STORMWATER REPORT

20 LEDIN AVENUE REDEVELOPMENT
WASTE MANAGEMENT OF MASSACHUSETTS, INC.
20 LEDIN AVENUE
AVON, MASSACHUSETTS

Prepared For:

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CEC Project 311-399

AUGUST 2021

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1.0 PROJECT NARRATIVE

1.1 INTRODUCTION

On behalf of Waste Management of Massachusetts, Inc. (the "Applicant"), Civil & Environmental Consultants, Inc. (CEC) has prepared this stormwater report and analysis to demonstrate compliance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards, in accordance with the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00) and the Town of Avon Zoning Bylaws. This Stormwater Management Report describes the proposed design as depicted on the Site Plans prepared by Civil & Environmental Consultants, Inc., dated April 23, 2021, provided under separate cover.

The applicant is proposing to redevelop an existing 2.3-acre parcel of land located at 20 Ledin Avenue in Avon, Massachusetts (the "Site") in order to expand an existing building by ±17,120 square feet (sf) along with associated landscape and utility infrastructure improvements (the "Project").

1.2 EXISTING CONDITIONS

The 2.3-acre parcel of land, located along Ledin Avenue within the existing Avon Industrial Park, is currently used as an industrial space with an approximate ±0.75 acre area of undeveloped land on the south side of the property, consisting of boulders, ledge, and a wooded area. The Site is bounded to the north by Ledin Avenue, to the south and east by developed industrial property, and to the west by an existing Waste Management of Massachusetts, Inc. industrial property. See Figure 1 for a Site Location Map and Figure 2 for an Aerial Site Plan.

Under existing conditions, approximately one-half of the Site (1.2-acres) consists of impervious areas including the existing building as well as walkways and the paved parking lot. The remaining area is approximately one-third grassed areas and two-thirds undeveloped land comprised of boulders and wooded areas.

1.2.1 Topography

Existing topography within the Site ranges from elevation 249 (NGVD 29) in the southwest corner of the property to elevation 226 ft. in the southeast corner of the property by the easterly edge of the property near the existing off-site wetland, located on the adjacent property of 10 Ledin Avenue. The developed portion of the site generally pitches away from the building from west to east at a slopes between approximately two (2) to six (6) percent, while the undeveloped portion pitches from west to east at a slope of approximately ten (10) percent for about two-thirds of the area and then slope down to the wetland area at the easterly property boundary at an approximate 2 horizontal to 1 vertical grade.

1.2.2 Flood Zones

The Site is not located within a flood zone as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) for the Town of Avon, Map 25021 C0218E effective July 17, 2012. Refer to Figure 3.

1.2.3 Wetlands

A wetlands investigation was performed by Lucas Environmental, LLC in July 2019. The result of the investigation indicated that a wetland resource area is present to the southeast of the Site on an adjoining property. The wetland area is shown on the Site Plans included under separate cover, and a more detailed description of the wetland areas is included in the Notice of Intent under separate cover.

1.2.4 Geotechnical

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the soils within the Site are classified as Canton fine sandy loam (#422B) and Urban land (#602).

The Canton fine sandy loam is identified as extremely stony and is comprised of Charlton soils, which are characterized as well drained soils derived from loamy melt-out till, Montauk soils, which are characterized as well drained soils derived from lodgment or flow till derived primarily from granite, gneiss, and/or schist, and Scituate soils, which are characterized as moderately well drained soils formed in a loamy eolian influenced mantle of till underlain by sandy lodgement till. These mapped soils are classified as Hydrologic Soils Group (HSG) B.

The Urban land is identified by the NRCS as "areas where 85% of the land surface is covered by structures or impervious surfaces such as buildings, pavement, industrial site, and railway yards. Full identification of the underlying soil was not possible in the mapping process."[1]

Additionally, BSC Group conducted a subsurface evaluation in 2003 in support of a septic system repair at the Site. Five test pits were excavated at the Site including two in the northeast quadrant adjacent to the property line and three in the central southern portion of the site. All of the borings, once below pavement, gravel and fill materials, encountered a sandy loam with loose cobbles and stones. Refusal was found between approximately 5-feet below grade to 8-feet below grade. Groundwater was not encountered at any of the borings. For the purpose of determining the separation from groundwater for proposed stormwater infiltration practices, where no groundwater was observed, the groundwater was assumed to be located at the bottom of the borings or bedrock. Refer to Appendix B for the supporting information including the test pit logs.

For the purposes of the hydrologic analysis, the soils identified within this area were classified as HSG B based on surrounding soils and previous test pits performed by others. For the purpose of the stormwater management design, the soils were assumed to be classified as "sandy loam", which has an infiltration rate of 1.02 inches per hour based on the Rawl's rates as identified in the Massachusetts Stormwater Management Handbook.

1.3 PROPOSED PROJECT

As previously noted, the Project includes the expansion of an existing building, consisting of a ±17,120 sf building, along with associated site, landscape and utility infrastructure improvements. The Project is proposed within an existing industrial park and is consistent with the Town of Avon zoning and intended land-use for the Site. The Project will include new water quality and quantity controls designed to protect surface and groundwater resources and adjacent properties from potential impacts resulting from the proposed Project. Although much of the project includes redevelopment, the proposed improvements have been designed in accordance with the MassDEP Stormwater Management Standards for a new development.

[1]National Cooperative Soil Survey. (2009). *Soil Survey of Middlesex County, Massachusetts.* Natural Resources Conservation Service.

In the proposed condition, approximately 86% of the Site will be impervious consisting of paved parking areas, sidewalks and building roof areas. The remainder of the Site will consist of landscaped areas. The overall drainage patterns on the Site will be maintained in the proposed condition with the grades generally consistent with the original grades in the central portion of the Site. Stormwater runoff from the paved driveways and sidewalk areas will be directed to water quality units with inlets providing sediment removal as well as oil and gas protection. The stormwater will be conveyed to additional water quality best management practices providing additional water quality treatment prior to infiltration. The roof runoff and a portion of the rear parking areas will be routed to subsurface infiltration chambers where groundwater recharge will be provided. Outlet control structures are proposed that will divert stormwater flows in excess of the infiltrative capacity of the chambers to the municipal stormwater system located in Ledin Avenue. The proposed design will reduce the peak rate of runoff from the Site, increase the quality of water leaving the Site, and provide additional recharge. Furthermore, the water quality units within the Site have been designed to provide the required 80% TSS removal for the stormwater runoff from the impervious pavement areas from the adjacent property that are draining into the Site.

2.0 STORMWATER MANAGEMENT SYSTEM

2.1 DESCRIPTION OF RUNOFF CONTROLS

The stormwater management improvements consist of components designed to manage runoff from the Site. These components attenuate runoff discharge peaks, minimize erosion, minimize the transport of sediments, improve water quality, and prevent impacts to the municipal drainage system and any downstream resource areas.

