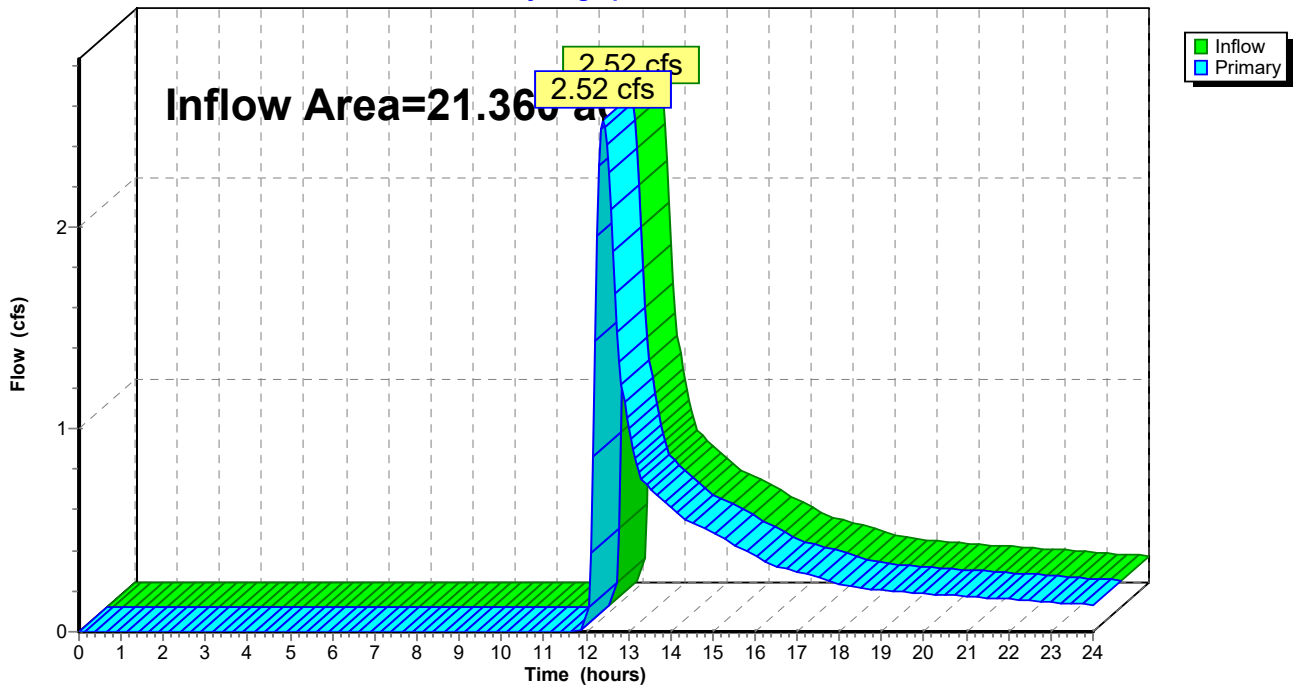
Summary for Link 1L: SE Corner

Inflow Area = 21.360 ac, 30.31% Impervious, Inflow Depth > 0.23" for 10 Yr event
Inflow = 2.52 cfs @ 12.40 hrs, Volume= 0.408 af
Primary = 2.52 cfs @ 12.40 hrs, Volume= 0.408 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: SE Corner

Hydrograph



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Type III 24-hr 10 Yr Rainfall=4.55"

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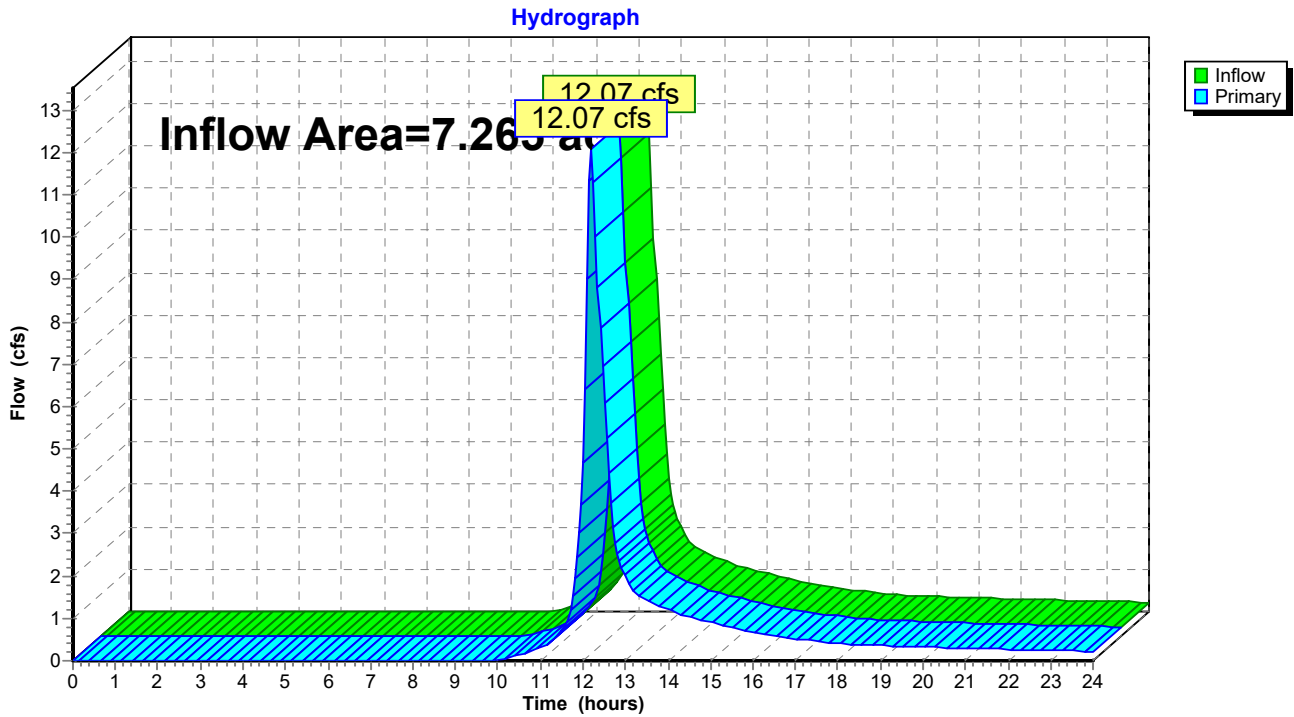
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Summary for Link 2L: Wly Wetland

Inflow Area = 7.265 ac, 3.48% Impervious, Inflow Depth > 1.85" for 10 Yr event
Inflow = 12.07 cfs @ 12.20 hrs, Volume= 1.121 af
Primary = 12.07 cfs @ 12.20 hrs, Volume= 1.121 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Wly Wetland



2604-01 - Proposed Conditions Revisions

Type III 24-hr 25 Yr Rainfall=5.50"

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 P-1: Drainage Collection Runoff Area=8.041 ac 30.37% Impervious Runoff Depth>2.85"
Flow Length=345' Tc=14.0 min CN=75 Runoff=20.79 cfs 1.912 af

Subcatchment P-2: Clubhouse Area Runoff Area=5.263 ac 70.70% Impervious Runoff Depth>4.46"
Flow Length=305' Tc=12.5 min CN=91 Runoff=21.22 cfs 1.956 af

Subcatchment P-3: ByPass MBTA Rd Runoff Area=8.056 ac 3.86% Impervious Runoff Depth>1.03"
Flow Length=1,801' Tc=19.5 min CN=52 Runoff=5.19 cfs 0.691 af

Subcatchment P-4: ByPass to W'ly Wetland Runoff Area=7.265 ac 3.48% Impervious Runoff Depth>2.58"
Flow Length=258' Tc=13.6 min CN=72 Runoff=17.07 cfs 1.564 af

Subcatchment P-5: Nly PL Runoff Area=2.410 ac 1.24% Impervious Runoff Depth>1.99"
Flow Length=77' Tc=8.0 min CN=65 Runoff=5.00 cfs 0.400 af

Pond 1P: Inf Basin Peak Elev=287.35' Storage=57,106 cf Inflow=30.70 cfs 3.161 af
Discarded=3.53 cfs 3.136 af Primary=0.15 cfs 0.020 af Outflow=3.68 cfs 3.157 af

Pond 4P: Stormtrap Peak Elev=357.14' Storage=0.837 af Inflow=21.22 cfs 1.956 af
Discarded=0.07 cfs 0.103 af Primary=13.70 cfs 1.249 af Outflow=13.77 cfs 1.352 af

Link 1L: SE Corner Inflow=5.19 cfs 0.712 af
Primary=5.19 cfs 0.712 af

Link 2L: Wly Wetland Inflow=17.07 cfs 1.564 af
Primary=17.07 cfs 1.564 af

Total Runoff Area = 31.035 ac Runoff Volume = 6.523 af Average Runoff Depth = 2.52"
78.23% Pervious = 24.278 ac 21.77% Impervious = 6.757 ac

2604-01 - Proposed Conditions Revisions

Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Subcatchment P-1: Drainage Collection

Runoff = 20.79 cfs @ 12.20 hrs, Volume= 1.912 af, Depth> 2.85"

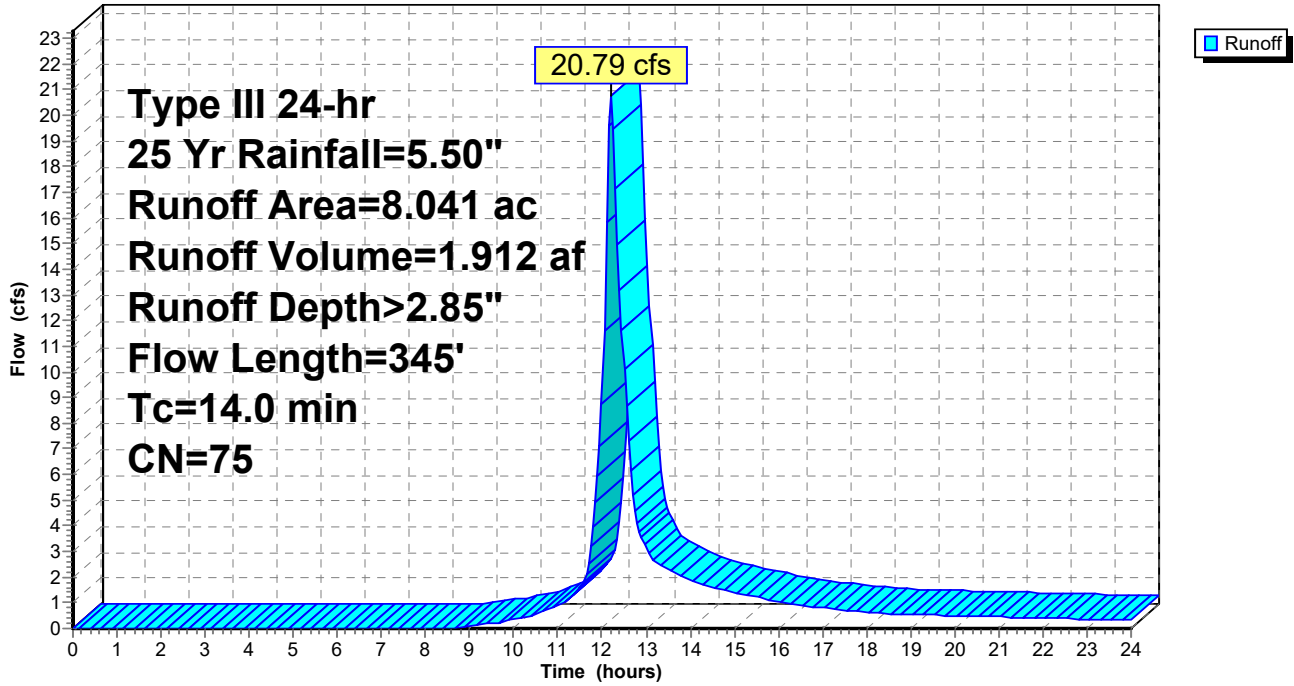
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Yr Rainfall=5.50"

Area (ac)	CN	Description
0.080	30	Woods, Good, HSG A
1.391	39	>75% Grass cover, Good, HSG A
0.339	98	Paved parking, HSG A
0.294	70	Woods, Good, HSG C
3.834	74	>75% Grass cover, Good, HSG C
1.412	98	Paved parking, HSG C
0.691	98	Roofs, HSG C
8.041	75	Weighted Average
5.599		69.63% Pervious Area
2.442		30.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	145	0.0470	3.49		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.1	62	0.3300	9.25		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
0.9	88	0.0100	1.61		Shallow Concentrated Flow, D-E Unpaved Kv= 16.1 fps
14.0	345	Total			

Subcatchment P-1: Drainage Collection

Hydrograph



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Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Subcatchment P-2: Clubhouse Area

Runoff = 21.22 cfs @ 12.17 hrs, Volume= 1.956 af, Depth> 4.46"

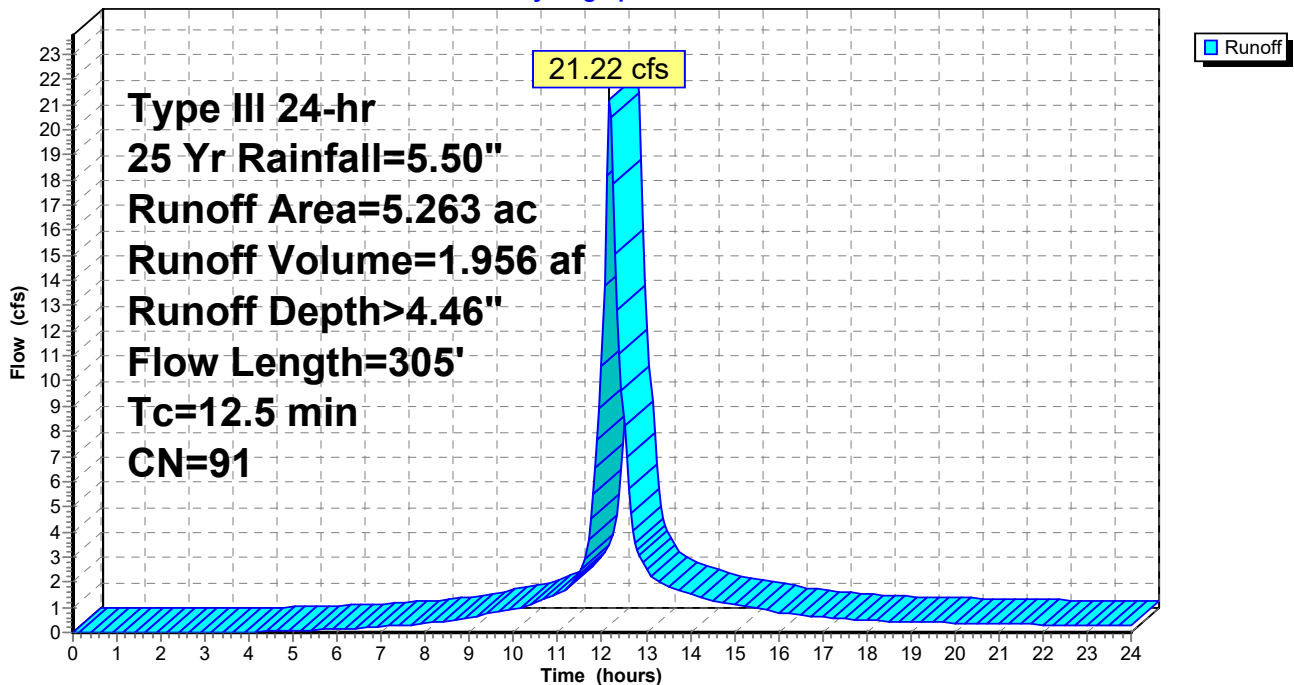
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Yr Rainfall=5.50"

Area (ac)	CN	Description
1.542	74	>75% Grass cover, Good, HSG C
2.330	98	Paved parking, HSG C
1.391	98	Roofs, HSG C
5.263	91	Weighted Average
1.542		29.30% Pervious Area
3.721		70.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20"
0.7	89	0.0200	2.28		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.0	166	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.5	305	Total			

Subcatchment P-2: Clubhouse Area

Hydrograph



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Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Subcatchment P-3: ByPass MBTA Rd