The stormwater management system implements a treatment drain of the Best Management Practices designed to provide 80% TSS (Total Suspended Solids) removal for stormwater runoff from the proposed drive aisles and parking areas. The proposed stormwater management system will use the following specific control measures:

Proprietary particle separators (Stormceptor® water quality units): The proposed Stormceptor water quality units provide efficient removal of free oils, debris and total suspended solids (TSS). Although not the main objective of the water quality unit, some removal of heavy metals and other nutrients is also achieved. Water quality units allow for safe and easy removal of collected material and should be inspected and cleaned in accordance with the Operations and Maintenance (O&M) Plan and per manufacturer's recommendations. See the Long Term Pollution Prevention and O&M Plan included in Section 6 and Appendix C for supporting information.

The use of these units for treatment of stormwater is accepted as a good practice and is in accordance with sound professional standards. A Massachusetts Stormwater Evaluation Project (MASTEP) Technology Review has been performed for the Stormceptor® affirming testing methods are acceptable for achieving the pollutant removal efficiencies noted[2]. See Appendix C for the MASTEP Technology Review.

[2] University of Massachusetts – Amherst, Stormwater Technologies Clearinghouse http://www.mastep.net/database/data.cfm (accessed October 2014)

Stormwater Infiltration Chambers (StormTech® MC-3500 chambers) with Isolator Row: The Isolator Row will provide efficient removal of free oils, debris and total suspended solids (TSS) as an added level of pretreatment of the stormwater runoff. The Isolator Rows allow for safe and easy removal of collected material and should be inspected and cleaned in accordance with the O&M Plan and per manufacturer's recommendations.

Stormwater recharge for the proposed redevelopment is provided through the infiltration treated runoff from the pavement areas and clean runoff from the building's roof areas via the StormTech® MC-3500 chambers, which are located beneath the paved parking, and circulation areas.

The use of Isolator Rows for treatment of stormwater is accepted as a good practice and is in accordance with sound professional standards. A Massachusetts Stormwater Evaluation Project (MASTEP) Technology Review has been performed for the Stormtech® Isolator Row affirming testing methods are acceptable for achieving the pollutant removal efficiencies noted. See Appendix C for the MASTEP Technology Reviews and supporting information.

All of these proposed runoff controls are detailed on the Site Plans included in Appendix D.

2.2 CONSTRUCTION SEQUENCE PLAN

The purpose of the Construction Sequence Plan is to develop a working schedule for the implementation of the proposed stormwater improvements.

Prior to initiating any work, the siltation control barriers will be installed along the limit of work. Once the appropriate permits are obtained, the construction project will commence in the following sequence:

1. Install all necessary erosion and siltation barriers as shown on the design drawings and install temporary fencing as needed.
2. Perform clearing and stripping of the Site, stockpiling materials to be re-used for earthwork activities.
3. Perform excavation for building foundation areas and subsurface utilities.
4. Install proposed utilities and stormwater infrastructure and construct building foundations.

5. Place clean fill/pavement base materials and install pavement base and curbing.
6. Construct buildings.
7. Install proposed final landscaping.
8. Remove existing erosion control measures.

All construction water will be collected and treated in accordance with the Erosion and Sediment Control Plan included in Section 5.0.

3.0 STORMWATER ANALYSIS

3.1 METHODS OF ANALYSIS

A hydrologic analysis has been performed for the Site comparing existing conditions and post-development conditions using a software program developed by HydroCAD. This program analyzes site hydrology by the graphic peak discharge method documented in Technical Release No. 20 and Technical Release No. 55 published by the United States Department of Agriculture (USDA) Soil Conservation Service.

The following variables were developed for the contributing watersheds (drainage areas) in order to complete the analysis:

- **Rainfall Depth:** A hydrologic analysis was performed for the 24-hour 2-year, 10-year, 25-year, and 100-year, storm events (3.41, 5.22, 6.35, and 8.10 inches respectively) for each drainage area. The rainfall depths for the study area were obtained from the latest NOAA Atlas-14 rainfall data for the Town of Avon.
- **Runoff Curve Number (RCN):** The RCN is a hydrologic characteristic that contributes to the peak rate of runoff and volume from a given storm event. It is dependent upon soil conditions and land use. Generally, higher curve numbers are associated with less pervious soils and, hence, greater amounts of runoff. As previously noted, based on the geotechnical investigation, the soils consist of Hydrologic Soil Group (HSG) B and was used accordingly in determining RCNs.
- **Time of Concentration:** The time of concentration is defined as the time it takes runoff to travel from the hydraulically most distant part of the watershed to the downstream point of interest. This parameter is dependent on the characteristics of the ground surface and condition of the travel path. Times of concentration were calculated for the various sub catchments using the HydroCAD program, with a minimum time of concentration of six (6) minutes used in accordance with the protocol outlined in Technical Release No. 55.

3.2 DRAINAGE AREAS

In order to perform the analysis, the contributing drainage areas for pre-development, existing, and post-development conditions were delineated. The delineation of the drainage areas were determined by the topography depicted on the Existing Conditions plan based on the topographic field survey performed in March 2019, with supplemental data collected in July 2019. Brief descriptions of the existing conditions and proposed conditions drainage areas are as follows:

- **Existing Conditions:** The Site is divided into three (3) drainage areas and the stormwater flows to two (2) design points, which are identified as the municipal drainage system on Ledin Avenue flowing to the northeast and the neighboring property to the east. Refer to Figure HYD-EX for the existing conditions drainage areas. The descriptions of the existing conditions drainage areas are listed below:
    - Subcatchment 1A-EX is the ±2.0-acre front portion of the property that drains towards Ledin Avenue and an existing catch basin located within the roadway. The drainage area is comprised of gravel, grassed areas, roof and paved areas. Stormwater from this drainage area drains overland and untreated into the municipal stormwater system.
    - Subcatchment 1OFF-EX is the ±1.49-acre area that drains into the Site from the adjacent property, 40 Ledin Avenue. The drainage area is comprised of roof areas, pavement and brush areas. Stormwater from this drainage area flows overland and untreated from the adjoining property onto the Site. It is collected by a catch basin located in the southeast corner of the Site and conveyed into the municipal stormwater system in Ledin Avenue. The catch basin also collects stormwater from sub catchment 1A-EX.
    - Subcatchment 2A-EX is the ±0.34-acre undeveloped, southeast portion of the property that is comprised of woods and brush. Stormwater from this drainage area flows overland and untreated to the east to the adjoining property. This drainage area is adjacent to the wetlands to the south and east of the Site.

TABLE 3.1 EXISTING CONDITIONS					
Drainage Area	**Discharge Location**	**Design Point**	**Area (ft^2)**	**Curve Number[1]**	**Time of Concentration (minutes)[2]**
1A-EX	Ledin Avenue	1	85,194	86	11.9
1OFF-EX			69,932	97	6.8
2A-EX	Adjoining Property	2	14,709	61	6.0

Notes:

1. Curve number refers to the weighted curve number than encompasses the varied terrain, and associated individual curve number values, within the drainage area.
2. A minimum time of concentration of 6 minutes was used if a time of concentration of less than 6 minutes was determined when evaluating the drainage area.

- **Proposed Conditions:** The Site is divided into five (6) drainage areas and the stormwater flows to one (1) design point, which is identified as the municipal drainage system in Ledin Avenue flowing to the northeast. Refer to Figure HYD-PR for the proposed conditions drainage areas. The descriptions of the proposed conditions drainage areas are listed below:
    - Subcatchment 1A-PR is the ±0.63-acre front portion of the property that drains towards Ledin Avenue and an existing catch basin located within the roadway. The drainage area is comprised of gravel, grassed areas and paved areas. Stormwater from this drainage area drains overland into the municipal stormwater system in Ledin Avenue.
    - Subcatchment 1B-PR is the ±0.16-acre area along the westerly side of the proposed building, consisting of grassed and paved areas that drain into the proposed catchbasins in the southwest portions of the Site, routed to a proprietary water quality unit and conveyed into the municipal stormwater system in Ledin Avenue. A portion of Subcatchment 1OFF-EX also drains to the catch basins located in Subcatchment 1B-PR.
    - Subcatchment 1C-PR is the ±0.97-acre roof area of the existing and proposed building expansion roof areas. Runoff collected from this area will be conveyed to the subsurface chambers where it will recharge into the groundwater. Flows exceeding the design capacity of the chambers will be directed into the Ledin Avenue municipal stormwater system.

- Subcatchment 1D-PR is the ±0.50-acre paved and grassed area located in the southern portion of the site. Runoff collected from this area will be collected in a water quality unit and routed through a drain inlet where stormwater is conveyed to the subsurface chambers where it will recharge into the groundwater. Flows exceeding the design capacity of the chambers will be directed into the Ledin Avenue municipal stormwater system.
- Subcatchment 1OFF-EX is the ±1.05-acre area that drains from the adjacent property, 40 Ledin Avenue. These areas will remain unchanged in the proposed condition. The drainage area is comprised of a roof areas, brush, and pavement. Stormwater from this drainage area flows overland and untreated from the adjoining property onto the Site. The runoff from this subcatchment is collected via deep sump hooded catch basins within the Site, routed to the proprietary water quality unit, and conveyed to the municipal drainage system in Ledin Avenue.
- Subcatchment 2OFF-EX is the ±0.60-acre area that drains from the adjacent property, 40 Ledin Avenue, which also contains some area from the 20 Ledin Ave Site. The drainage area is comprised of a roof areas, brush, and pavement. Stormwater from this drainage area flows overland and untreated from the adjoining property onto the Site. The runoff from this subcatchment is collected via a trench drain within the Site, routed to the proprietary water quality unit, and conveyed to the municipal drainage system in Ledin Avenue.

TABLE 3.2
POST-DEVELOPMENT CONDITIONS

Drainage Area	Discharge Location	Design Point	Area (ft^2)	Curve Number[1]	Time of Concentration (minutes)[2]
1A-PR	Ledin Avenue	1	25,547	94	6.0
1B-PR			7,160	74	6.0
1C-PR			42,421	98	6.0
1D-PR			21,766	96	6.0
1OFF-PR			45,932	98	6.8
2OFF-PR			26,056	95	6.0

3.3 RESULTS OF ANALYSIS

A stormwater analysis was performed for the 2-year, 10-year, 25-year, and 100-year storm events in order to determine that there will be no increase in stormwater runoff once the proposed construction is complete and the stormwater control structures are in place. Detailed calculations are attached in Appendix A. The points of compliance for existing, and post-development conditions are the two design points noted above. A summary of the peak stormwater runoff and volumes is provided below.

TABLE 3.3 PROJECT STORMWATER RUNOFF RATES								
	Runoff Rate (cfs)							
	2-Year		10-Year		25-Year		100-Year	
	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.
1	8.36	8.01	13.88	12.84	17.34	16.69	22.68	22.57
2	0.14	-	0.54	-	0.84	-	1.35	-

As shown in Table 3.3, runoff from post-development runoff rates in Ledin Avenue do not exceed existing runoff rates and the runoff to the adjacent property has been eliminated. Supporting calculations are provided in Appendix C.

3.3.1 Hydrology

The proposed drainage infrastructure, consisting of deep sump hooded catch basins, water quality units, manholes and subsurface groundwater chambers have been designed to convey storm events up to and including the 25-year storm event.

4.0 STORMWATER CONTROL SYSTEM DESIGN CRITERIA

4.1 MASSDEP STORMWATER MANAGEMENT POLICY

Stormwater discharges from the proposed Project is subject to the Massachusetts DEP Stormwater Management Policy (the Policy). The Policy is designed *"to protect the wetlands and waters of the Commonwealth from adverse impacts of storm water runoff."* To accomplish this goal, the Policy establishes ten (10) performance standards to control stormwater quantity and quality. These standards establish the level of required controls, which can be achieved through the use of site planning, structural and non-structural controls, and other best management practices (BMPs). The Stormwater Checklist is provided in Appendix A. Stormwater modeling methodology is discussed in detail in section 3.0. Results of the stormwater modeling of the existing and proposed conditions are provided as Appendix C.

4.1.1 Stormwater Management Controls

The following section documents compliance with the MassDEP Stormwater Management Standards.

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 project is designed so that there are no new stormwater conveyances that could discharge untreated stormwater into, or cause erosion to, wetlands or waters of the Commonwealth. The proposed project generally retains the overall drainage patterns of the pre-development conditions and no discharges to wetlands are proposed.

Standard 2
Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

The total post-development peak discharge rates do not exceed pre-development rates for the 2, 10, 25 and 100-year storm events. Stormwater modeling methodology is discussed in detail in Section 3.0. The model output is provided in Appendix C. The results are provided above in Table 3.3.

Standard 3

Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site conditions, based on soil types.

The project is designed to comply with these criteria. The project will result in the addition of approximately 32,478 square feet of new impervious areas. In accordance with the stormwater standards, 0.35-inches of recharge must be provided for the increase in impervious areas on the Site for HSG B soils. Accordingly, a total of 947 cubic feet (cf) of groundwater recharge is required based on the increase of impervious areas. Since all of the impervious area onsite will not be captured the adjusted required recharge volume is 1,326 cf. Through the introduction of the various stormwater infiltration practices, a total of 2,668 cf of recharge is proposed, providing significantly more recharge than the regulatory requirement.

Based on the conservative infiltration rate of 1.02 inches per hour utilized in the analysis, each of the infiltration systems has been designed to provide the drawdown of all stormwater below the low flow outlets in less than 72 hours. Supporting calculations are provided in Appendix C.

Standard 4

For new development, stormwater management systems must be designed to remove 80% of the average annual load (post-development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when:

A. *Suitable nonstructural practices for source control and pollution prevention are implemented;*
B. *Stormwater management best practices (BMPs) are sized to capture the prescribed runoff volume; and*
C. *Stormwater management BMPs are maintained as designed.*

The proposed development utilizes several methods of storm water management to reduce TSS generation including deep sump hooded catch basins, proprietary water quality units, StormTech Isolator Rows, Subsurface Infiltration Chambers, consistent with the Policy. The estimated TSS removal rate from the proposed BMP treatment train for each system exceeds the 80% requirement. Supporting calculations can be found in Appendix C.

The Site will include vehicle and equipment storage and may be classified as a Land Use with Higher Potential Pollutant Loads (LUHPPL). Accordingly, the proposed stormwater management system has been designed to treat the 1" Water Quality Volume and provide 44% TSS removal pre-treatment prior to infiltration. Supporting calculations can be found in Appendix C.