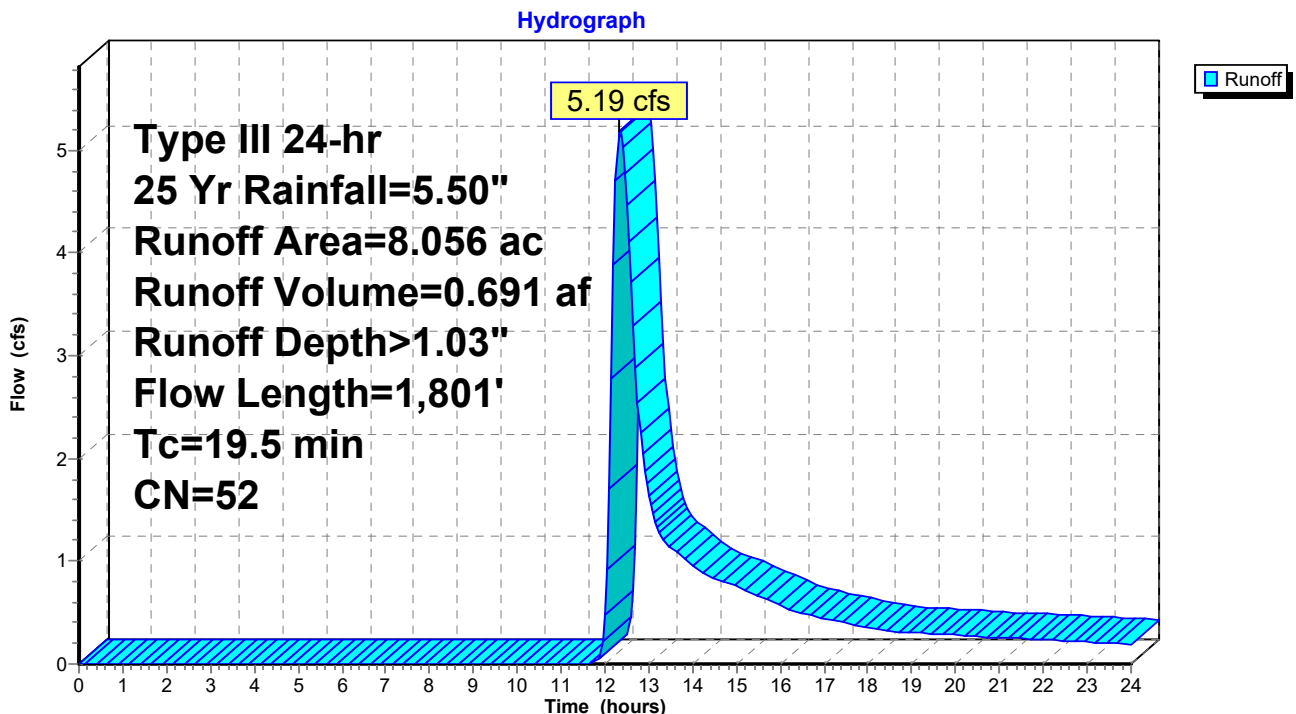
Runoff = 5.19 cfs @ 12.34 hrs, Volume= 0.691 af, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Yr Rainfall=5.50"

Area (ac)	CN	Description
3.340	30	Woods, Good, HSG A
0.600	39	>75% Grass cover, Good, HSG A
3.306	70	Woods, Good, HSG C
0.380	74	>75% Grass cover, Good, HSG C
0.311	98	Paved roads w/curbs & sewers, HSG A
0.119	39	>75% Grass cover, Good, HSG A
8.056	52	Weighted Average
7.745		96.14% Pervious Area
0.311		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	50	0.0180	0.06		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
6.6	1,751	0.0760	4.44		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
19.5	1,801	Total			

Subcatchment P-3: ByPass MBTA Rd



2604-01 - Proposed Conditions Revisions

Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Subcatchment P-4: ByPass to W'ly Wetland

Runoff = 17.07 cfs @ 12.20 hrs, Volume= 1.564 af, Depth> 2.58"

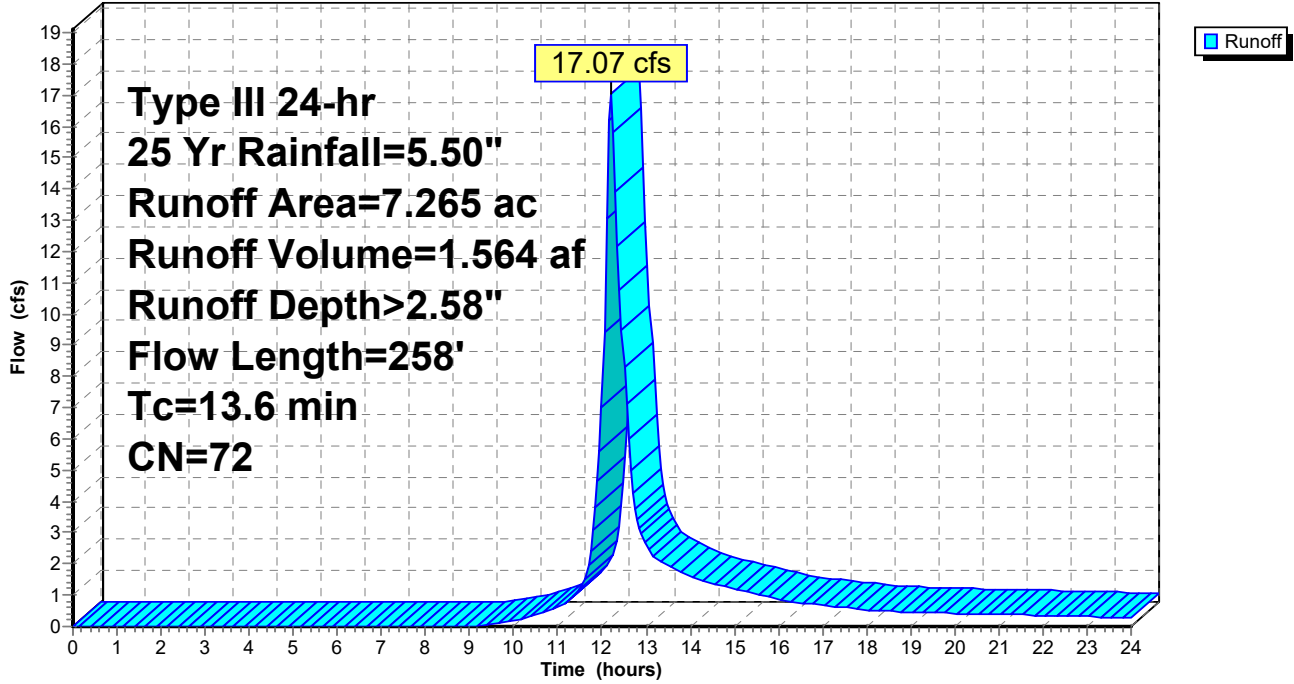
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type III 24-hr 25 Yr Rainfall=5.50"

Area (ac)	CN	Description
5.540	70	Woods, Good, HSG C
0.830	74	>75% Grass cover, Good, HSG C
0.020	98	Paved parking, HSG C
0.430	77	Woods, Good, HSG D
0.212	74	>75% Grass cover, Good, HSG C
0.210	98	Unconnected roofs, HSG C
0.023	98	Unconnected pavement, HSG C
7.265	72	Weighted Average
7.012		96.52% Pervious Area
0.253		3.48% Impervious Area
0.233		92.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	208	0.0270	2.65		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
13.6	258	Total			

Subcatchment P-4: ByPass to W'ly Wetland

Hydrograph



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Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Subcatchment P-5: Nly PL

Runoff = 5.00 cfs @ 12.12 hrs, Volume= 0.400 af, Depth> 1.99"

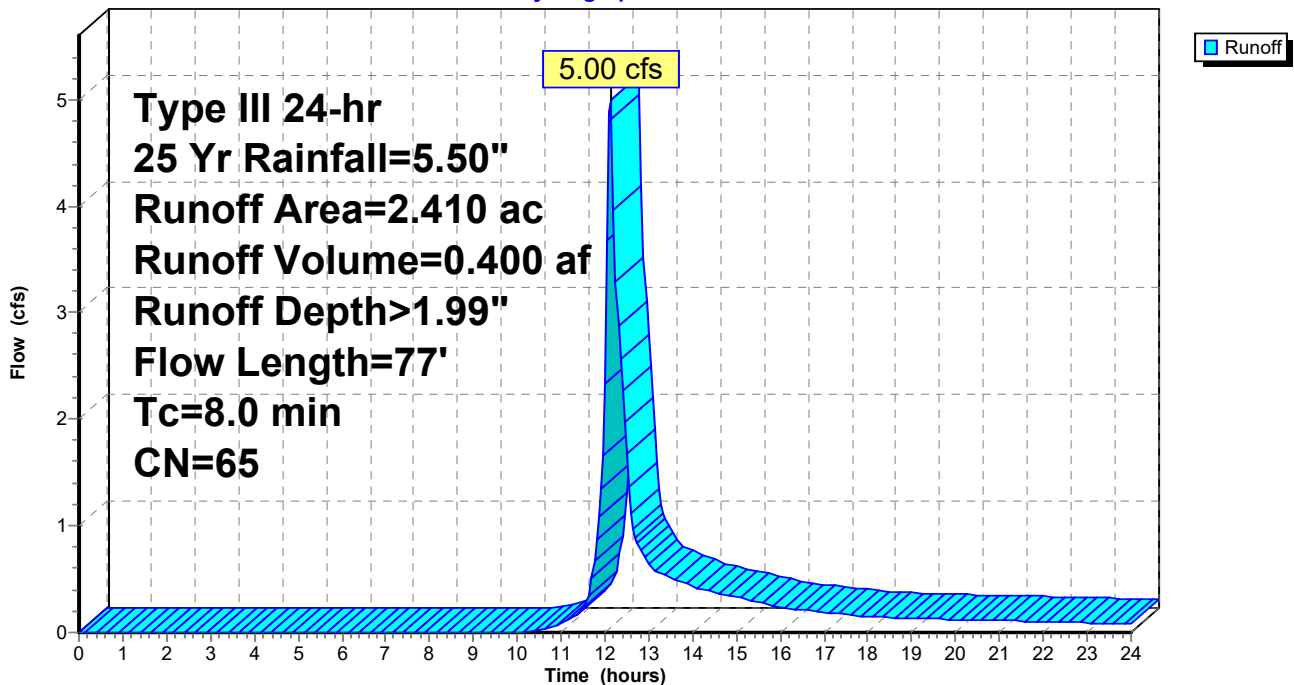
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Yr Rainfall=5.50"

Area (ac)	CN	Description
0.070	30	Woods, Good, HSG A
0.520	39	>75% Grass cover, Good, HSG A
0.440	70	Woods, Good, HSG C
1.350	74	>75% Grass cover, Good, HSG C
0.030	98	Paved parking, HSG C
2.410	65	Weighted Average
2.380		98.76% Pervious Area
0.030		1.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	27	0.0700	4.26		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
8.0	77	Total			

Subcatchment P-5: Nly PL

Hydrograph



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Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Pond 1P: Inf Basin

Inflow Area = 13.304 ac, 46.32% Impervious, Inflow Depth > 2.85" for 25 Yr event
 Inflow = 30.70 cfs @ 12.28 hrs, Volume= 3.161 af
 Outflow = 3.68 cfs @ 13.87 hrs, Volume= 3.157 af, Atten= 88%, Lag= 95.3 min
 Discarded = 3.53 cfs @ 13.87 hrs, Volume= 3.136 af
 Primary = 0.15 cfs @ 13.87 hrs, Volume= 0.020 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 287.35' @ 13.87 hrs Surf.Area= 18,446 sf Storage= 57,106 cf

Plug-Flow detention time= 175.4 min calculated for 3.150 af (100% of inflow)
 Center-of-Mass det. time= 174.2 min (1,027.4 - 853.2)

Volume	Invert	Avail.Storage	Storage Description
#1	283.50'	112,982 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.50	10,661	0	0
284.00	12,357	5,755	5,755
285.00	14,108	13,233	18,987
286.00	15,917	15,013	34,000
287.00	17,782	16,850	50,849
288.00	19,703	18,743	69,592
289.00	21,681	20,692	90,284
290.00	23,716	22,699	112,982

Device	Routing	Invert	Outlet Devices
#1	Discarded	283.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	280.91'	24.0" Round Culvert L= 119.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 280.91' / 277.45' S= 0.0291 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	286.90'	2.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	287.25'	6.0" Vert. Orifice/Grate X 3.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	288.50'	16.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=3.53 cfs @ 13.87 hrs HW=287.35' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 3.53 cfs)

Primary OutFlow Max=0.15 cfs @ 13.87 hrs HW=287.35' (Free Discharge)

↳ **2=Culvert** (Passes 0.15 cfs of 35.27 cfs potential flow)
 ↳ **3=Orifice/Grate** (Orifice Controls 0.06 cfs @ 2.90 fps)
 ↳ **4=Orifice/Grate** (Orifice Controls 0.08 cfs @ 1.05 fps)
 ↳ **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

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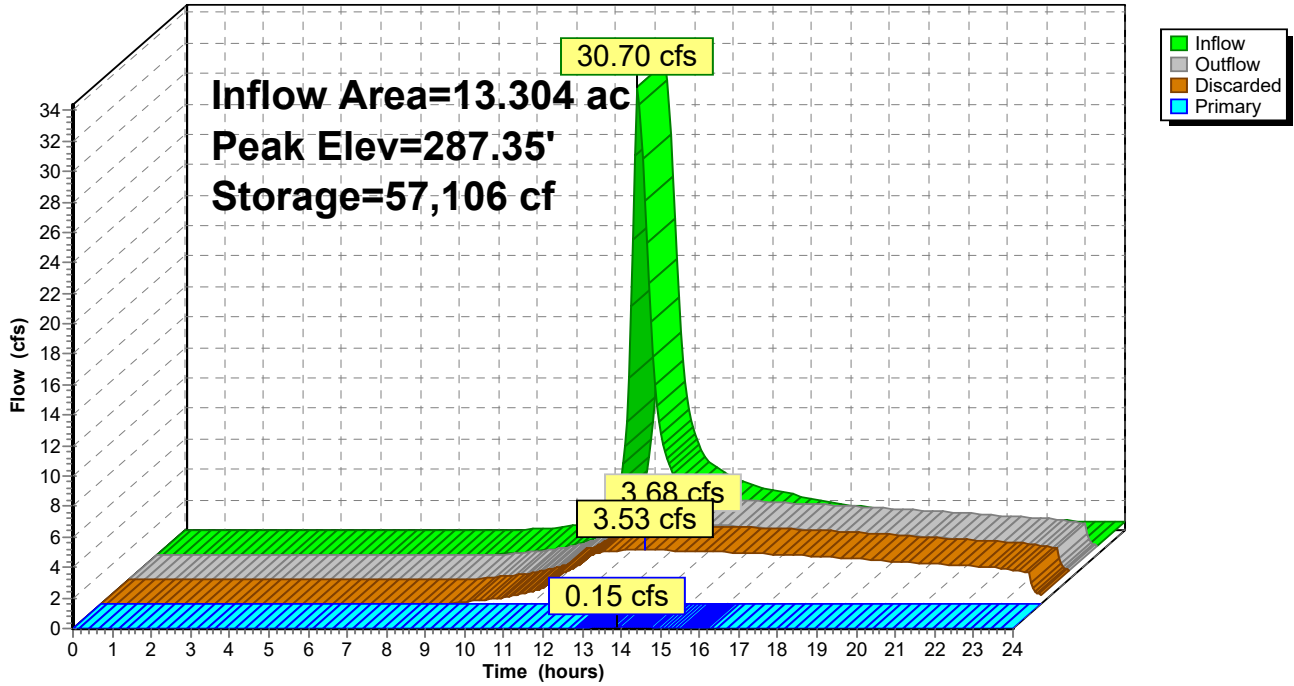
Type III 24-hr 25 Yr Rainfall=5.50"

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Pond 1P: Inf Basin

Hydrograph



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Type III 24-hr 25 Yr Rainfall=5.50"

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Summary for Pond 4P: Stormtrap

Inflow Area = 5.263 ac, 70.70% Impervious, Inflow Depth > 4.46" for 25 Yr event
 Inflow = 21.22 cfs @ 12.17 hrs, Volume= 1.956 af
 Outflow = 13.77 cfs @ 12.34 hrs, Volume= 1.352 af, Atten= 35%, Lag= 10.1 min
 Discarded = 0.07 cfs @ 5.75 hrs, Volume= 0.103 af
 Primary = 13.70 cfs @ 12.34 hrs, Volume= 1.249 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 357.14' @ 12.33 hrs Surf.Area= 0.239 ac Storage= 0.837 af

Plug-Flow detention time= 181.9 min calculated for 1.352 af (69% of inflow)
 Center-of-Mass det. time= 89.8 min (878.4 - 788.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	352.50'	0.125 af	32.27'W x 323.23'L x 5.50'H Field A 1.317 af Overall - 1.005 af Embedded = 0.312 af x 40.0% Voids
#2A	353.50'	0.789 af	StormTrap ST2 SingleTrap 4-0 x 40 Inside #1 Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf 40 Chambers in 2 Rows 16.96' x 307.92' Core + 6.66' Border = 30.27' x 321.23' System
		0.914 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	352.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	350.00'	24.0" Round Culvert L= 74.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 350.00' / 348.52' S= 0.0200 1/ S= 0.0200 1/ Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	355.20'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	355.85'	4.0" Vert. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	356.50'	7.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.07 cfs @ 5.75 hrs HW=352.56' (Free Discharge)↑ **1=Exfiltration** (Exfiltration Controls 0.07 cfs)**Primary OutFlow** Max=13.58 cfs @ 12.34 hrs HW=357.13' (Free Discharge)↑ **2=Culvert** (Passes 13.58 cfs of 37.46 cfs potential flow)↑ **3=Orifice/Grate** (Orifice Controls 0.04 cfs @ 6.62 fps)↑ **4=Orifice/Grate** (Orifice Controls 1.78 cfs @ 5.09 fps)↑ **5=Broad-Crested Rectangular Weir** (Weir Controls 11.77 cfs @ 2.48 fps)