A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included in Section 6.0 of this report.

Standard 5

Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs. The use of infiltration practices without pre-treatment is prohibited.

The Site may be classified as a Land Use with Higher Potential Pollutant Loads (LUHPPL). Accordingly, the proposed stormwater management system has been designed to treat the 1" Water Quality Volume and provide 44% TSS removal pre-treatment prior to infiltration. Pretreatment is provided by deep sump hooded catch basins and proprietary water quality units prior to discharge to the infiltration chambers. Pre-treatment is provided by deep-sump hooded catch basins and the StormTech Isolator Row prior to discharge to the subsurface Infiltration Chambers. Supporting calculations can be found in Appendix C.

Standard 6

Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resources Waters (ORWs), shellfish beds, bathing beaches, cold water fisheries, and recharge areas for public water supplies.

This site is located within an outstanding resource water, specifically located within the Avon Reservoir. The development of the site will comply fully with table CA 2: Standard 6 of the Massachusetts Stormwater Handbook. The project will be required to file a Notice of Intent (WM 09) with MassDEP. The stormwater BMP has been designed to use proprietary treatment units and subsurface chambers. The stormwater BMP recharges more than the required 1-inch times the impervious area and more than 44% TSS is removed prior to discharge to the infiltration BMP. The backup calculations can be found in the attached stormwater report in appendix C. Additionally, offsite area from a 40 Ledin Ave will be routed through BMP's that will help treat the currently untreated stormwater runoff for a Site that may be classified as a Land Use with Higher Potential Pollutant Loads.

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Standard 7

Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. Where it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

The project fully complies with the Stormwater Standards.

Standard 8

Erosion and sediment controls must be implemented to prevent impacts during construction, or land disturbance activities.

Erosion and sediment controls are integral to the project improvements. The plan includes compost silt socks, which will be installed down-gradient of the proposed work area and silt sacks, which will be installed in existing catch basins within the adjacent rights of way. A preliminary Erosion and Sediment Control Plan has been developed and is included in Section 5.0 of this report. A detailed Stormwater Pollution Prevention Plan will be prepared and a Notice of Intent will be submitted to the United States Environmental Protection Agency prior to commencement of construction activity. Measures will be utilized throughout construction to prevent erosion, control sediments, and stabilize exposed soils as discussed in Section 5.0.

Standard 9

All stormwater management systems must have an operations and maintenance plan to ensure that systems function as designed.

A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included in Section 6.0 of this report.

Standard 10

All illicit discharges to the stormwater management system are prohibited.

There are no illicit discharges at the Site.

5.0 CONSTRUCTION PERIOD POLLUTION PREVENTION AND SEDIMENTATION AND EROSION CONTROL PLAN

5.1 INTRODUCTION

The greatest potential for sediment generation will occur during the construction. An extensive erosion and sedimentation program is proposed and will be diligently implemented during construction of the project. The erosion control program will minimize erosion and sedimentation that could potentially impact resources areas. Water quality will be maintained by minimizing erosion of exposed soils and siltation. Erosion control barriers will be installed and exposed soil areas re-vegetated as soon as possible after work in an area is completed.

This Erosion and Sediment Control Plan includes preliminary measures and requirements for management and implementation of erosion and sediment controls during construction. A detailed Stormwater Pollution Prevention Plan (SWPPP) will be prepared and a Notice of Intent (NOI) will be filed with the United States Environmental Protection Agency (USEPA) in accordance with USEPA's National Pollutant Discharge Elimination System (NPDES) General Permit program for stormwater discharges from construction sites prior to the commencement of any construction activity. The SWPPP will contain elements from this Erosion and Sediment Control Plan and will include additional and more detailed inspection and maintenance procedures and will include maintenance logs, forms, and additional erosion and sediment control measures.

Responsible Party for Plan Compliance:
Waste Management of Massachusetts, Inc.
26 Patriot Place
Foxborough, Massachusetts 02035

Emergency Contact Information:
To be determined.

5.2 CONSTRUCTION PHASE EROSION CONTROL MEASURES

The adjacent resource areas will be protected during construction by implementing siltation control measures, including the placement of compost silt socks as close as feasible to the down gradient limit of construction activity. The project may also implement other stabilization methods such as erosion netting and hydro seeding.

5.2.1 Short and Long Term Goals and Criteria

Short and long-term goals will include a variety of stabilizing sediment and erosion controls around the limit of work. All construction-phase erosion and sediment controls have been designed to retain sediment on-site to the extent practicable and limit runoff and the discharge of pollutants (sediment) from exposed areas of the Site.

All control measures will be installed and maintained in accordance with the manufacturer's specifications and good engineering practices. Weekly inspections and routine monitoring will be used to determine the effectiveness of controls in use.

Litter and solid construction debris potentially exposed to the stormwater will be prevented from becoming a pollution source through routine monitoring and the use of laborers to "pick" as necessary.

5.2.2 Stabilization Practices

The construction site activities will include numerous stabilizing practices. Sediment and erosion controls such as erosion netting, mulching and hydro-seeding may act as interim practices. Erosion netting material may include single net straw blankets or coconut blankets. Permanent stabilization practices will include the use of a hydro-seeding over vegetative support soil where additional exposure threatens stormwater quality. Seeding will be carried out with a seed mixture equal to the "Roadside Slope Mix" included below. All siltation barriers will remain in place until all exposed areas are re-vegetated.

PLANTING SCHEDULE FOR EXPOSED AREAS

1. All exposed areas will receive 6 inches of topsoil or compost material.
2. Seed will be equal to "Roadside Slope Mix" as specified by the Mass. Highway Department. Please refer to chart below for specifications. This mixture will be spread at a rate of 5 pounds per 1,000 square feet.

TABLE 5.1
ROADSIDE SLOPE MIX

Common Name	Germination Proportion	Purity Minimum	Minimum
Creeping Red Fescue	50%	85%	95%
Kentucky 3	30%	85%	95%
Domestic Rye	10%	90%	98%
Red Top	5%	85%	92%
Ladino Clover	5%	85%	96%

5.2.3 Structural Practices

Perimeter controls will consist of compost silt socks. In order to ensure effective performance, proper installation is required. 2" x 2" wooden stakes will be positioned on the downhill side (away from the job Site) of the silt socks. The posts will be driven at least one foot into the ground.

If deemed necessary after construction begins, a wash pad may be included to wash off vehicle wheels before leaving the Site.

5.3 NON-STRUCTURAL CONTROLS

5.3.1 Good Housekeeping

Non-structural controls are as effective as structural controls in sediment control. Non-structural controls to be used at the construction Site include:

- Regular sweeping of paved surface; and,
- Prompt cleanup of any waste or spilled waste materials.

5.3.2 Exposure Minimization

Exposure will be minimized by providing both permanent and temporary soil stabilization (see Section 5.2.2) over areas that have been completely constructed, or areas that will not be revisited within a 30-day period.

Where practicable, industrial materials and activities will be protected from exposure to rain, snow, snowmelt, or runoff.