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Type III 24-hr 25 Yr Rainfall=5.50"

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Pond 4P: Stormtrap - Chamber Wizard Field A

Chamber Model = StormTrap ST2 SingleTrap 4-0 (StormTrap ST2 SingleTrap® Type II+IV)

Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf

Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf

20 Chambers/Row x 15.40' Long = 307.92' Row Length +79.9" Border x 2 +12.0" End Stone x 2 = 323.23' Base Length

2 Rows x 101.7" Wide + 79.9" Side Border x 2 + 12.0" Side Stone x 2 = 32.27' Base Width

12.0" Stone Base + 54.0" Chamber Height = 5.50' Field Height

40 Chambers x 470.3 cf + 15,569.7 cf Border = 34,380.5 cf Chamber Storage

40 Chambers x 587.4 cf + 20,259.5 cf Border = 43,757.4 cf Displacement

57,369.8 cf Field - 43,757.4 cf Chambers = 13,612.4 cf Stone x 40.0% Voids = 5,444.9 cf Stone Storage

Chamber Storage + Stone Storage = 39,825.5 cf = 0.914 af

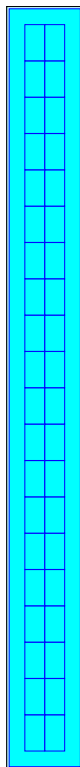
Overall Storage Efficiency = 69.4%

Overall System Size = 323.23' x 32.27' x 5.50'

40 Chambers (plus border)

2,124.8 cy Field

504.2 cy Stone



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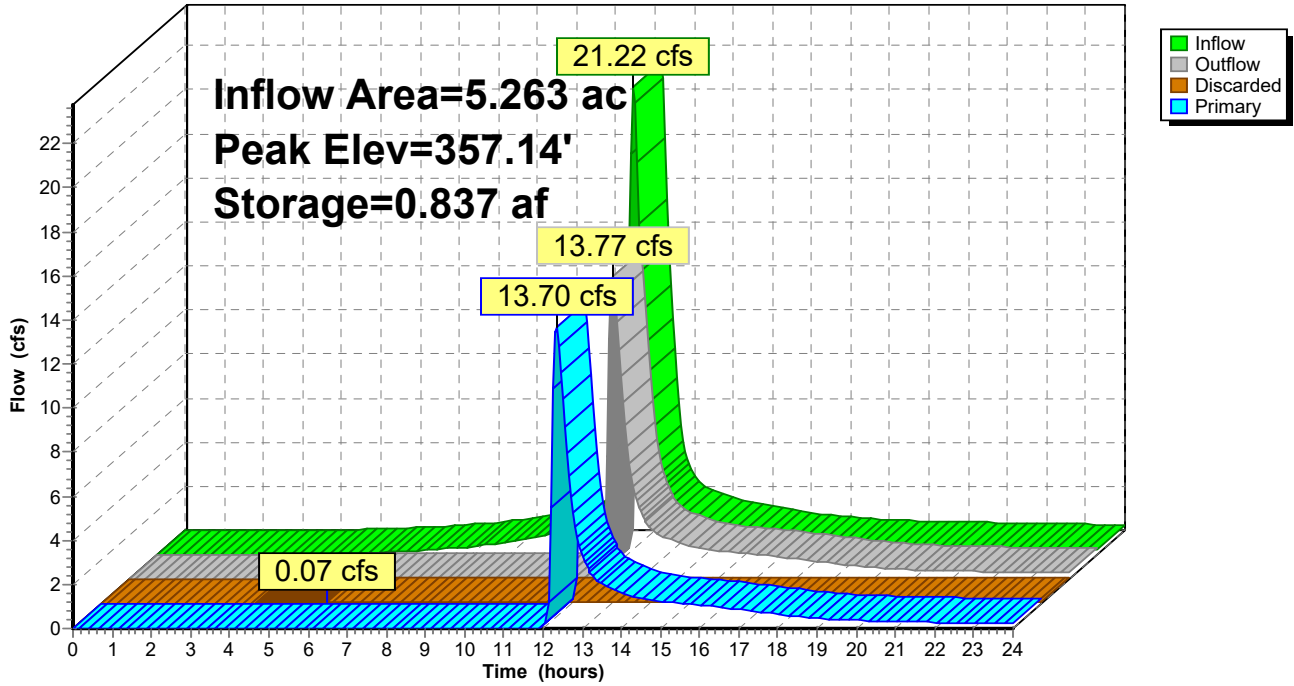
Type III 24-hr 25 Yr Rainfall=5.50"

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Pond 4P: Stormtrap

Hydrograph



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Type III 24-hr 25 Yr Rainfall=5.50"

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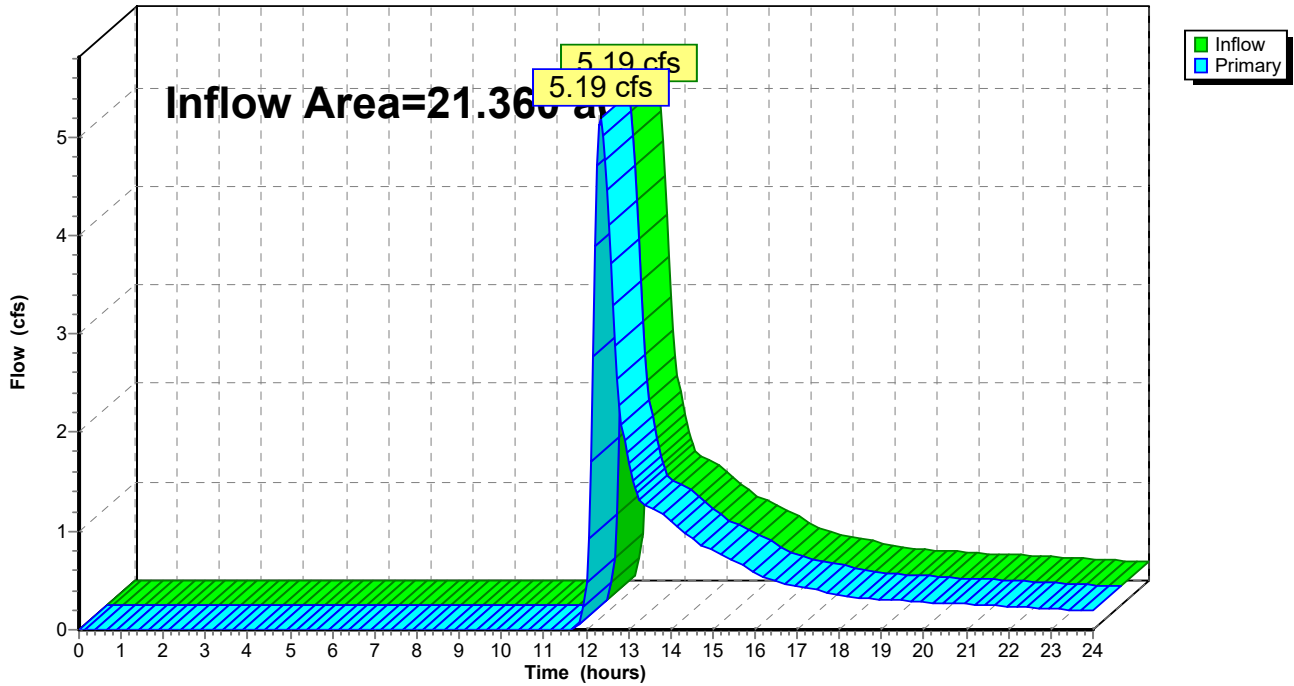
Summary for Link 1L: SE Corner

Inflow Area = 21.360 ac, 30.31% Impervious, Inflow Depth > 0.40" for 25 Yr event
Inflow = 5.19 cfs @ 12.34 hrs, Volume= 0.712 af
Primary = 5.19 cfs @ 12.34 hrs, Volume= 0.712 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: SE Corner

Hydrograph



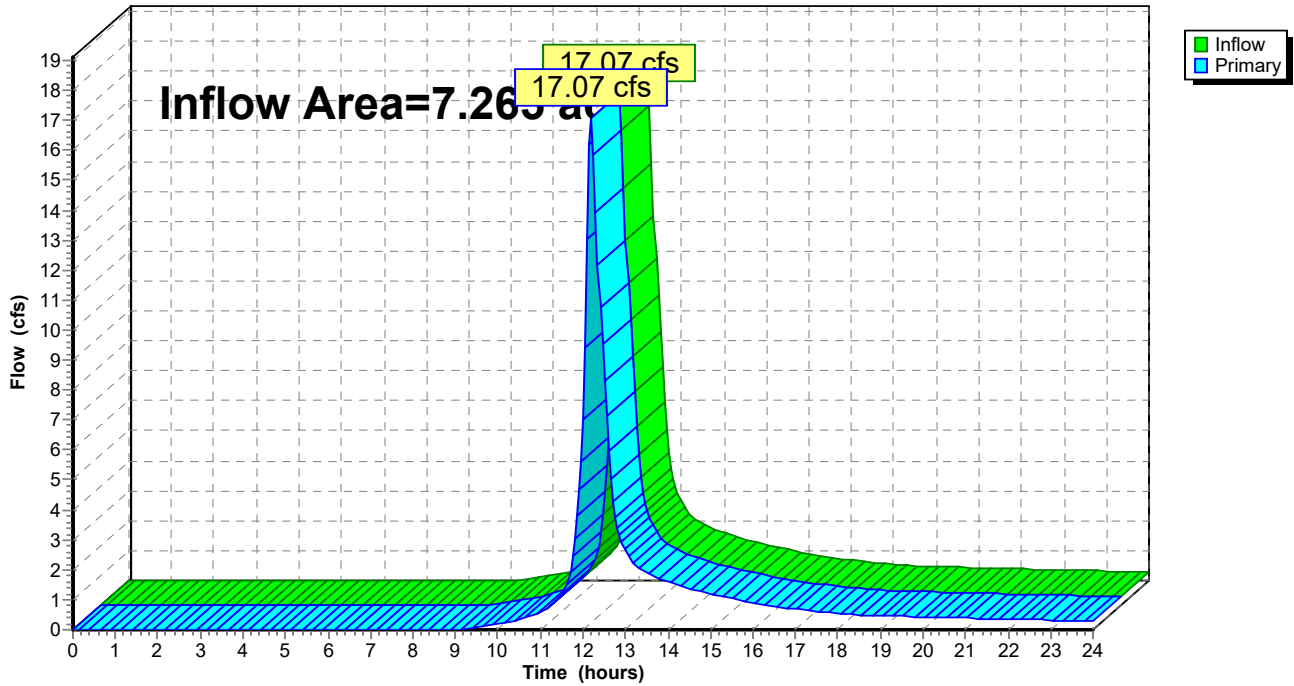
Summary for Link 2L: Wly Wetland

Inflow Area = 7.265 ac, 3.48% Impervious, Inflow Depth > 2.58" for 25 Yr event
Inflow = 17.07 cfs @ 12.20 hrs, Volume= 1.564 af
Primary = 17.07 cfs @ 12.20 hrs, Volume= 1.564 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Wly Wetland

Hydrograph



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Type III 24-hr 100 Yr Rainfall=6.70"

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 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 P-1: Drainage Collection Runoff Area=8.041 ac 30.37% Impervious Runoff Depth>3.88"
Flow Length=345' Tc=14.0 min CN=75 Runoff=28.28 cfs 2.598 af

Subcatchment P-2: Clubhouse Area Runoff Area=5.263 ac 70.70% Impervious Runoff Depth>5.63"
Flow Length=305' Tc=12.5 min CN=91 Runoff=26.46 cfs 2.471 af

Subcatchment P-3: ByPass MBTA Rd Runoff Area=8.056 ac 3.86% Impervious Runoff Depth>1.66"
Flow Length=1,801' Tc=19.5 min CN=52 Runoff=9.42 cfs 1.117 af

Subcatchment P-4: ByPass to W'ly Wetland Runoff Area=7.265 ac 3.48% Impervious Runoff Depth>3.57"
Flow Length=258' Tc=13.6 min CN=72 Runoff=23.71 cfs 2.159 af

Subcatchment P-5: Nly PL Runoff Area=2.410 ac 1.24% Impervious Runoff Depth>2.87"
Flow Length=77' Tc=8.0 min CN=65 Runoff=7.37 cfs 0.576 af

Pond 1P: Inf Basin Peak Elev=288.48' Storage=79,354 cf Inflow=50.09 cfs 4.353 af
Discarded=3.96 cfs 3.525 af Primary=2.94 cfs 0.648 af Outflow=6.90 cfs 4.173 af

Pond 4P: Stormtrap Peak Elev=357.38' Storage=0.887 af Inflow=26.46 cfs 2.471 af
Discarded=0.07 cfs 0.107 af Primary=22.56 cfs 1.755 af Outflow=22.63 cfs 1.862 af

Link 1L: SE Corner Inflow=9.42 cfs 1.765 af
Primary=9.42 cfs 1.765 af

Link 2L: Wly Wetland Inflow=23.71 cfs 2.159 af
Primary=23.71 cfs 2.159 af

Total Runoff Area = 31.035 ac Runoff Volume = 8.920 af Average Runoff Depth = 3.45"
78.23% Pervious = 24.278 ac 21.77% Impervious = 6.757 ac

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Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Subcatchment P-1: Drainage Collection

Runoff = 28.28 cfs @ 12.20 hrs, Volume= 2.598 af, Depth> 3.88"

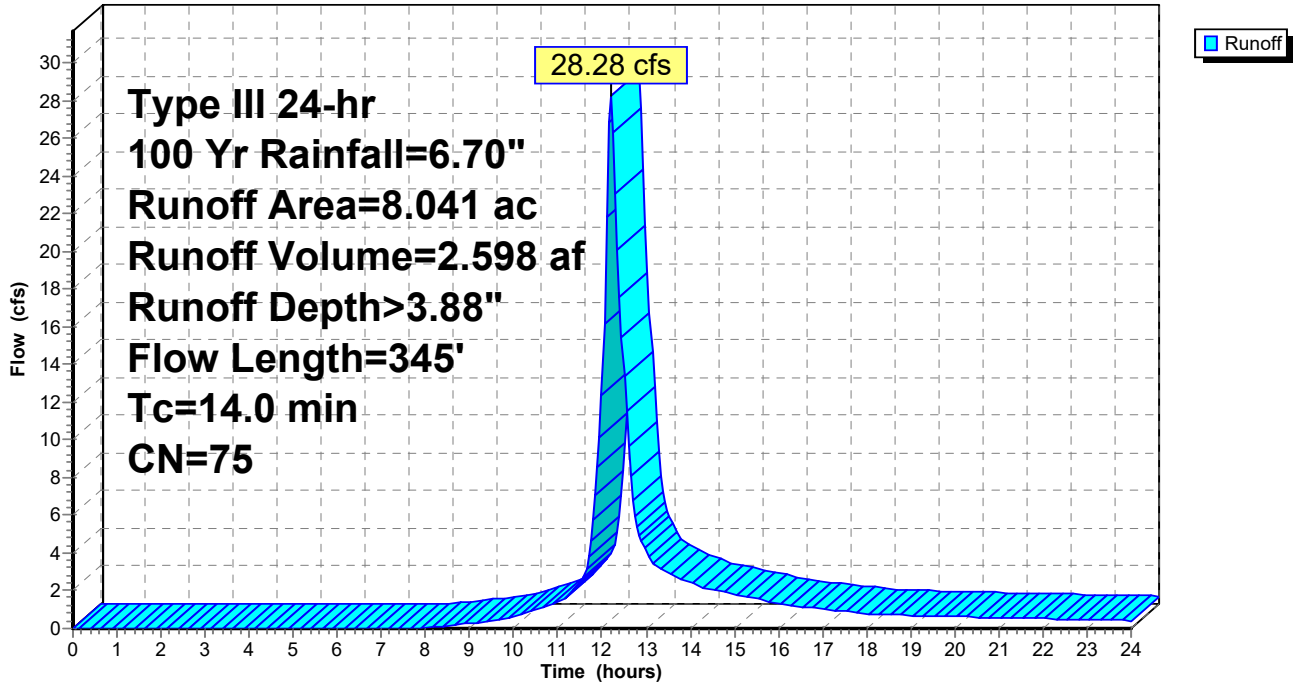
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Yr Rainfall=6.70"

Area (ac)	CN	Description
0.080	30	Woods, Good, HSG A
1.391	39	>75% Grass cover, Good, HSG A
0.339	98	Paved parking, HSG A
0.294	70	Woods, Good, HSG C
3.834	74	>75% Grass cover, Good, HSG C
1.412	98	Paved parking, HSG C
0.691	98	Roofs, HSG C
8.041	75	Weighted Average
5.599		69.63% Pervious Area
2.442		30.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.7	145	0.0470	3.49		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
0.1	62	0.3300	9.25		Shallow Concentrated Flow, C-D Unpaved Kv= 16.1 fps
0.9	88	0.0100	1.61		Shallow Concentrated Flow, D-E Unpaved Kv= 16.1 fps
14.0	345	Total			

Subcatchment P-1: Drainage Collection

Hydrograph



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Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Subcatchment P-2: Clubhouse Area

Runoff = 26.46 cfs @ 12.17 hrs, Volume= 2.471 af, Depth> 5.63"

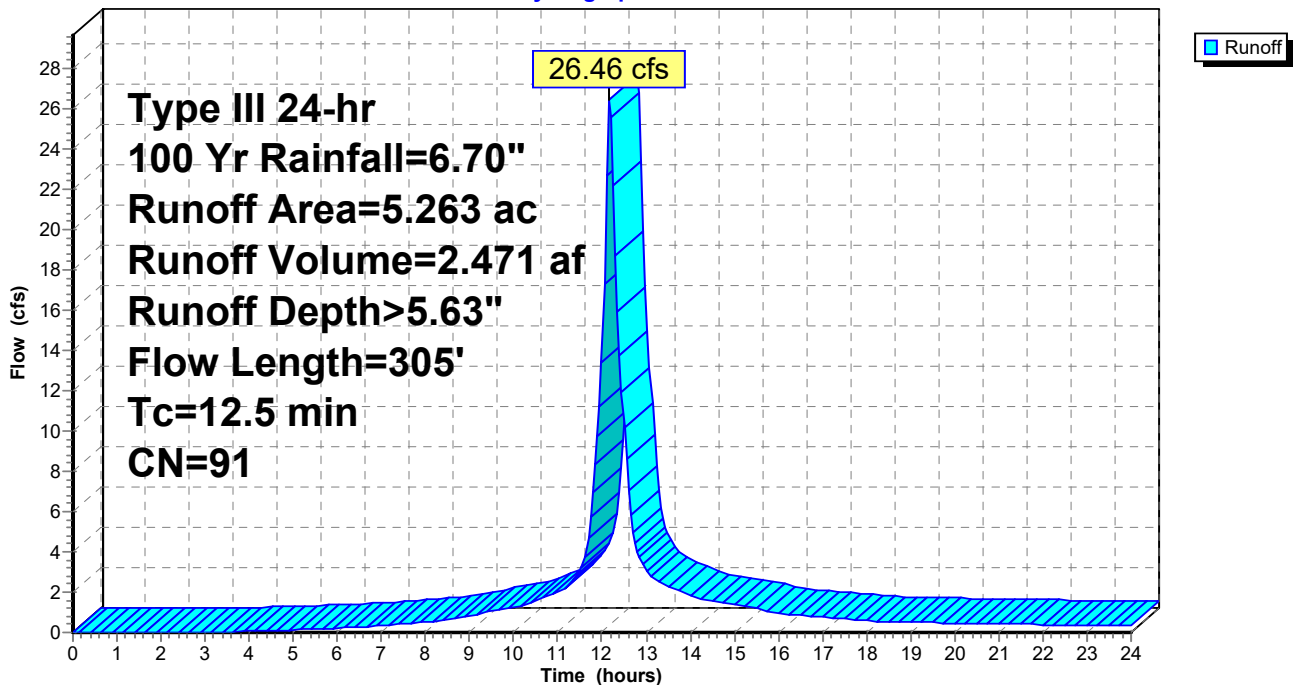
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Yr Rainfall=6.70"

Area (ac)	CN	Description
1.542	74	>75% Grass cover, Good, HSG C
2.330	98	Paved parking, HSG C
1.391	98	Roofs, HSG C
5.263	91	Weighted Average
1.542		29.30% Pervious Area
3.721		70.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.8	50	0.0100	0.08		Sheet Flow, A-B Grass: Dense n= 0.240 P2= 3.20"
0.7	89	0.0200	2.28		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
1.0	166	0.0200	2.87		Shallow Concentrated Flow, C-D Paved Kv= 20.3 fps
12.5	305	Total			

Subcatchment P-2: Clubhouse Area

Hydrograph



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Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Subcatchment P-3: ByPass MBTA Rd

Runoff = 9.42 cfs @ 12.31 hrs, Volume= 1.117 af, Depth> 1.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Yr Rainfall=6.70"

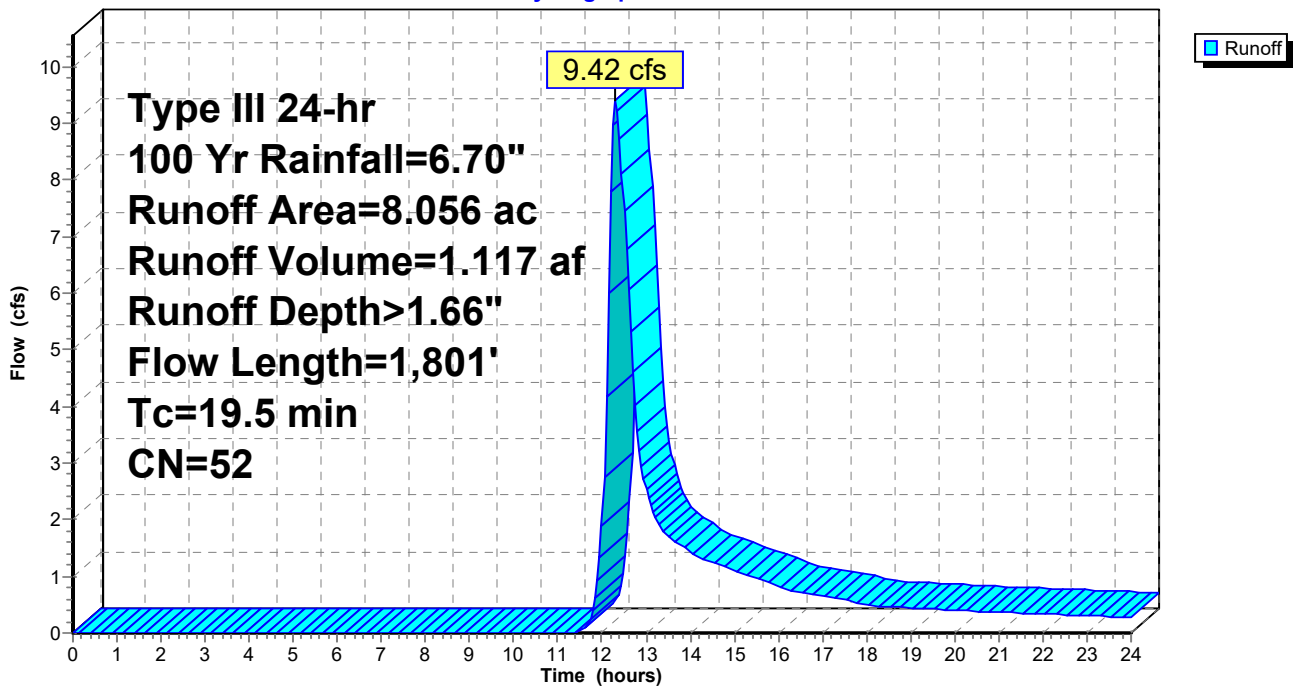
Area (ac)	CN	Description
3.340	30	Woods, Good, HSG A
0.600	39	>75% Grass cover, Good, HSG A
3.306	70	Woods, Good, HSG C
0.380	74	>75% Grass cover, Good, HSG C
0.311	98	Paved roads w/curbs & sewers, HSG A
0.119	39	>75% Grass cover, Good, HSG A

8.056	52	Weighted Average
7.745		96.14% Pervious Area
0.311		3.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.9	50	0.0180	0.06		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
6.6	1,751	0.0760	4.44		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
19.5	1,801	Total			

Subcatchment P-3: ByPass MBTA Rd

Hydrograph



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Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Subcatchment P-4: ByPass to W'ly Wetland

Runoff = 23.71 cfs @ 12.19 hrs, Volume= 2.159 af, Depth> 3.57"

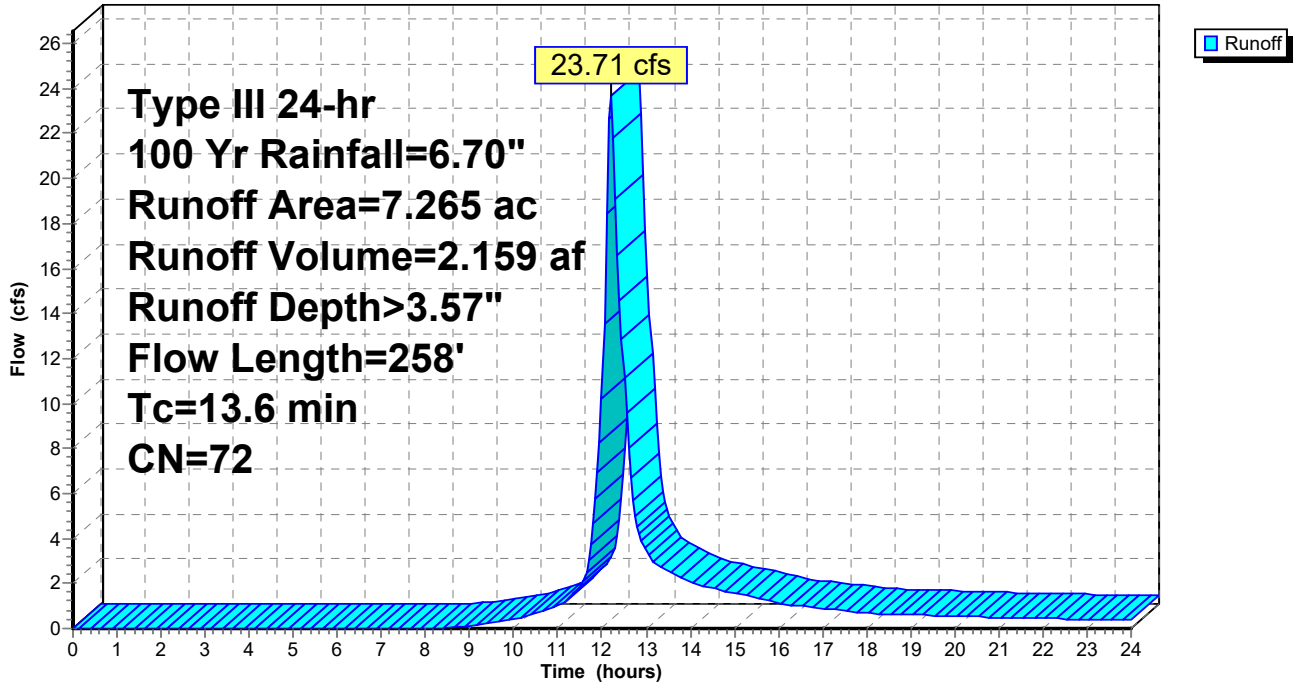
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Yr Rainfall=6.70"

Area (ac)	CN	Description
5.540	70	Woods, Good, HSG C
0.830	74	>75% Grass cover, Good, HSG C
0.020	98	Paved parking, HSG C
0.430	77	Woods, Good, HSG D
0.212	74	>75% Grass cover, Good, HSG C
0.210	98	Unconnected roofs, HSG C
0.023	98	Unconnected pavement, HSG C
7.265	72	Weighted Average
7.012		96.52% Pervious Area
0.253		3.48% Impervious Area
0.233		92.09% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0200	0.07		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
1.3	208	0.0270	2.65		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
13.6	258	Total			

Subcatchment P-4: ByPass to W'ly Wetland

Hydrograph



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Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Subcatchment P-5: Nly PL

Runoff = 7.37 cfs @ 12.12 hrs, Volume= 0.576 af, Depth> 2.87"

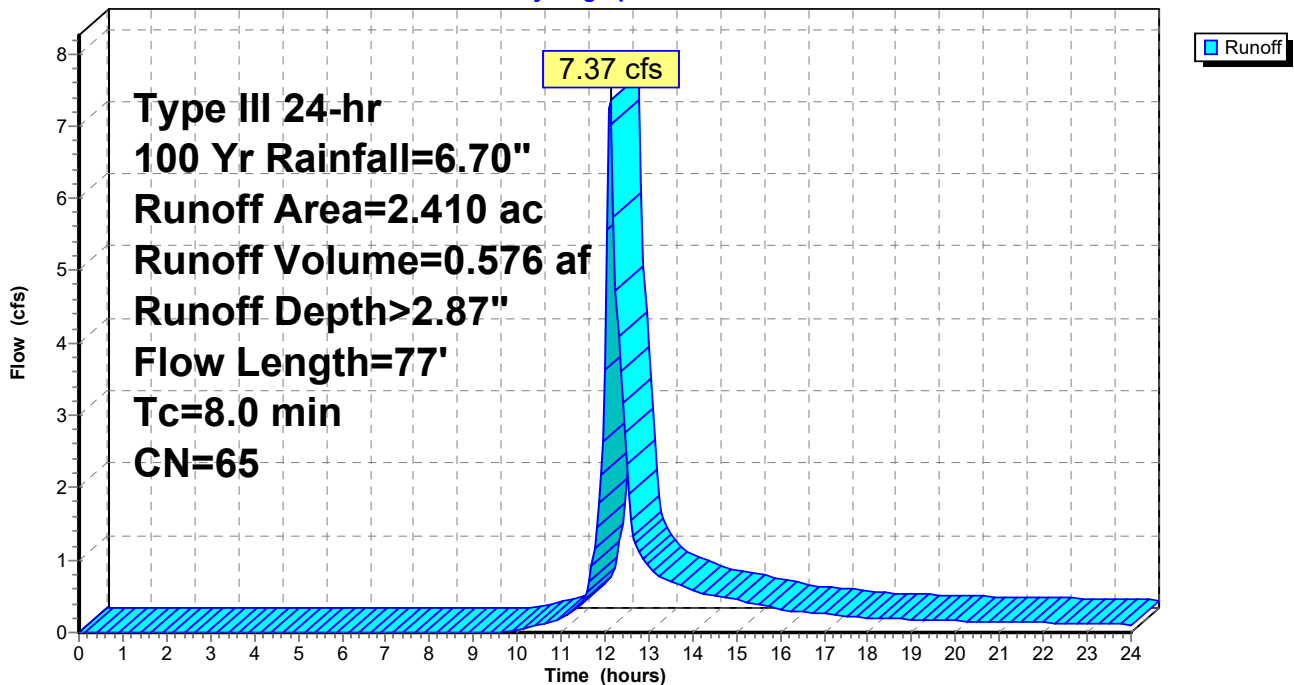
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Yr Rainfall=6.70"

Area (ac)	CN	Description
0.070	30	Woods, Good, HSG A
0.520	39	>75% Grass cover, Good, HSG A
0.440	70	Woods, Good, HSG C
1.350	74	>75% Grass cover, Good, HSG C
0.030	98	Paved parking, HSG C
2.410	65	Weighted Average
2.380		98.76% Pervious Area
0.030		1.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	50	0.0600	0.10		Sheet Flow, A-B Woods: Light underbrush n= 0.400 P2= 3.20"
0.1	27	0.0700	4.26		Shallow Concentrated Flow, B-C Unpaved Kv= 16.1 fps
8.0	77	Total			

Subcatchment P-5: Nly PL

Hydrograph



2604-01 - Proposed Conditions Revisions

Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Pond 1P: Inf Basin

Inflow Area = 13.304 ac, 46.32% Impervious, Inflow Depth > 3.93" for 100 Yr event
 Inflow = 50.09 cfs @ 12.22 hrs, Volume= 4.353 af
 Outflow = 6.90 cfs @ 13.13 hrs, Volume= 4.173 af, Atten= 86%, Lag= 54.4 min
 Discarded = 3.96 cfs @ 13.13 hrs, Volume= 3.525 af
 Primary = 2.94 cfs @ 13.13 hrs, Volume= 0.648 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 288.48' @ 13.13 hrs Surf.Area= 20,660 sf Storage= 79,354 cf

Plug-Flow detention time= 176.6 min calculated for 4.173 af (96% of inflow)
 Center-of-Mass det. time= 154.3 min (995.1 - 840.8)

Volume	Invert	Avail.Storage	Storage Description
#1	283.50'	112,982 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.50	10,661	0	0
284.00	12,357	5,755	5,755
285.00	14,108	13,233	18,987
286.00	15,917	15,013	34,000
287.00	17,782	16,850	50,849
288.00	19,703	18,743	69,592
289.00	21,681	20,692	90,284
290.00	23,716	22,699	112,982

Device	Routing	Invert	Outlet Devices
#1	Discarded	283.50'	8.270 in/hr Exfiltration over Surface area
#2	Primary	280.91'	24.0" Round Culvert L= 119.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 280.91' / 277.45' S= 0.0291 '/' Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	286.90'	2.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	287.25'	6.0" Vert. Orifice/Grate X 3.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	288.50'	16.0' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=3.95 cfs @ 13.13 hrs HW=288.48' (Free Discharge)

↳ **1=Exfiltration** (Exfiltration Controls 3.95 cfs)

Primary OutFlow Max=2.94 cfs @ 13.13 hrs HW=288.48' (Free Discharge)

↳ **2=Culvert** (Passes 2.94 cfs of 38.78 cfs potential flow)

↳ **3=Orifice/Grate** (Orifice Controls 0.13 cfs @ 5.90 fps)

↳ **4=Orifice/Grate** (Orifice Controls 2.81 cfs @ 4.77 fps)