5.3.3 Preventative Maintenance

A preventative maintenance program includes the timely inspection and maintenance of stormwater management devices. Examples of preventative maintenance include:

- Removal of obstructions, if any, from inlets and outlets.
- Removal of accumulated sediment and vacuuming water from sumps.
- Repairing and re-planting slope areas that experience erosion.

5.3.4 Inspections

An experienced Construction Monitor will conduct inspections of construction areas once every 7 calendar days and within 24 hours of the occurrence of a storm event of 0.25 inches or greater, or the occurrence of runoff from snowmelt sufficient to cause a discharge. Storm event information from a weather station representative of the Site's location may be used to determine if a storm event of 0.25 inches or greater has occurred on the Site. Total rainfall will be measured for any day of rainfall during normal business hours that measures 0.25 inches or greater. Construction areas an experienced Construction Monitor will inspect include:

- Disturbed areas of the construction Site that have not been finally stabilized,
- Areas used for storage of materials that are exposed to precipitation,
- Structural control measures,
- Locations where vehicles enter or exit the Site, and
- The stormwater management system and discharge outlets.

Disturbed areas and areas used for storage of materials that are exposed to precipitation will be inspected for evidence of, or the potential for, pollutants entering the drainage system.

Sediment and erosion control measures identified will be observed to ensure that they are operating correctly. The discharge locations or points will be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles enter or exit the Site will be inspected for evidence of offsite sediment tracking.

Based on the results of these routine inspections, the Contractor will correct any deficiencies found as soon as practicable. Results of the inspections, corrective actions taken in response to any deficiencies, and any opportunities for improvement that are identified will be documented in an inspection report.

5.4 RECORDKEEPING

The following records will be maintained on the Site:

1. Dates when major grading activities occur,
2. Dates when construction activities temporarily or permanently cease on a portion of the Site,
3. Dates when stabilization measures are initiated, and
4. In addition, the following records will also be kept:
    - The Order of Conditions; and any additional permit conditions/approvals,
    - All inspection reports, and
    - Any spill reports.

Table 5.2 - Construction BMPs Maintenance Log

Project Name: Ledin Avenue Building Expansion
Project Location: 20 Ledin Avenue, Avon, MA
Project Number: 311-399

Date: 4/22/2021
Prepared By: KPS
Approved By: BG

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed (List Items if Required)	Date of Cleaning or Repair	Performed by
Pavement Sweeping	To be monitored as needed			Paved areas within the active construction site can be swept on a regular basis to remove larger sediment particles from construction activities. Pavement areas adjacent to the Site will be swept if dirt and debris is tracked from the active construction site.			
Catch Basin Inlet Protection (Silt Sack Sediment Trap)	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for proper operation. If clogged, remove accumulated sediment and properly dispose of to maintain the capacity of the catch basin.			
Erosion Control Barrier (Compost Filter Socks and Silt Fence)	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for deterioration or failure. Remove sediment when buildup exceeds 6 inches or half the barrier height. The underside of straw bales should be kept in close contact with the earth and reset as necessary.			
Stabilized Construction Exit	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			The exit shall be maintained in a condition that will prevent tracking of sediment onto public rights-of-way. The contractor shall sweep or wash pavement at exits which have experienced mud-tracking onto the pavement or traveled way. When wheel washing is required, it shall be done on an area stabilized with aggregate that drains into an approved sediment trapping device. When the construction exit becomes ineffective, the stone shall be removed along with the collected soil material and redistributed on-site in a stable manner. The exit should then be reconstructed. All sediment shall be prevented from entering storm drains, ditches, or waterways.			

Stormwater Supervisor Contact Information: _____

6.0 OPERATIONS AND MAINTENANCE (O&M) PLAN

6.1 GENERAL

Stormwater management systems with multiple components, such as the one proposed for the Project, assures the cleanest possible discharges of stormwater to the environment. However, these systems must be routinely maintained to keep them in good working order. Additionally, this plan identifies potential sources of pollution that may affect the quality of stormwater discharges and describes the implementation of Long-Term Pollution Prevention practices to reduce potential pollutants in stormwater discharge. The party identified below will be responsible for the operation and maintenance of the stormwater management system and Site. Schedules and procedures for inspection and maintenance of the existing and proposed stormwater management system components are provided in the following sections.

Responsible Party for Plan Compliance:
Waste Management of Massachusetts, Inc.
26 Patriot Place
Foxborough, Massachusetts 02035

Emergency Contact Information:
To be determined.

Estimated O&M Budget:
It is estimated that an annual budget of $2,000 should be allocated to performing routine inspections and maintenance identified in this O&M Plan.

6.2 ROUTINE INSPECTIONS

Inspections of the stormwater management system as a whole, and of the individual components of the system, will be carried out on a routine basis in accordance with the schedule identified in Section 6.3. Each will be inspected for sediment buildup, presence of oil, color and structural damage. The results of each inspection will be entered into an inspection log. Refer to Table 6.1 for the inspection log form.

6.3 MAINTENANCE PLAN

The Responsible Party incorporate a routine maintenance program to assure proper operation of the stormwater management system. Maintenance will be performed based on the results of inspections in accordance with the schedules identified in Table 6.1. The program will include the following maintenance activities:

Deep Sump Catch Basins

- All catch basins shall be inspected a minimum of at least four times per year.
- Sediment, if more than two feet deep, and/or floatable pollutants shall be pumped from the basin and disposed of at an approved offsite facility in accordance with all applicable regulations.
- Any structural damage or other indication of malfunction will be reported to the site manager and repaired as necessary.
- During cleanings, confirm the oil/debris trap (hood) is installed properly, is free of clogs, and is functional. Reinstall or replace as needed.
- During colder periods, the catch basin grates must be kept free of snow and ice.
- During warmer periods, the catch basin grates must be kept free of leaves, litter, sand, and debris.

Water-Quality Structures

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Inspect and clean twice per year or as required by manufacturer.
- Remove sediment and other trapped pollutants at the frequency or level specified by the manufacturer.

Roof Drain Leaders

- Perform routine roof inspections twice per year, typically in the spring and fall.
- Inspect for blockage and remove debris if required.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.

Subsurface Infiltration System

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Perform routine inspections on a monthly basis for the first three months after installation. Then, at a minimum, the treatment structure is to be inspected twice annually and the infiltrating structure is to be inspected annually.
- The subsurface infiltration system will be inspected twice during for the first year and annually thereafter by removing the manhole/access port covers and determining the thickness of sediment that has accumulated.
- If sediment is more than two inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred.

6.4 LONG TERM POLLUTION PREVENTION MAINTENANCE

The Responsible Party incorporate a routine maintenance program to ensure the continued effectiveness of the structural water quality controls. Maintenance will be performed based on the results of inspections in accordance with the schedules identified below. The program will include the following maintenance activities:

Maintenance of Pavement Systems

Regular maintenance of pavement surfaces will prevent pollutants such as oil and grease, trash, and sediments from entering the stormwater management system. The following practices should be performed:

- Sweep or vacuum asphalt pavement areas quarterly with a commercial cleaning unit and dispose of removed material.
- Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.