↳ **5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

2604-01 - Proposed Conditions Revisions

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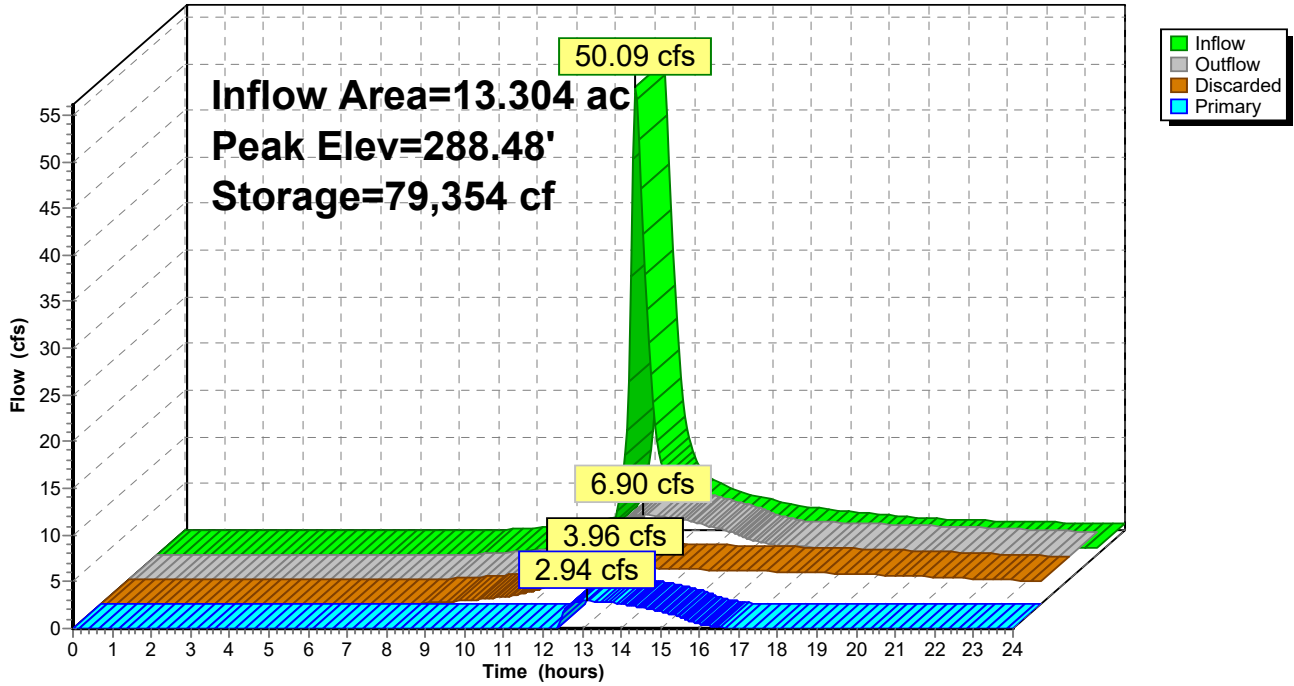
Type III 24-hr 100 Yr Rainfall=6.70"

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Pond 1P: Inf Basin

Hydrograph



2604-01 - Proposed Conditions Revisions

Type III 24-hr 100 Yr Rainfall=6.70"

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Summary for Pond 4P: Stormtrap

Inflow Area = 5.263 ac, 70.70% Impervious, Inflow Depth > 5.63" for 100 Yr event
 Inflow = 26.46 cfs @ 12.17 hrs, Volume= 2.471 af
 Outflow = 22.63 cfs @ 12.25 hrs, Volume= 1.862 af, Atten= 14%, Lag= 5.1 min
 Discarded = 0.07 cfs @ 4.90 hrs, Volume= 0.107 af
 Primary = 22.56 cfs @ 12.25 hrs, Volume= 1.755 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 357.38' @ 12.25 hrs Surf.Area= 0.239 ac Storage= 0.887 af

Plug-Flow detention time= 159.4 min calculated for 1.858 af (75% of inflow)
 Center-of-Mass det. time= 77.2 min (859.8 - 782.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	352.50'	0.125 af	32.27'W x 323.23'L x 5.50'H Field A 1.317 af Overall - 1.005 af Embedded = 0.312 af x 40.0% Voids
#2A	353.50'	0.789 af	StormTrap ST2 SingleTrap 4-0 x 40 Inside #1 Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf 40 Chambers in 2 Rows 16.96' x 307.92' Core + 6.66' Border = 30.27' x 321.23' System
		0.914 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	352.50'	0.270 in/hr Exfiltration over Surface area
#2	Primary	350.00'	24.0" Round Culvert L= 74.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 350.00' / 348.52' S= 0.0200 1/ S= 0.0200 1/ Cc= 0.900 n= 0.012, Flow Area= 3.14 sf
#3	Device 2	355.20'	1.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#4	Device 2	355.85'	4.0" Vert. Orifice/Grate X 4.00 C= 0.600 Limited to weir flow at low heads
#5	Device 2	356.50'	7.5' long x 0.5' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Discarded OutFlow Max=0.07 cfs @ 4.90 hrs HW=352.56' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Primary OutFlow Max=22.50 cfs @ 12.25 hrs HW=357.38' (Free Discharge)

↑ **2=Culvert** (Passes 22.50 cfs of 38.21 cfs potential flow)

↑ **3=Orifice/Grate** (Orifice Controls 0.04 cfs @ 7.04 fps)

↑ **4=Orifice/Grate** (Orifice Controls 1.96 cfs @ 5.62 fps)

↑ **5=Broad-Crested Rectangular Weir** (Weir Controls 20.50 cfs @ 3.10 fps)

2604-01 - Proposed Conditions Revisions

Type III 24-hr 100 Yr Rainfall=6.70"

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Pond 4P: Stormtrap - Chamber Wizard Field A

Chamber Model = StormTrap ST2 SingleTrap 4-0 (StormTrap ST2 SingleTrap® Type II+IV)

Inside= 101.7"W x 48.0"H => 30.55 sf x 15.40'L = 470.3 cf

Outside= 101.7"W x 54.0"H => 38.16 sf x 15.40'L = 587.4 cf

20 Chambers/Row x 15.40' Long = 307.92' Row Length +79.9" Border x 2 +12.0" End Stone x 2 = 323.23' Base Length

2 Rows x 101.7" Wide + 79.9" Side Border x 2 + 12.0" Side Stone x 2 = 32.27' Base Width

12.0" Stone Base + 54.0" Chamber Height = 5.50' Field Height

40 Chambers x 470.3 cf + 15,569.7 cf Border = 34,380.5 cf Chamber Storage

40 Chambers x 587.4 cf + 20,259.5 cf Border = 43,757.4 cf Displacement

57,369.8 cf Field - 43,757.4 cf Chambers = 13,612.4 cf Stone x 40.0% Voids = 5,444.9 cf Stone Storage

Chamber Storage + Stone Storage = 39,825.5 cf = 0.914 af

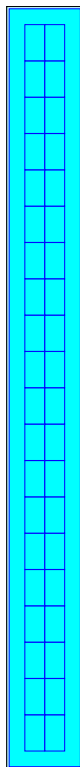
Overall Storage Efficiency = 69.4%

Overall System Size = 323.23' x 32.27' x 5.50'

40 Chambers (plus border)

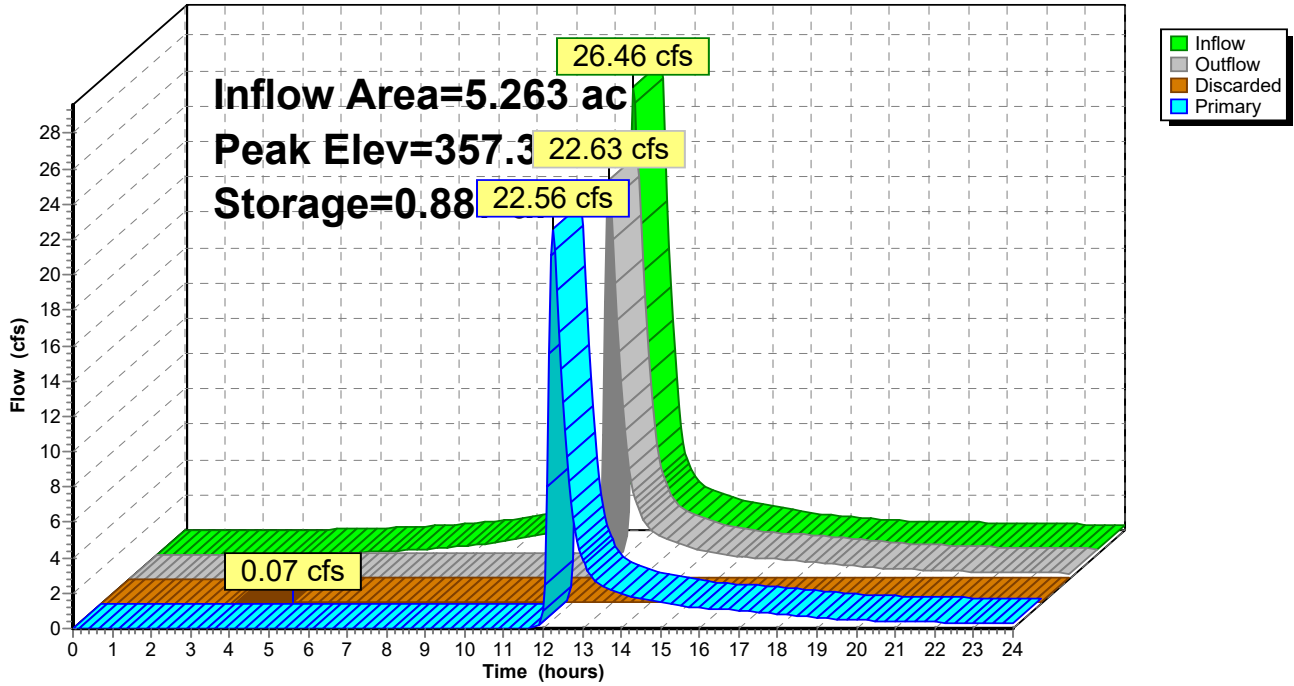
2,124.8 cy Field

504.2 cy Stone



Pond 4P: Stormtrap

Hydrograph



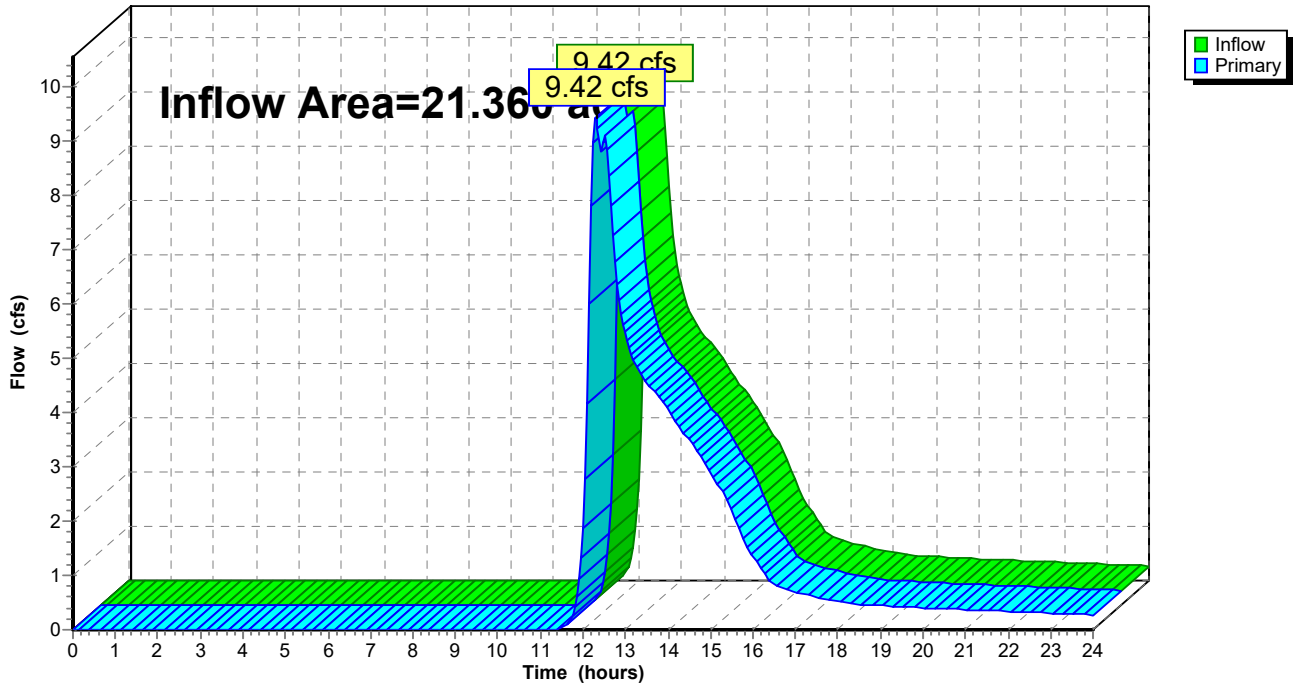
Summary for Link 1L: SE Corner

Inflow Area = 21.360 ac, 30.31% Impervious, Inflow Depth > 0.99" for 100 Yr event
Inflow = 9.42 cfs @ 12.31 hrs, Volume= 1.765 af
Primary = 9.42 cfs @ 12.31 hrs, Volume= 1.765 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 1L: SE Corner

Hydrograph



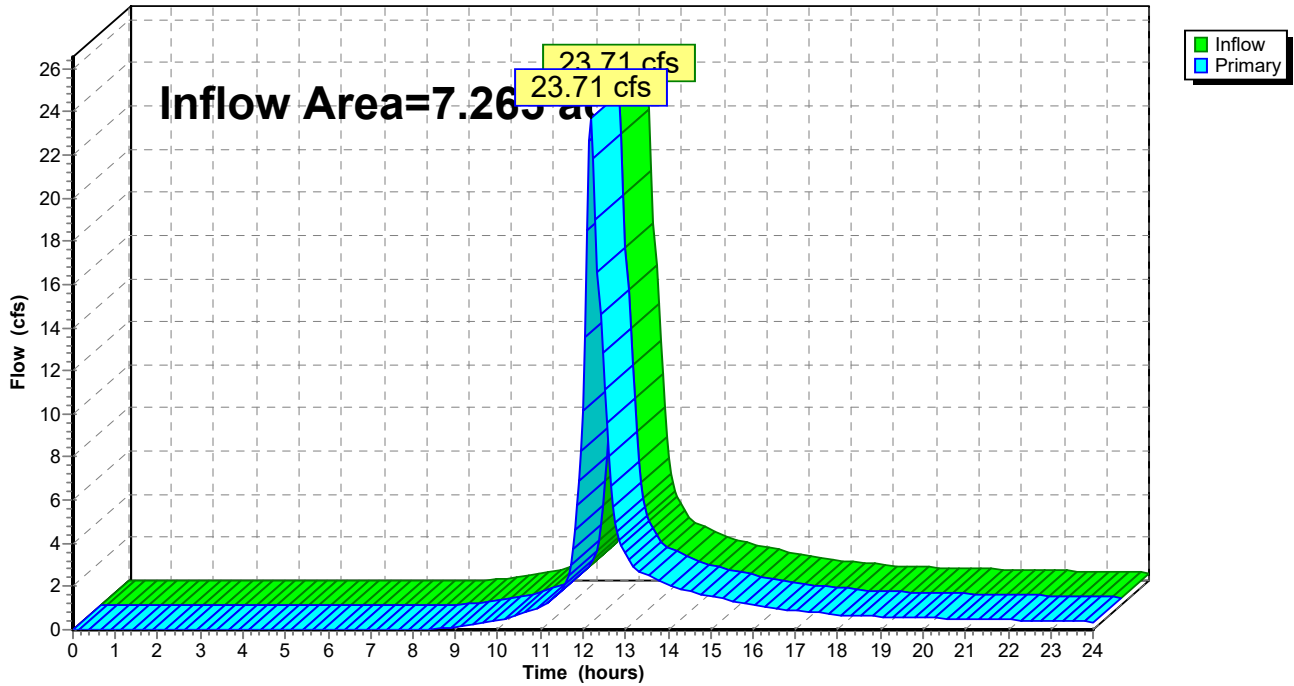
Summary for Link 2L: Wly Wetland

Inflow Area = 7.265 ac, 3.48% Impervious, Inflow Depth > 3.57" for 100 Yr event
Inflow = 23.71 cfs @ 12.19 hrs, Volume= 2.159 af
Primary = 23.71 cfs @ 12.19 hrs, Volume= 2.159 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Link 2L: Wly Wetland

Hydrograph



Appendix C

Stormwater Checklist

TSS Calculation Worksheet

Illicit Discharge Statement

Pipe Sizing

Soil Information

**A
P
P
E
N
D
I
X
C**

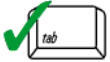
STORMWATER CHECKLIST



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 8²
- 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.



Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

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



Checklist for Stormwater Report

Checklist (continued)

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

- 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 Field¹
- 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.

TSS CALCULATION WORKSHEET

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C value within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location:

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

TSS Removal Calculation Worksheet

Total TSS Removal =

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

Project:

Prepared By:

Date:

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

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C value within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location:

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

TSS Removal Calculation Worksheet

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

Total TSS Removal =

Project:

Prepared By:

Date:

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

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C value within Row
5. Total TSS Removal = Sum All Values in Column D

Location:

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

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

Total TSS Removal =

Project:
 Prepared By:
 Date:

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

TSS Removal Calculation Worksheet

ILLICIT DISCHARGE STATEMENT

ILLCIT DISCHARGE STATEMENT

Project: Arbella at Ashland
Ashland, MA

Date: December 23, 2020

The stormwater management system proposed shall not be connected to the wastewater management system and shall not be contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease per Massachusetts DEP stormwater standard 10.

Engineer:

Allen & Major Associates, Inc.
10 Main Street
Lakeville, MA 02347

Philip Cordeiro

Print Name

Signature

Owner:

UA Senior Manager, LLC
Rensselaer Technology Park 300 Jordon Road
Troy, NY 12180

Print Name

Signature

PIPE SIZING



DESIGN YEAR: 25
K= 230 B= 30

Title **Stormwater Conveyance Sizing (25 YEAR STORM)**
Project **Arbella at Ashland - Ashland, MA**
Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Minimum Slope: 0.50%
Minimum Size: 12 inch
Rainfall Intensity (in/hr): 6.57 (25 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.00 fps
Max. Velocity: 12.00 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
Stormtrap System																
PCB 1A	PDMH 1	22.37	364.94	364.71	1.00	CIRCULAR	12.000	0.0120	0.68	0 00:05	3.71	0.10	3.86	0.18	0.28	Good
PCB 1B	PDMH 1	14.80	364.93	364.71	1.50	CIRCULAR	12.000	0.0120	0.85	0 00:05	4.56	0.05	4.73	0.18	0.29	Good
BLDG 6 ROOF	PDMH 1	39.64	365.50	364.71	2.00	CIRCULAR	12.000	0.0120	0.62	0 00:05	4.92	0.13	5.46	0.11	0.23	Good
PDMH 1	PDMH 2	162	364.61	362.19	1.50	CIRCULAR	12.000	0.0120	2.10	0 00:05	5.94	0.45	4.73	0.44	0.46	Good
BLDG 7 ROOF	PDMH 2	39	364.00	363.22	2.00	CIRCULAR	12.000	0.0120	0.62	0 00:05	4.90	0.13	5.46	0.11	0.23	Good
PDMH 2	PDMH 3	85	362.09	360.64	1.71	CIRCULAR	12.000	0.0120	2.68	0 00:05	6.56	0.22	5.04	0.53	0.52	Good
PCB 3A	PDMH 3	10	360.74	360.64	1.00	CIRCULAR	12.000	0.0120	1.48	0 00:05	4.60	0.04	3.86	0.38	0.43	Good
PCB 3B	PDMH 3	11	360.75	360.64	1.00	CIRCULAR	12.000	0.0120	1.78	0 00:05	4.83	0.04	3.87	0.46	0.48	Good
PDMH 3	PDMH 4	102	360.14	359.45	0.67	CIRCULAR	18.000	0.0120	5.70	0 00:05	5.59	0.31	9.32	0.61	0.85	Good
PCB 4A	PDMH 4	9	360.00	359.95	0.50	CIRCULAR	12.000	0.0120	0.60	0 00:05	2.80	0.05	2.73	0.22	0.32	Good
PCB 4B	PDMH 4	10.36	360.00	359.95	0.50	CIRCULAR	12.000	0.0120	0.54	0 00:05	2.72	0.06	2.73	0.20	0.30	Good
PDMH 4	PDMH 5	53.69	358.95	358.82	0.25	CIRCULAR	24.000	0.0120	6.76	0 00:05	4.02	0.22	12.24	0.55	1.06	Good
PCB 5A	PDMH 5	16.71	359.88	359.71	1.00	CIRCULAR	12.000	0.0120	1.87	0 00:05	4.89	0.06	3.86	0.49	0.49	Good
BLDG 8 ROOF	PDMH 5	26.26	359.98	359.71	1.00	CIRCULAR	12.000	0.0120	0.29	0 00:05	3.29	0.13	3.86	0.08	0.19	Good
PDMH 5	PDMH 6	161.89	358.71	358.18	0.33	CIRCULAR	24.000	0.0120	8.66	0 00:06	4.82	0.56	14.08	0.62	1.13	Good
BLDG 2 ROOF	PDMH 6	54.30	359.00	358.46	1.00	CIRCULAR	12.00	0.0120	2.750	0 00:05	5.40	0.17	3.86	0.71	0.62	Good
PDMH 6	PDMH 7	96.95	358.08	357.60	0.50	CIRCULAR	24.00	0.0120	11.040	0 00:06	5.89	0.27	17.33	0.64	1.16	Good
PCB 7A	PDMH 7	19.28	359.00	358.61	2.00	CIRCULAR	12.00	0.0120	1.680	0 00:05	6.13	0.05	5.46	0.31	0.38	Good
BLDG 9 ROOF	PDMH 7	23.26	359.00	358.61	1.66	CIRCULAR	12.00	0.0120	0.470	0 00:05	4.00	0.1	4.97	0.09	0.21	Good
PDMH 7	PDMH 8	205.00	357.50	356.06	0.70	CIRCULAR	24.00	0.0120	12.750	0 00:06	7.01	0.49	20.50	0.62	1.14	Good
PCB 8A	PDMH 8	19.45	358.00	357.61	2.00	CIRCULAR	12.00	0.0120	2.420	0 00:05	6.75	0.05	5.46	0.44	0.47	Good
BLDG 10 ROOF	PDMH 8	24.92	358.00	357.61	1.56	CIRCULAR	12.00	0.0120	0.470	0 00:05	3.95	0.11	4.82	0.10	0.21	Good
PDMH 8	PDMH 9(WQS)	80.32	355.96	355.16	1.00	CIRCULAR	24.00	0.0120	15.010	0 00:06	8.20	0.16	24.51	0.61	1.13	Good
PDMH 9(WQS)	ST A	5.51	355.06	355.00	1.00	CIRCULAR	24.00	0.0120	15.010	0 00:06	8.18	0.01	24.48	0.61	1.13	Good
BLDG 1 ROOF	ST B	36.02	357.00	356.25	2.08	CIRCULAR	12.00	0.0120	2.410	0 00:05	6.86	0.09	5.57	0.43	0.46	Good
PCB 9(WQS)	ST C	2.07	356.33	356.25	4.00	CIRCULAR	12.00	0.0120	1.040	0 00:05	6.86	0.01	7.72	0.14	0.25	Good
BLDG 11 ROOF	ST E	11.64	356.72	356.25	4.00	CIRCULAR	12.00	0.0120	0.530	0 00:05	5.60	0.03	7.72	0.07	0.18	Good
PCB 10(WQS)	ST D	25.78	357.28	356.25	4.00	CIRCULAR	12.00	0.0120	0.620	0 00:05	5.93	0.07	7.72	0.08	0.19	Good
PCB 11(WQS)	ST F	5.26	356.46	356.25	4.01	CIRCULAR	12.00	0.0120	1.310	0 00:05	7.33	0.01	7.73	0.17	0.28	Good



DESIGN YEAR: 25
K= 230 B= 30

Title **Stormwater Conveyance Sizing (25 YEAR STORM)**
Project **Arbella at Ashland - Ashland, MA**
Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Minimum Slope: 0.50%
Minimum Size: 12 inch
Rainfall Intensity (in/hr): 6.57 (25 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.00 fps
Max. Velocity: 12.00 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
Infiltration Basin																
ST G	PDMH 10	8.00	353.50	353.34	2.00	CIRCULAR	24.00	0.0120	13.800	0 00:00	10.43	0.01	34.67	0.40	0.87	Good
PDMH 10	PDMH 11	106.50	352.12	349.99	2.00	CIRCULAR	24.00	0.0120	13.710	0 00:02	10.39	0.17	34.66	0.40	0.87	Good
PCB 17A	PDMH 17	29.63	370.15	370.00	0.50	CIRCULAR	12.000	0.0120	1.14	0 00:05	3.36	0.15	2.73	0.42	0.45	Good
PCB 17B	PDMH 17	31.36	370.16	370.00	0.50	CIRCULAR	12.00	0.0120	0.210	0 00:05	2.72	0.19	2.73	0.08	0.19	Good
PCB 17C	PDMH 17	65.41	368.50	368.17	0.50	CIRCULAR	12.00	0.0120	0.360	0 00:05	3.64	0.3	2.73	0.13	0.24	Good
PDMH 17	PDMH 16	103.49	368.07	367.56	0.50	CIRCULAR	15.000	0.0120	1.67	0 00:05	3.70	0.47	4.95	0.34	0.50	Good
PCB 16A	PDMH 16	8.33	369.29	369.12	2.00	CIRCULAR	12.00	0.0120	1.720	0 00:05	6.16	0.02	5.46	0.31	0.39	Good
PDMH 16	PDMH 15	103.14	367.46	366.42	1.00	CIRCULAR	15.00	0.0120	3.250	0 00:05	5.65	0.3	7.00	0.46	0.60	Good
BLDG 3 ROOF	PDMH 15	69.58	370.02	368.63	2.00	CIRCULAR	12.00	0.0120	1.640	0 00:05	6.56	0.18	5.46	0.30	0.37	Good
PCB 15A	PDMH 15	79.00	369.66	368.63	1.30	CIRCULAR	12.00	0.0120	0.230	0 00:05	4.52	0.29	4.41	0.05	0.16	Good
PDMH 15	PDMH 14	121.70	366.31	365.09	1.00	CIRCULAR	15.00	0.0120	5.020	0 00:05	6.27	0.32	7.00	0.72	0.78	Good
PCB 14A	PDMH 14	19.20	366.38	366.00	2.00	CIRCULAR	12.00	0.0120	0.610	0 00:05	4.60	0.07	5.46	0.11	0.23	Good
PCB 14B	PDMH 14	6.59	366.14	366.04	1.56	CIRCULAR	12.00	0.0120	1.730	0 00:05	5.64	0.02	4.83	0.36	0.41	Good
PCB 14C	PDMH 14	34.47	366.58	366.04	1.56	CIRCULAR	12.00	0.0120	0.320	0 00:05	4.06	0.14	4.83	0.07	0.18	Good
PDMH 14	PDMH 13	16.29	364.99	364.58	2.50	CIRCULAR	15.00	0.0120	7.450	0 00:05	9.67	0.03	11.06	0.67	0.75	Good
BLDG 5 ROOF	PDMH 13	79.04	367.07	366.28	1.00	CIRCULAR	12.00	0.0120	1.200	0 00:05	5.54	0.24	3.86	0.31	0.38	Good
PDMH 13	PDMH 12	201.84	364.48	359.44	2.50	CIRCULAR	15.00	0.0120	8.590	0 00:05	10.09	0.33	11.07	0.78	0.83	Good
PCB 12A	PDMH 12	16.26	359.66	359.25	2.50	CIRCULAR	12.00	0.0120	0.740	0 00:05	5.26	0.05	6.10	0.12	0.24	Good
PCB 12B	PDMH 12	14.53	359.40	359.25	1.00	CIRCULAR	12.00	0.0120	1.100	0 00:05	4.25	0.06	3.86	0.28	0.36	Good
BLDG 4 ROOF	PDMH 12	36.88	359.62	359.25	1.00	CIRCULAR	12.00	0.0120	1.210	0 00:05	4.37	0.14	3.86	0.31	0.38	Good
PDMH 12	PDMH 11	23.06	358.85	358.39	2.00	CIRCULAR	18.00	0.0120	11.370	0 00:05	9.87	0.04	16.10	0.71	0.93	Good
PDMH 11	PDMH 18	28.99	349.89	349.17	2.50	CIRCULAR	24.00	0.0120	25.080	0 00:05	13.11	0.04	38.75	0.65	1.17	Good
PCB 18A	PDMH 18	40.06	357.92	357.32	1.50	CIRCULAR	12.00	0.0120	2.760	0 00:10	6.26	0.11	4.73	0.58	0.55	Good
PCB 18B	PDMH 18	15.02	357.25	357.10	1.00	CIRCULAR	12.00	0.0120	0.290	0 00:05	2.89	0.09	3.86	0.07	0.18	Good
PDMH 18	PDMH 19	166.54	345.71	343.21	1.50	CIRCULAR	30.00	0.0120	26.840	0 00:06	11.07	0.25	54.42	0.49	1.24	Good
PCB 19A	PDMH 19	19.92	345.25	344.71	2.70	CIRCULAR	12.00	0.0120	1.690	0 00:05	6.84	0.05	6.34	0.27	0.35	Good
PCB 19B	PDMH 19	13.44	345.25	344.71	4.00	CIRCULAR	12.00	0.0120	0.590	0 00:05	5.82	0.04	7.72	0.08	0.19	Good
PDMH 19	PDMH 20	187.43	330.81	328.00	1.50	CIRCULAR	30.00	0.0120	28.780	0 00:06	11.26	0.28	54.41	0.53	1.29	Good
PCB 20A	PDMH 20	21.08	330.50	330.00	2.37	CIRCULAR	12.00	0.0120	0.520	0 00:05	4.68	0.08	5.94	0.09	0.20	Good
PCB 20B	PDMH 20	12.86	330.50	330.00	3.89	CIRCULAR	12.00	0.0120	1.390	0 00:05	7.36	0.03	7.61	0.18	0.29	Good
PDMH 20	PDMH 21	147.45	320.21	318.00	1.50	CIRCULAR	30.00	0.0120	30.370	0 00:06	11.40	0.22	54.42	0.56	1.33	Good



DESIGN YEAR: 25
K= 230 B= 30

Title **Stormwater Conveyance Sizing (25 YEAR STORM)**
Project **Arbella at Ashland - Ashland, MA**
Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Minimum Slope: 0.50%
Minimum Size: 12 inch
Rainfall Intensity (in/hr): 6.57 (25 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.00 fps
Max. Velocity: 12.00 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
PDMH 21	PDMH 22	96.11	311.44	310.00	1.50	CIRCULAR	30.00	0.0120	30.360	0 00:06	11.39	0.14	54.43	0.56	1.33	Good
PCB 22A	PDMH 22	23.91	312.48	312.00	2.00	CIRCULAR	12.00	0.0120	0.620	0 00:05	4.62	0.09	5.46	0.11	0.23	Good
PCB 22B	PDMH 22	20.01	312.40	312.00	2.00	CIRCULAR	12.00	0.0120	0.800	0 00:05	4.98	0.07	5.46	0.15	0.26	Good
PDMH 22	PDMH 23	219.35	297.79	294.50	1.50	CIRCULAR	30.00	0.0120	31.480	0 00:06	11.52	0.32	54.42	0.58	1.36	Good
PCB 23A	PDMH 23	30.37	294.25	293.64	2.00	CIRCULAR	12.00	0.0120	0.650	0 00:05	4.69	0.11	5.46	0.12	0.23	Good
PCB 23B	PDMH 23	15.53	293.95	293.64	2.00	CIRCULAR	12.00	0.0120	0.680	0 00:05	4.74	0.05	5.46	0.12	0.24	Good
PDMH 23	PDMH 24	39.63	286.59	286.00	1.50	CIRCULAR	30.00	0.0120	32.510	0 00:06	11.57	0.06	54.40	0.60	1.39	Good
PDMH 24	PDMH 25(WQS)	7.56	285.75	285.67	1.01	CIRCULAR	12.00	0.0120	4.010	0 00:01	5.27	0.02	3.87	1.04	1.00	Surcharged
PDMH 25(WQS)	PFES 1A	16.40	285.57	285.41	1.00	CIRCULAR	12.00	0.0120	3.870	0 00:02	5.15	0.05	3.86	1.00	0.91	>Capacity
PDMH 24	PFES 1	20.22	286.00	285.70	1.50	CIRCULAR	30.00	0.0120	28.640	0 00:06	11.22	0.03	54.39	0.53	1.29	Good
OCS	PDMH 27	118.45	280.91	277.45	2.93	CIRCULAR	24.00	0.0120	0.390	0 00:06	4.17	0.47	41.92	0.01	0.14	Good
PCB 26A	PDMH 26(WQS)	6.55	279.46	279.20	4.00	CIRCULAR	12.00	0.0120	1.060	0 00:05	6.90	0.02	7.72	0.14	0.25	Good
PCB 26B	PDMH 26(WQS)	60.00	279.50	279.20	0.50	CIRCULAR	12.00	0.0120	0.980	0 00:05	4.04	0.25	2.73	0.36	0.41	Good
PDMH 26(WQS)	PDMH 27	5.93	279.10	279.04	1.00	CIRCULAR	12.00	0.0120	2.010	0 00:05	4.96	0.02	3.86	0.52	0.51	Good
PDMH 27	PFES 2	258.12	277.35	269.61	3.00	CIRCULAR	24.00	0.0120	2.370	0 00:05	7.41	0.58	42.45	0.06	0.32	Good