Maintenance of Vegetated Areas

Proper maintenance of vegetated areas can prevent the pollution of stormwater runoff by controlling the source of pollutants such as suspended sediments, excess nutrients, and chemicals from landscape care products. Practices that should be followed under the regular maintenance of the vegetated landscape include:

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- Grass vegetation should not be cut to a height less than four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas, but should not be applied on a regular basis unless necessary.

Management of Snow and Ice

The Project has been designed such that snow stockpile areas can take advantage of the stormwater Best Management Practices (BMPs) proposed on the Site. Melting snow from the stockpiles will be collected by the site stormwater collection system, which will then be processed through a series of stormwater BMPs to remove sediment, debris and contaminants from the stockpiled snow. Snow stockpiles areas are not located within 100 feet of any open water body or regulated wetland resource area. Under no circumstances shall snow be disposed or stored in stormwater basins, ponds, rain gardens, swales, channels, or trenches.

Additionally, should significant snow fall events occur, which result in stockpiled snow impacting the operation of the Project Site, through the temporary loss of parking or limiting access in any way, the property manager may choose to have snow removed from the site. All snow removal operations will be done in accordance with Massachusetts DEP guidelines BRPG01-01, effective date March 8, 2001.

6.5 EMPLOYEE TRAINING

Training of personnel is essential to achieving proper operation and maintenance of the stormwater management system. Therefore, those Facility personnel who are responsible for operation and maintenance will be trained on the following subjects:

- Environmental laws and regulations relating to stormwater,
- The components and goals of the current Erosion and Sediment Control Plan,
- Site specific permit conditions and requirements,
- General Facility spill response procedures,
- General good housekeeping procedures, and
- General material management procedures.

Refresher training sessions will be held once a year following the completion of the Site Compliance Evaluation.

Table 6.2 - Stormwater Operations and Maintenance Log

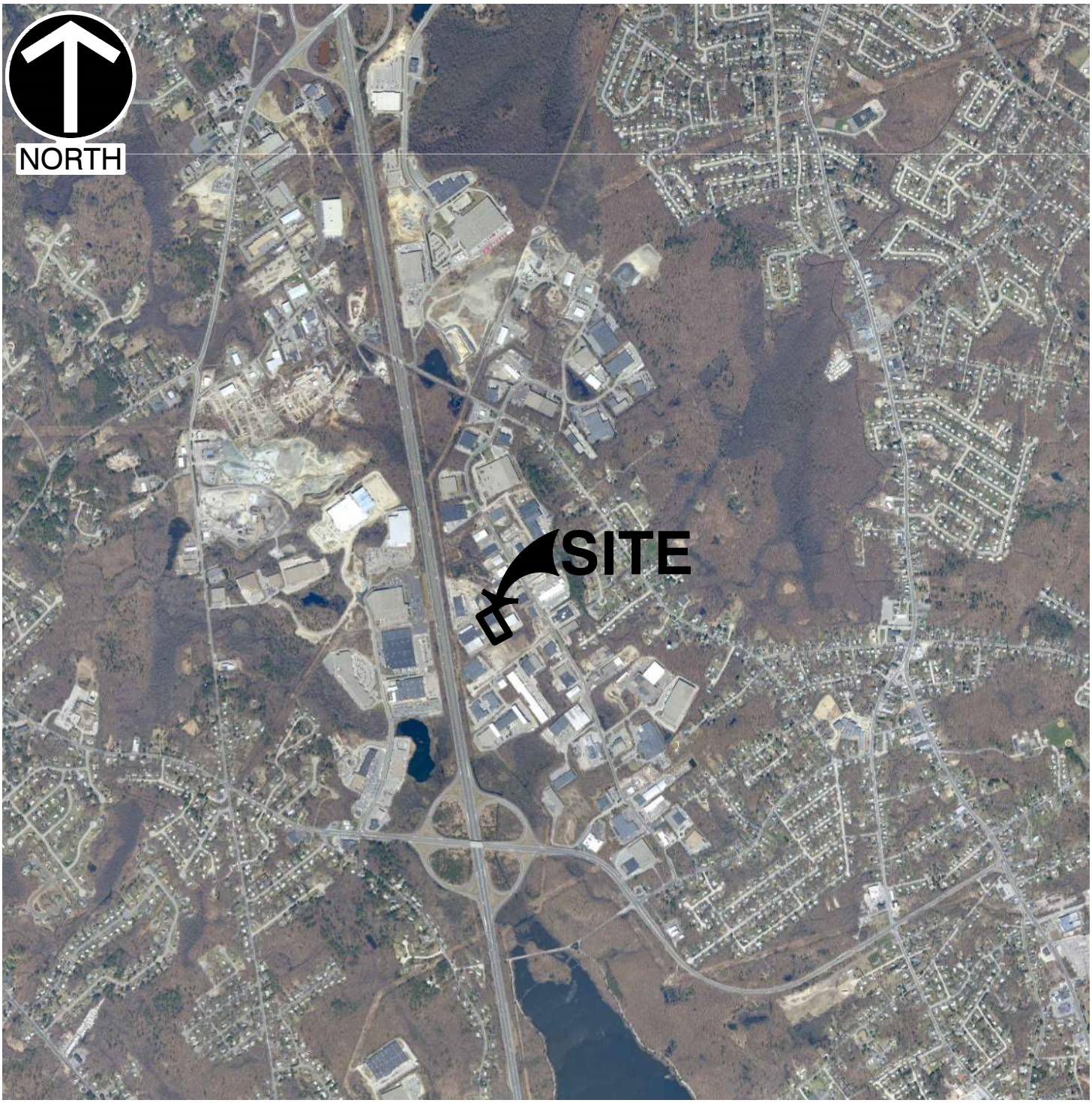
Project Name: Ledin Avenue Building Expansion
Project Location: 20 Ledin Avenue, Avon, MA
Project Number: 311-399

Date: 4/23/2021
Prepared By: DR
Approved By: KPS

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed (List Items if Required)	Date of Cleaning or Repair	Performed by
Deep Sump Catch Basins	Inspect four times per year. Clean four times per year, in the spring and fall, or whenever sediment buildup exceeds two (2) feet in depth.			Remove trash and deposits. During cleanings, confirm the oil/debris trap (hood) is installed properly, is free of clogs, and is functional. Reinstall or replace as needed. Take care not to damage the oil/debris trap (hood) during cleaning.			
Water Quality Structure	Inspect twice per year or as required by the manufacturer.			Clean twice per year or as required by the manufacturer. Remove sediment and other trapped pollutants at the frequency or level specified by the manufacturer. No use of clamshell buckets without prior approval. Increase inspection frequency, as needed, based on observed sediment loading.			
Subsurface Infiltration System	Inspect monthly for the first three months. Then, at a minimum, the treatment structure is to be inspected twice annually and the infiltrating structure is to be inspected annually as required by the manufacturer.			Remove sediment once per year or when buildup exceeds two (2) inches in depth.			

Stormwater Supervisor Contact Information: _____

FIGURES



REFERENCE

1. ORTHOGRAPHIC AERIAL IMAGERY, MAPS AND PARCELS ARE BASED ON GIS DATA PROVIDED BY THE BUREAU OF GEOGRAPHIC INFORMATIONS (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY SYSTEMS. ACCESSED JULY 2019.