Title **Stormwater Conveyance Sizing (25 YEAR STORM)**

Project **Arbella at Ashland - Ashland, MA**

Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Watershed	Drainage Node ID	Area (acres)	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	Time of Concentration (days hh:mm:ss)
1	PCB 26B	0.22	0.7000	0.55	0.38	1.00	6.571	0 00:05:00
2	PCB 26A	0.21	0.7600	0.55	0.42	1.06	6.571	0 00:05:00
3	PCB 23B	0.16	0.6700	0.55	0.37	0.68	6.571	0 00:05:00
4	PCB 22B	0.21	0.5800	0.55	0.32	0.81	6.571	0 00:05:00
5	PCB 20A	0.12	0.6700	0.55	0.37	0.53	6.571	0 00:05:00
6	PCB 20B	0.57	0.3700	0.55	0.20	1.39	6.571	0 00:05:00
7	PCB 19B	0.17	0.5400	0.55	0.30	0.59	6.571	0 00:05:00
8	PCB 19A	0.64	0.4000	0.55	0.22	1.69	6.571	0 00:05:00
9	PCB 18B	0.05	0.8400	0.55	0.46	0.29	6.571	0 00:05:00
10	PCB 11(WQS)	0.34	0.5800	0.55	0.32	1.31	6.571	0 00:05:00
11	PCB 10(WQS)	0.17	0.5500	0.55	0.30	0.63	6.571	0 00:05:00
12	BLDG 1 ROOF	0.41	0.9000	0.55	0.49	2.43	6.571	0 00:05:00
13	PCB 9(WQS)	0.20	0.7900	0.55	0.43	1.04	6.571	0 00:05:00
14	BLDG ROOF 11	0.09	0.9000	0.55	0.49	0.53	6.571	0 00:05:00
15	PCB 8A	0.55	0.6700	0.55	0.37	2.43	6.571	0 00:05:00
16	BLDG 10 ROOF	0.08	0.9000	0.55	0.49	0.47	6.571	0 00:05:00
17	BLDG 2 ROOF	0.47	0.9000	0.55	0.49	2.78	6.571	0 00:05:00
18	PCB 7A	0.36	0.7200	0.55	0.39	1.68	6.571	0 00:05:00
19	BLDG 9 ROOF	0.08	0.9000	0.55	0.49	0.47	6.571	0 00:05:00
20	PCB 5A	0.42	0.6900	0.55	0.38	1.88	6.571	0 00:05:00
21	BLDG 8 ROOF	0.05	0.9000	0.55	0.49	0.30	6.571	0 00:05:00
22	PCB 4B	0.10	0.8100	0.55	0.44	0.55	6.571	0 00:05:00
23	PCB 4A	0.12	0.7900	0.55	0.43	0.61	6.571	0 00:05:00
24	PCB 2A	0.34	0.6600	0.55	0.36	1.49	6.571	0 00:05:00
25	PCB 2B	0.56	0.4900	0.55	0.27	1.79	6.571	0 00:05:00
26	BLDG 7 ROOF	0.11	0.9000	0.55	0.49	0.62	6.571	0 00:05:00
27	BLDG 6 ROOF	0.11	0.9000	0.55	0.49	0.62	6.571	0 00:05:00
28	PCB 1A	0.14	0.7300	0.55	0.40	0.69	6.571	0 00:05:00
29	PCB 1B	0.57	0.2300	0.55	0.13	0.86	6.571	0 00:05:00
30	BLDG 3 ROOF	0.28	0.9000	0.55	0.49	1.66	6.571	0 00:05:00
31	PCB 17C	0.16	0.3400	0.55	0.19	0.37	6.571	0 00:05:00
32	PCB 17A	0.35	0.5000	0.55	0.27	1.15	6.571	0 00:05:00
33	PCB 16A	0.37	0.7000	0.55	0.38	1.72	6.571	0 00:05:00
34	PCB 17B	0.05	0.6000	0.55	0.33	0.21	6.571	0 00:05:00
35	PCB 15A	0.08	0.4400	0.55	0.24	0.24	6.571	0 00:05:00
36	PCB 14B	0.52	0.5100	0.55	0.28	1.74	6.571	0 00:05:00
37	PCB 14C	0.08	0.6300	0.55	0.35	0.33	6.571	0 00:05:00
38	PCB 14A	0.13	0.7200	0.55	0.39	0.62	6.571	0 00:05:00



Title **Stormwater Conveyance Sizing (25 YEAR STORM)**

Project **Arbella at Ashland - Ashland, MA**

Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Watershed	Drainage Node ID	Area (acres)	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	Time of Concentration (days hh:mm:ss)
39	BLDG 5 ROOF	0.21	0.9000	0.55	0.49	1.22	6.571	0 00:05:00
40	PCB 12A	0.15	0.7500	0.55	0.41	0.75	6.571	0 00:05:00
41	PCB 13A	1.50	0.3200	0.96	0.31	2.76	5.750	0 00:10:00
42	BLDG 4 ROOF	0.21	0.9000	0.55	0.49	1.22	6.571	0 00:05:00
43	PCB 12B	0.36	0.4600	0.55	0.25	1.10	6.571	0 00:05:00
44	PCB 22A	0.14	0.6900	0.55	0.38	0.62	6.571	0 00:05:00
45	PCB 23A	0.15	0.6700	0.55	0.37	0.66	6.571	0 00:05:00



DESIGN YEAR: 100
 K= 290 B= 31

Title **Stormwater Conveyance Sizing (100 YEAR STORM)**
 Project **Arbella at Ashland - Ashland, MA**
 Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Minimum Slope: 0.50%
 Minimum Size: 12 inch
 Rainfall Intensity (in/hr): 8.05 (100 year storm)
 Manning's n: 0.012 HDPE
 Manning's n: 0.013 RCP
 Min. Velocity: 2.00 fps
 Max. Velocity: 12.00 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
Stormtrap System																
PCB 1A	PDMH 1	22.37	364.94	364.71	1.00	CIRCULAR	12.000	0.0120	0.83	0 00:05	3.93	0.09	3.86	0.22	0.31	Good
PCB 1B	PDMH 1	14.80	364.93	364.71	1.50	CIRCULAR	12.000	0.0120	1.05	0 00:05	4.85	0.05	4.73	0.22	0.32	Good
BLDG 6 ROOF	PDMH 1	39.64	365.50	364.71	2.00	CIRCULAR	12.000	0.0120	0.75	0 00:05	4.99	0.13	5.46	0.14	0.25	Good
PDMH 1	PDMH 2	162	364.61	362.19	1.50	CIRCULAR	12.000	0.0120	2.57	0 00:05	6.26	0.43	4.73	0.54	0.52	Good
BLDG 7 ROOF	PDMH 2	39	364.00	363.22	2.00	CIRCULAR	12.000	0.0120	0.75	0 00:05	4.97	0.13	5.46	0.14	0.25	Good
PDMH 2	PDMH 3	85	362.09	360.64	1.71	CIRCULAR	12.000	0.0120	3.29	0 00:05	6.88	0.21	5.04	0.65	0.59	Good
PCB 3A	PDMH 3	10	360.74	360.64	1.00	CIRCULAR	12.000	0.0120	1.82	0 00:05	4.85	0.04	3.86	0.47	0.48	Good
PCB 3B	PDMH 3	11	360.75	360.64	1.00	CIRCULAR	12.000	0.0120	2.19	0 00:05	5.09	0.04	3.87	0.57	0.54	Good
PDMH 3	PDMH 4	102	360.14	359.45	0.67	CIRCULAR	18.000	0.0120	7.03	0 00:05	5.85	0.29	9.32	0.75	0.97	Good
PCB 4A	PDMH 4	9	360.00	359.95	0.50	CIRCULAR	12.000	0.0120	0.74	0 00:05	2.96	0.05	2.73	0.27	0.35	Good
PCB 4B	PDMH 4	10.36	360.00	359.95	0.50	CIRCULAR	12.000	0.0120	0.67	0 00:05	2.88	0.06	2.73	0.24	0.34	Good
PDMH 4	PDMH 5	53.69	358.95	358.82	0.25	CIRCULAR	24.000	0.0120	8.34	0 00:05	4.21	0.21	12.24	0.68	1.21	Good
PCB 5A	PDMH 5	16.71	359.88	359.71	1.00	CIRCULAR	12.000	0.0120	2.30	0 00:05	5.14	0.05	3.86	0.60	0.55	Good
BLDG 8 ROOF	PDMH 5	26.26	359.98	359.71	1.00	CIRCULAR	12.000	0.0120	0.36	0 00:05	3.43	0.13	3.86	0.09	0.21	Good
PDMH 5	PDMH 6	161.89	358.71	358.18	0.33	CIRCULAR	24.000	0.0120	10.68	0 00:06	5.05	0.53	14.08	0.76	1.30	Good
BLDG 2 ROOF	PDMH 6	54.30	359.00	358.46	1.00	CIRCULAR	12.00	0.0120	3.370	0 00:05	5.58	0.16	3.86	0.87	0.72	Good
PDMH 6	PDMH 7	96.95	358.08	357.60	0.50	CIRCULAR	24.00	0.0120	13.620	0 00:06	6.16	0.26	17.33	0.79	1.33	Good
PCB 7A	PDMH 7	19.28	359.00	358.61	2.00	CIRCULAR	12.00	0.0120	2.050	0 00:05	6.47	0.05	5.46	0.38	0.42	Good
BLDG 9 ROOF	PDMH 7	23.26	359.00	358.61	1.66	CIRCULAR	12.00	0.0120	0.580	0 00:05	4.23	0.09	4.97	0.12	0.23	Good
PDMH 7	PDMH 8	205.00	357.50	356.06	0.70	CIRCULAR	24.00	0.0120	15.770	0 00:06	7.35	0.46	20.50	0.77	1.31	Good
PCB 8A	PDMH 8	19.45	358.00	357.61	2.00	CIRCULAR	12.00	0.0120	2.960	0 00:05	7.10	0.05	5.46	0.54	0.52	Good
BLDG 10 ROOF	PDMH 8	24.92	358.00	357.61	1.56	CIRCULAR	12.00	0.0120	0.580	0 00:05	4.14	0.1	4.82	0.12	0.23	Good
PDMH 8	PDMH 9(WQS)	80.32	355.96	355.16	1.00	CIRCULAR	24.00	0.0120	18.560	0 00:06	8.60	0.16	24.51	0.76	1.30	Good
PDMH 9(WQS)	ST A	5.51	355.06	355.00	1.00	CIRCULAR	24.00	0.0120	18.560	0 00:06	8.57	0.01	24.48	0.76	1.30	Good
BLDG 1 ROOF	ST B	36.02	357.00	356.25	2.08	CIRCULAR	12.00	0.0120	2.950	0 00:05	7.21	0.08	5.57	0.53	0.52	Good
PCB 9(WQS)	ST C	2.07	356.33	356.25	4.00	CIRCULAR	12.00	0.0120	1.280	0 00:05	7.27	0	7.72	0.17	0.28	Good
BLDG 11 ROOF	ST E	11.64	356.72	356.25	4.00	CIRCULAR	12.00	0.0120	0.650	0 00:05	5.98	0.03	7.72	0.08	0.20	Good
PCB 10(WQS)	ST D	25.78	357.28	356.25	4.00	CIRCULAR	12.00	0.0120	0.770	0 00:05	6.28	0.07	7.72	0.10	0.21	Good
PCB 11(WQS)	ST F	5.26	356.46	356.25	4.01	CIRCULAR	12.00	0.0120	1.610	0 00:05	7.77	0.01	7.73	0.21	0.31	Good



DESIGN YEAR: 100
K= 290 B= 31

Title **Stormwater Conveyance Sizing (100 YEAR STORM)**
Project **Arbella at Ashland - Ashland, MA**
Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Minimum Slope: 0.50%
Minimum Size: 12 inch
Rainfall Intensity (in/hr): 8.05 (100 year storm)
Manning's n: 0.012 HDPE
Manning's n: 0.013 RCP
Min. Velocity: 2.00 fps
Max. Velocity: 12.00 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
Infiltration Basin																
ST G	PDMH 10	8.00	353.50	353.34	2.00	CIRCULAR	24.00	0.0120	23.540	0 00:00	12.05	0.01	34.67	0.68	1.18	Good
PDMH 10	PDMH 11	106.50	352.12	349.99	2.00	CIRCULAR	24.00	0.0120	22.570	0 00:02	11.74	0.15	34.66	0.65	1.18	Good
PCB 17A	PDMH 17	29.63	370.15	370.00	0.50	CIRCULAR	12.000	0.0120	1.40	0 00:05	3.51	0.14	2.73	0.51	0.51	Good
PCB 17B	PDMH 17	31.36	370.16	370.00	0.50	CIRCULAR	12.00	0.0120	0.260	0 00:05	2.85	0.18	2.73	0.09	0.21	Good
PCB 17C	PDMH 17	65.41	368.50	368.17	0.50	CIRCULAR	12.00	0.0120	0.440	0 00:05	3.78	0.29	2.73	0.16	0.27	Good
PDMH 17	PDMH 16	103.49	368.07	367.56	0.50	CIRCULAR	15.000	0.0120	2.04	0 00:05	3.90	0.44	4.95	0.41	0.56	Good
PCB 16A	PDMH 16	8.33	369.29	369.12	2.00	CIRCULAR	12.00	0.0120	2.100	0 00:05	6.50	0.02	5.46	0.39	0.43	Good
PDMH 16	PDMH 15	103.14	367.46	366.42	1.00	CIRCULAR	15.00	0.0120	4.000	0 00:05	5.94	0.29	7.00	0.57	0.68	Good
BLDG 3 ROOF	PDMH 15	69.58	370.02	368.63	2.00	CIRCULAR	12.00	0.0120	2.000	0 00:05	6.54	0.18	5.46	0.37	0.42	Good
PCB 15A	PDMH 15	79.00	369.66	368.63	1.30	CIRCULAR	12.00	0.0120	0.290	0 00:05	4.66	0.28	4.41	0.07	0.17	Good
PDMH 15	PDMH 14	121.70	366.31	365.09	1.00	CIRCULAR	15.00	0.0120	6.190	0 00:05	6.54	0.31	7.00	0.88	0.91	Good
PCB 14A	PDMH 14	19.20	366.38	366.00	2.00	CIRCULAR	12.00	0.0120	0.750	0 00:05	4.88	0.07	5.46	0.14	0.25	Good
PCB 14B	PDMH 14	6.59	366.14	366.04	1.56	CIRCULAR	12.00	0.0120	2.120	0 00:05	5.95	0.02	4.83	0.44	0.46	Good
PCB 14C	PDMH 14	34.47	366.58	366.04	1.56	CIRCULAR	12.00	0.0120	0.400	0 00:05	4.15	0.14	4.83	0.08	0.19	Good
PDMH 14	PDMH 13	16.29	364.99	364.58	2.50	CIRCULAR	15.00	0.0120	9.190	0 00:05	10.08	0.03	11.06	0.83	0.87	Good
BLDG 5 ROOF	PDMH 13	79.04	367.07	366.28	1.00	CIRCULAR	12.00	0.0120	1.480	0 00:05	5.57	0.24	3.86	0.38	0.43	Good
PDMH 13	PDMH 12	201.84	364.48	359.44	2.50	CIRCULAR	15.00	0.0120	10.580	0 00:05	10.45	0.32	11.07	0.96	0.98	Good
PCB 12A	PDMH 12	16.26	359.66	359.25	2.50	CIRCULAR	12.00	0.0120	0.910	0 00:05	5.59	0.05	6.10	0.15	0.26	Good
PCB 12B	PDMH 12	14.53	359.40	359.25	1.00	CIRCULAR	12.00	0.0120	1.350	0 00:05	4.48	0.05	3.86	0.35	0.41	Good
BLDG 4 ROOF	PDMH 12	36.88	359.62	359.25	1.00	CIRCULAR	12.00	0.0120	1.490	0 00:05	4.62	0.13	3.86	0.39	0.43	Good
PDMH 12	PDMH 11	23.06	358.85	358.39	2.00	CIRCULAR	18.00	0.0120	13.970	0 00:05	10.26	0.04	16.10	0.87	1.08	Good
PDMH 11	PDMH 18	28.99	349.89	349.17	2.50	CIRCULAR	24.00	0.0120	36.540	0 00:05	14.02	0.03	38.75	0.94	1.55	Good
PCB 18A	PDMH 18	40.06	357.92	357.32	1.50	CIRCULAR	12.00	0.0120	3.380	0 00:10	6.56	0.1	4.73	0.72	0.63	Good
PCB 18B	PDMH 18	15.02	357.25	357.10	1.00	CIRCULAR	12.00	0.0120	0.350	0 00:05	3.06	0.08	3.86	0.09	0.20	Good
PDMH 18	PDMH 19	166.54	345.71	343.21	1.50	CIRCULAR	30.00	0.0120	38.700	0 00:05	12.05	0.23	54.42	0.71	1.56	Good
PCB 19A	PDMH 19	19.92	345.25	344.71	2.70	CIRCULAR	12.00	0.0120	2.070	0 00:05	7.23	0.05	6.34	0.33	0.39	Good
PCB 19B	PDMH 19	13.44	345.25	344.71	4.00	CIRCULAR	12.00	0.0120	0.720	0 00:05	6.17	0.04	7.72	0.09	0.21	Good
PDMH 19	PDMH 20	187.43	330.81	328.00	1.50	CIRCULAR	30.00	0.0120	41.090	0 00:06	12.21	0.26	54.41	0.76	1.62	Good
PCB 20A	PDMH 20	21.08	330.50	330.00	2.37	CIRCULAR	12.00	0.0120	0.640	0 00:05	4.96	0.07	5.94	0.11	0.22	Good
PCB 20B	PDMH 20	12.86	330.50	330.00	3.89	CIRCULAR	12.00	0.0120	1.700	0 00:05	7.81	0.03	7.61	0.22	0.32	Good
PDMH 20	PDMH 21	147.45	320.21	318.00	1.50	CIRCULAR	30.00	0.0120	43.040	0 00:06	12.31	0.2	54.42	0.79	1.68	Good