SCALE IN FEET

0 2,000 4,000

Civil & Environmental Consultants, Inc.
333 Baldwin Road · Pittsburgh, PA 15205
412-429-2324 · 800-365-2324
www.cecinc.com

WASTE MANAGEMENT OF MASSACHUSETTS

20 LEDIN AVENUE REDEVELOPMENT
AVON, MASSACHUSETTS

SITE LOCATION MAP

DRAWN BY:	EMW	CHECKED BY:	KPS	APPROVED BY:	KPS	FIGURE NO.:	1
DATE:	APRIL 2021	DWG SCALE:	1"=2,000'	PROJECT NO:	311-399		

REFERENCE

1. ORTHOGRAPHIC AERIAL IMAGERY, MAPS AND PARCELS ARE BASED ON GIS DATA PROVIDED BY THE BUREAU OF GEOGRAPHIC INFORMATIONS (MASSGIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY SYSTEMS. ACCESSED JULY 2019.

SCALE IN FEET

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WASTE MANAGEMENT OF MASSACHUSETTS

20 LEDIN AVENUE REDEVELOPMENT
AVON, MASSACHUSETTS

AERIAL SITE PLAN

DRAWN BY:	EMW	CHECKED BY:	KPS	APPROVED BY:	KPS	FIGURE NO.:	2
DATE:	APRIL 2021	DWG SCALE:	1"=2,000'	PROJECT NO:	311-399		

National Flood Hazard Layer FIRMette

FEMA

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

1:6,000

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 7/11/2019 at 8:59:25 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

LEGEND

- A — DESIGN POINT
- A1–PR — SUBCATCHMENT AREA
- SUBCATCHMENT BOUNDARY
- TIME OF CONCENTRATION PATH
- EXISTING VEGETATED AREA
- EXISTING WOODED AREA
- EXISTING GRAVEL AREA
- EXISTING PAVED AREA
- EXISTING ROOF AREA

1. EXISTING CONDITIONS AS DEPICTED ON THESE PLANS ARE GENERAL AND ILLUSTRATIVE IN NATURE. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO EXAMINE THE SITE AND BE FAMILIAR WITH EXISTING CONDITIONS PRIOR TO BIDDING ON THIS PROJECT. IF CONDITIONS ENCOUNTERED DURING EXAMINATION ARE SIGNIFICANTLY DIFFERENT FROM THOSE SHOWN, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY.

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WASTE MANAGEMENT
SITE REDEVELOPMENT
20 LEDIN AVENUE
AVON, MASSACHUSSETTS

DRAINAGE AREA MAP

DRAWN BY:	EMW	CHECKED BY:	KPS	APPROVED BY:	KPS	FIGURE NO.:	HYD-EX
DATE:	APRIL 2021	DWG SCALE:	1"=60'	PROJECT NO:	311-399		

LEGEND

- A — DESIGN POINT
- A1–PR — SUBCATCHMENT AREA
- SUBCATCHMENT BOUNDARY
- TIME OF CONCENTRATION PATH
- EXISTING VEGETATED AREA
- EXISTING WOODED AREA
- EXISTING GRAVEL AREA
- EXISTING PAVED AREA
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SITE REDEVELOPMENT
20 LEDIN AVENUE
AVON, MASSACHUSSETTS

DRAINAGE AREA MAP

DRAWN BY:	EMW	CHECKED BY:	KPS	APPROVED BY:	KPS	FIGURE NO.:	HYD-PR
DATE:	APRIL 2021	DWG SCALE:	1"=60'	PROJECT NO:	311-399		

APPENDIX A

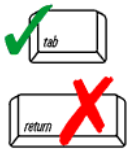
DEP STORMWATER CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

---

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

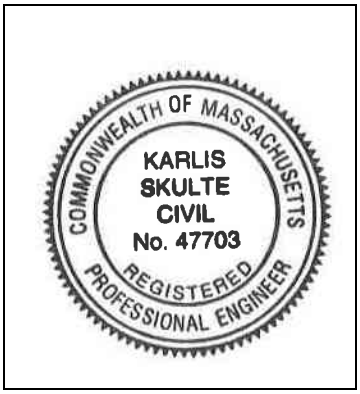
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



8/6/2024

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): Proprietary Water Quality Units

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

---

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B

GEOTECHNICAL INFORMATION

NRCS Soil Resources Report
Test Pit information from Septic System Repair
Test Pit information from 7/22/2021

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Norfolk and Suffolk Counties, Massachusetts

May 15, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

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Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 14, Sep 12, 2018

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

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	1.0	1.2%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	0.5	0.6%
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes	5.9	7.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	7.8	10.1%
424B	Canton fine sandy loam, 3 to 8 percent slopes, extremely bouldery	12.0	15.7%
602	Urban land, 0 to 15 percent slopes	48.0	62.7%
655	Udorthents, wet substratum	1.5	2.0%
Totals for Area of Interest		**76.6**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas

are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Norfolk and Suffolk Counties, Massachusetts

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, drumlins, drainageways, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

103B—Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: vktd
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 40 percent
Hollis and similar soils: 25 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex

Across-slope shape: Convex
Parent material: Friable coarse-loamy ablation till derived from granite

Typical profile
H1 - 0 to 6 inches: fine sandy loam
H2 - 6 to 36 inches: fine sandy loam
H3 - 36 to 60 inches: fine sandy loam

Properties and qualities
Slope: 3 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 7.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Description of Hollis

Setting
Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till derived from igneous rock

Typical profile
H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities
Slope: 3 to 8 percent
Percent of area covered with surface fragments: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: D
Hydric soil rating: No

Description of Rock Outcrop

Setting
Parent material: Igneous and metamorphic rock

Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Canton
Percent of map unit: 7 percent
Hydric soil rating: No

Chatfield
Percent of map unit: 5 percent
Hydric soil rating: No

Scituate
Percent of map unit: 2 percent
Hydric soil rating: No

Whitman
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

105D—Rock outcrop-Hollis complex, 3 to 25 percent slopes

Map Unit Setting
National map unit symbol: vkxr
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Rock outcrop: 65 percent
Hollis and similar soils: 25 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Rock Outcrop

Setting

Parent material: Igneous and metamorphic rock

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 0 inches to lithic bedrock

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Description of Hollis

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Shallow, friable loamy ablation till

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 14 inches: gravelly fine sandy loam
H3 - 14 to 18 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 25 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Chatfield

Percent of map unit: 7 percent
Hydric soil rating: No

Swansea

Percent of map unit: 2 percent
Landform: Bogs
Hydric soil rating: Yes

Whitman

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

422B—Canton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w818
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton, Extremely Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 5 inches: fine sandy loam
Bw1 - 5 to 16 inches: fine sandy loam
Bw2 - 16 to 22 inches: gravelly fine sandy loam
2C - 22 to 67 inches: gravelly loamy sand

Properties and qualities

Slope: 0 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water storage in profile: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 6 percent
Landform: Ground moraines, ridges, hills
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Scituate, extremely stony

Percent of map unit: 6 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk, extremely stony