DESIGN YEAR: 100
 K= 290 B= 31

Title **Stormwater Conveyance Sizing (100 YEAR STORM)**

Project **Arbella at Ashland - Ashland, MA**

Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Minimum Slope: 0.50%
 Minimum Size: 12 inch
 Rainfall Intensity (in/hr): 8.05 (100 year storm)
 Manning's n: 0.012 HDPE
 Manning's n: 0.013 RCP
 Min. Velocity: 2.00 fps
 Max. Velocity: 12.00 fps

From (Inlet) Node	To (Outlet) Node	Length (ft)	Inlet Invert Elevation (ft)	Outlet Invert Elevation (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (inches)	Manning's Roughness	Peak Flow (cfs)	Time of Peak Flow (days hh:mm)	Max Flow Velocity (ft/sec)	Travel Time (min)	Design Flow Capacity (cfs)	Max Flow / Design Flow Ratio	Max Flow Depth (ft)	Reported Condition
PDMH 21	PDMH 22	96.11	311.44	310.00	1.50	CIRCULAR	30.00	0.0120	43.030	0 00:06	12.30	0.13	54.43	0.79	1.68	Good
PCB 22A	PDMH 22	23.91	312.48	312.00	2.00	CIRCULAR	12.00	0.0120	0.760	0 00:05	4.89	0.08	5.46	0.14	0.25	Good
PCB 22B	PDMH 22	20.01	312.40	312.00	2.00	CIRCULAR	12.00	0.0120	0.980	0 00:05	5.27	0.06	5.46	0.18	0.29	Good
PDMH 22	PDMH 23	219.35	297.79	294.50	1.50	CIRCULAR	30.00	0.0120	44.420	0 00:06	12.41	0.29	54.42	0.82	1.72	Good
PCB 23A	PDMH 23	30.37	294.25	293.64	2.00	CIRCULAR	12.00	0.0120	0.800	0 00:05	4.98	0.1	5.46	0.15	0.26	Good
PCB 23B	PDMH 23	15.53	293.95	293.64	2.00	CIRCULAR	12.00	0.0120	0.830	0 00:05	5.03	0.05	5.46	0.15	0.26	Good
PDMH 23	PDMH 24	39.63	286.59	286.00	1.50	CIRCULAR	30.00	0.0120	45.700	0 00:06	12.41	0.05	54.40	0.84	1.76	Good
PDMH 24	PDMH 25(WQS)	7.56	285.75	285.67	1.01	CIRCULAR	12.00	0.0120	4.130	0 00:01	5.37	0.02	3.87	1.07	1.00	Surcharged
PDMH 25(WQS)	PFES 1A	16.40	285.57	285.41	1.00	CIRCULAR	12.00	0.0120	3.870	0 00:02	5.15	0.05	3.86	1.00	0.91	>Capacity
PDMH 24	PFES 1	20.22	286.00	285.70	1.50	CIRCULAR	30.00	0.0120	41.830	0 00:06	12.22	0.03	54.39	0.77	1.64	Good
OCS	PDMH 27	118.45	280.91	277.45	2.93	CIRCULAR	24.00	0.0120	4.010	0 00:03	8.43	0.23	41.92	0.10	0.42	Good
PCB 26A	PDMH 26(WQS)	6.55	279.46	279.20	4.00	CIRCULAR	12.00	0.0120	1.300	0 00:05	7.31	0.01	7.72	0.17	0.28	Good
PCB 26B	PDMH 26(WQS)	60.00	279.50	279.20	0.50	CIRCULAR	12.00	0.0120	1.200	0 00:05	4.30	0.23	2.73	0.44	0.46	Good
PDMH 26(WQS)	PDMH 27	5.93	279.10	279.04	1.00	CIRCULAR	12.00	0.0120	2.480	0 00:05	5.22	0.02	3.86	0.64	0.58	Good
PDMH 27	PFES 2	258.12	277.35	269.61	3.00	CIRCULAR	24.00	0.0120	6.460	0 00:05	9.81	0.44	42.45	0.15	0.53	Good



Title **Stormwater Conveyance Sizing (100 YEAR STORM)**

Project **Arbella at Ashland - Ashland, MA**

Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Watershed	Drainage Node ID	Area (acres)	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	Time of Concentration (days hh:mm:ss)
1	PCB 26B	0.22	0.7000	0.67	0.47	1.22	8.056	0 00:05:00
2	PCB 26A	0.21	0.7600	0.67	0.51	1.30	8.056	0 00:05:00
3	PCB 23B	0.16	0.6700	0.67	0.45	0.84	8.056	0 00:05:00
4	PCB 22B	0.21	0.5800	0.67	0.39	0.99	8.056	0 00:05:00
5	PCB 20A	0.12	0.6700	0.67	0.45	0.65	8.056	0 00:05:00
6	PCB 20B	0.57	0.3700	0.67	0.25	1.70	8.056	0 00:05:00
7	PCB 19B	0.17	0.5400	0.67	0.36	0.73	8.056	0 00:05:00
8	PCB 19A	0.64	0.4000	0.67	0.27	2.07	8.056	0 00:05:00
9	PCB 18B	0.05	0.8400	0.67	0.56	0.35	8.056	0 00:05:00
10	PCB 11(WQS)	0.34	0.5800	0.67	0.39	1.61	8.056	0 00:05:00
11	PCB 10(WQS)	0.17	0.5500	0.67	0.37	0.77	8.056	0 00:05:00
12	BLDG 1 ROOF	0.41	0.9000	0.67	0.60	2.97	8.056	0 00:05:00
13	PCB 9(WQS)	0.20	0.7900	0.67	0.53	1.28	8.056	0 00:05:00
14	BLDG ROOF 11	0.09	0.9000	0.67	0.60	0.65	8.056	0 00:05:00
15	PCB 8A	0.55	0.6700	0.67	0.45	2.97	8.056	0 00:05:00
16	BLDG 10 ROOF	0.08	0.9000	0.67	0.60	0.58	8.056	0 00:05:00
17	BLDG 2 ROOF	0.47	0.9000	0.67	0.60	3.41	8.056	0 00:05:00
18	PCB 7A	0.36	0.7200	0.67	0.48	2.06	8.056	0 00:05:00
19	BLDG 9 ROOF	0.08	0.9000	0.67	0.60	0.58	8.056	0 00:05:00
20	PCB 5A	0.42	0.6900	0.67	0.46	2.31	8.056	0 00:05:00
21	BLDG 8 ROOF	0.05	0.9000	0.67	0.60	0.36	8.056	0 00:05:00
22	PCB 4B	0.10	0.8100	0.67	0.54	0.67	8.056	0 00:05:00
23	PCB 4A	0.12	0.7900	0.67	0.53	0.75	8.056	0 00:05:00
24	PCB 2A	0.34	0.6600	0.67	0.44	1.82	8.056	0 00:05:00
25	PCB 2B	0.56	0.4900	0.67	0.33	2.20	8.056	0 00:05:00
26	BLDG 7 ROOF	0.11	0.9000	0.67	0.60	0.76	8.056	0 00:05:00
27	BLDG 6 ROOF	0.11	0.9000	0.67	0.60	0.76	8.056	0 00:05:00
28	PCB 1A	0.14	0.7300	0.67	0.49	0.84	8.056	0 00:05:00
29	PCB 1B	0.57	0.2300	0.67	0.15	1.05	8.056	0 00:05:00
30	BLDG 3 ROOF	0.28	0.9000	0.67	0.60	2.03	8.056	0 00:05:00
31	PCB 17C	0.16	0.3400	0.67	0.23	0.45	8.056	0 00:05:00
32	PCB 17A	0.35	0.5000	0.67	0.34	1.41	8.056	0 00:05:00
33	PCB 16A	0.37	0.7000	0.67	0.47	2.11	8.056	0 00:05:00
34	PCB 17B	0.05	0.6000	0.67	0.40	0.26	8.056	0 00:05:00
35	PCB 15A	0.08	0.4400	0.67	0.30	0.29	8.056	0 00:05:00
36	PCB 14B	0.52	0.5100	0.67	0.34	2.13	8.056	0 00:05:00
37	PCB 14C	0.08	0.6300	0.67	0.42	0.40	8.056	0 00:05:00
38	PCB 14A	0.13	0.7200	0.67	0.48	0.75	8.056	0 00:05:00



Title **Stormwater Conveyance Sizing (100 YEAR STORM)**

Project **Arbella at Ashland - Ashland, MA**

Date 12-23-2020 Rev 3-16-2021

A&M Project Number: 2604-01

Watershed	Drainage Node ID	Area (acres)	Weighted Runoff Coefficient	Accumulated Precipitation (inches)	Total Runoff (inches)	Peak Runoff (cfs)	Rainfall Intensity (inches/hr)	Time of Concentration (days hh:mm:ss)
39	BLDG 5 ROOF	0.21	0.9000	0.67	0.60	1.50	8.056	0 00:05:00
40	PCB 12A	0.15	0.7500	0.67	0.50	0.92	8.056	0 00:05:00
41	PCB 13A	1.50	0.3200	1.18	0.38	3.40	7.073	0 00:10:00
42	BLDG 4 ROOF	0.21	0.9000	0.67	0.60	1.50	8.056	0 00:05:00
43	PCB 12B	0.36	0.4600	0.67	0.31	1.35	8.056	0 00:05:00
44	PCB 22A	0.14	0.6900	0.67	0.46	0.76	8.056	0 00:05:00
45	PCB 23A	0.15	0.6700	0.67	0.45	0.81	8.056	0 00:05:00

Channel Report

Arbella at Ashland Swale Flow Capacity (Minimum Slope 5.%)

Trapezoidal

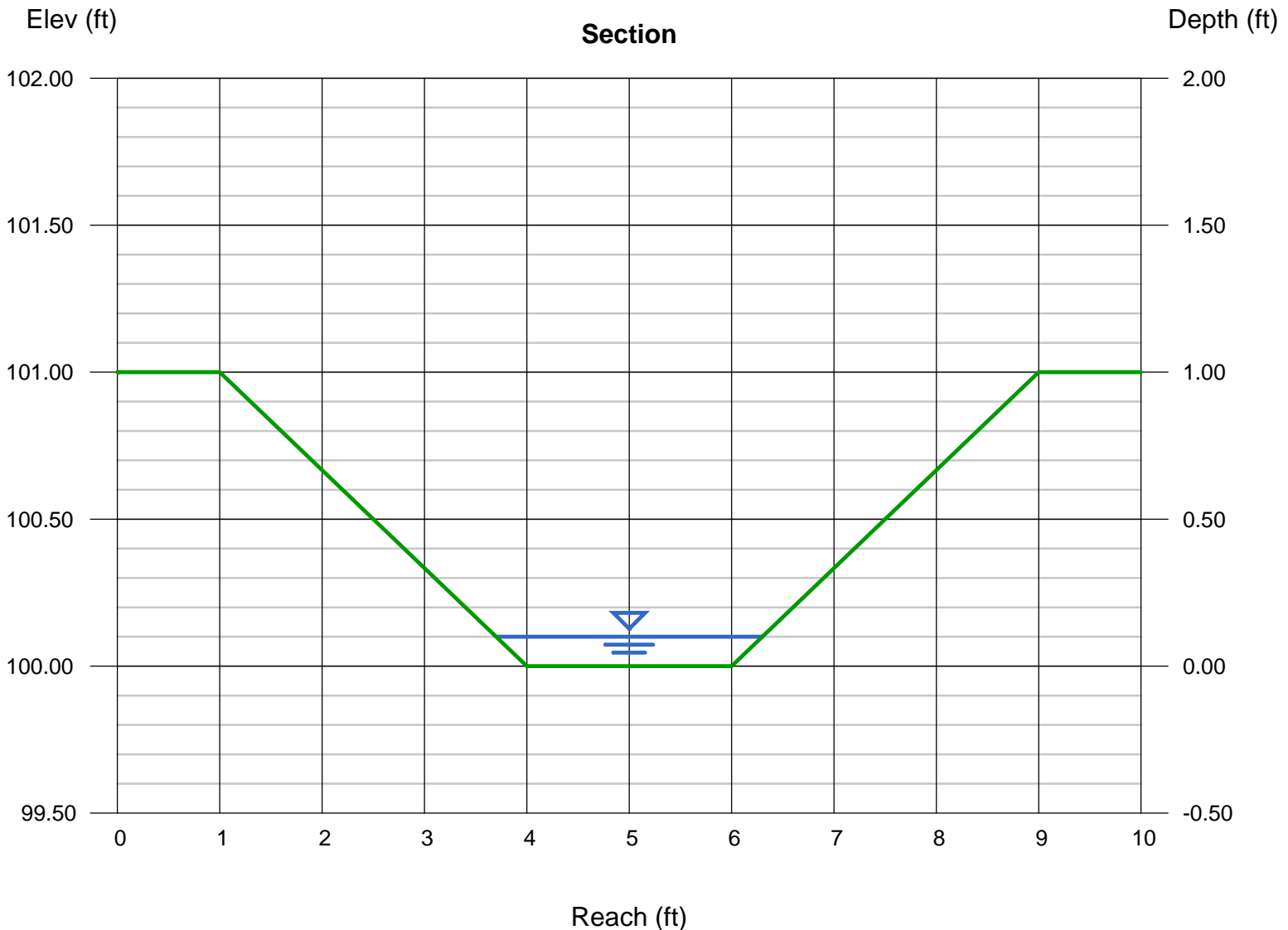
Bottom Width (ft) = 2.00
Side Slopes (z:1) = 3.00, 3.00
Total Depth (ft) = 1.00
Invert Elev (ft) = 100.00
Slope (%) = 5.00
N-Value = 0.002

Highlighted

Depth (ft) = 0.10
Q (cfs) = 7.518
Area (sqft) = 0.23
Velocity (ft/s) = 32.69
Wetted Perim (ft) = 2.63
Crit Depth, Yc (ft) = 0.58
Top Width (ft) = 2.60
EGL (ft) = 16.71

Calculations

Compute by: Q vs Depth
No. Increments = 10



Depth	Q	Area	Veloc
(ft)	(cfs)	(sqft)	(ft/s)
0.10	7.518	0.230	32.69
0.20	25.37	0.520	48.79
0.30	53.16	0.870	61.11
0.40	91.53	1.280	71.51
0.50	141.3	1.750	80.74
0.60	203.3	2.280	89.18
0.70	278.5	2.870	97.04
0.80	367.6	3.520	104.44
0.90	471.6	4.230	111.49
1.00	591.3	5.000	118.25

Wp	Yc	TopWidth	Energy
(ft)	(ft)	(ft)	(ft)
2.63	0.58	2.60	16.71
3.26	1.00	3.20	37.20
3.90	1.00	3.80	58.35
4.53	1.00	4.40	79.91
5.16	1.00	5.00	101.86
5.79	1.00	5.60	124.25
6.43	1.00	6.20	147.09
7.06	1.00	6.80	170.40
7.69	1.00	7.40	194.17
8.32	1.00	8.00	218.40

Appendix G

EWS-1 EXISTING WATERSHED PLAN

PWS-1 PROPOSED WATERSHED PLAN

**A
P
P
E
N
D
I
X
G**



LEGEND

- EXISTING WATERSHED
- PROPOSED WATERSHED
- SCS SOILS BOUNDARY
- Tc FLOW PATH
- SUBCATCHMENT LABEL
- SUBCATCHMENT BOUNDARY
- FLOW DIRECTION
- CATCH BASIN AREA

**ISSUED FOR
DHCD LIP APPLICATION**
08-07-2020



PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION
01	03/25/21	PER PEER REVIEW COMMENTS

APPLICANT OWNER:
JA SENIOR MANAGER, LLC
RENSELAER TECHNOLOGY PARK
300 JORDAN ROAD
TROY, NY 12180

ARBELLA AT ASHLAND
ASHLAND, MA

PROJECT NO.	260401	DATE:	08-07-2020
SCALE:	1" = 80'	DWG. NAME:	C2604-01
DESIGNED BY:	CM/C/PGM	CHECKED BY:	PLC

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environmental consulting • landscape architecture
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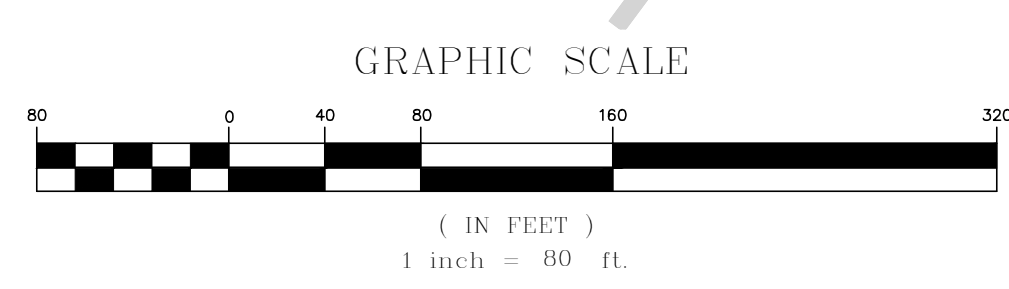
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DRAWING TITLE: **PROPOSED WATERSHED PLAN** SHEET No. **PWS-1**

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