Percent of map unit: 4 percent
Landform: Drumlins, hills, ground moraines, recessionial moraines
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 4 percent
Landform: Depressions, marshes, kettles, swamps, bogs
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

424B—Canton fine sandy loam, 3 to 8 percent slopes, extremely bouldery

Map Unit Setting

National map unit symbol: vkq5

Elevation: 0 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Canton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canton

Setting

Landform: Ice-contact slopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over loose sandy and gravelly ablation till

Typical profile

H1 - 0 to 3 inches: fine sandy loam
H2 - 3 to 18 inches: fine sandy loam
H3 - 18 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Percent of area covered with surface fragments: 9.0 percent
Depth to restrictive feature: 18 to 36 inches to strongly contrasting textural stratification
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Hydric soil rating: No

Minor Components

Montauk

Percent of map unit: 4 percent
Hydric soil rating: No

Charlton

Percent of map unit: 2 percent
Hydric soil rating: No

Chatfield
Percent of map unit: 2 percent
Hydric soil rating: No

Scituate
Percent of map unit: 2 percent
Hydric soil rating: No

602—Urban land, 0 to 15 percent slopes

Map Unit Setting
National map unit symbol: vkyj
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition
Urban land: 99 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting
Parent material: Excavated and filled land

Minor Components

Rock outcrops
Percent of map unit: 1 percent
Hydric soil rating: Unranked

655—Udorthents, wet substratum

Map Unit Setting
National map unit symbol: vkyd
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition
Udorthents and similar soils: 95 percent
Minor components: 5 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Landform position (two-dimensional): Shoulder, footslope
Landform position (three-dimensional): Riser, tread
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Parent material: Excavated and filled sandy and gravelly human transported material over highly-decomposed herbaceous organic material

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Minor Components

Urban land

Percent of map unit: 3 percent
Hydric soil rating: Unranked

Ipswich

Percent of map unit: 2 percent
Landform: Marshes
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

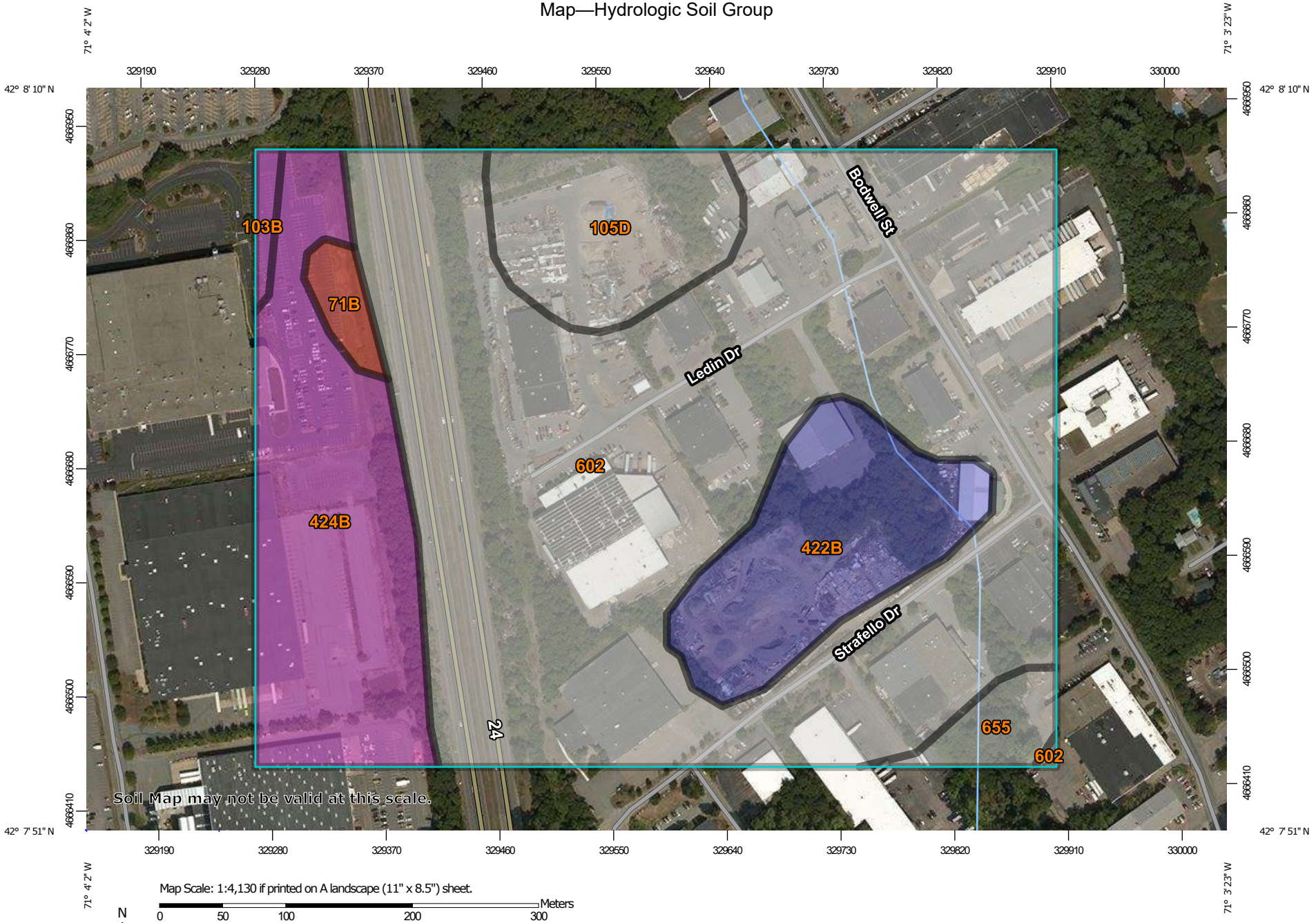
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:4,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 14, Sep 12, 2018

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

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

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

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	1.0	1.2%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	0.5	0.6%
105D	Rock outcrop-Hollis complex, 3 to 25 percent slopes		5.9	7.6%
422B	Canton fine sandy loam, 0 to 8 percent slopes, extremely stony	B	7.8	10.1%
424B	Canton fine sandy loam, 3 to 8 percent slopes, extremely bouldery	A	12.0	15.7%
602	Urban land, 0 to 15 percent slopes		48.0	62.7%
655	Udorthents, wet substratum		1.5	2.0%
Totals for Area of Interest			**76.6**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

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American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

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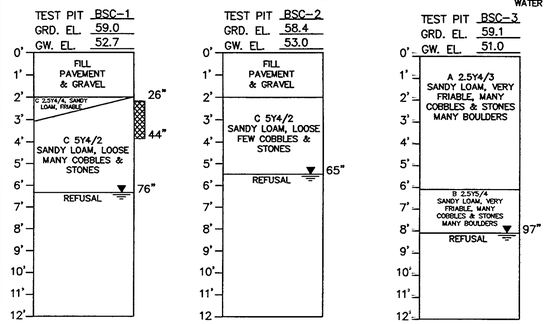
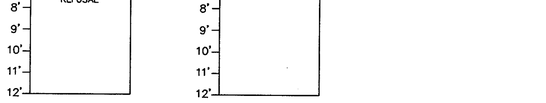
United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

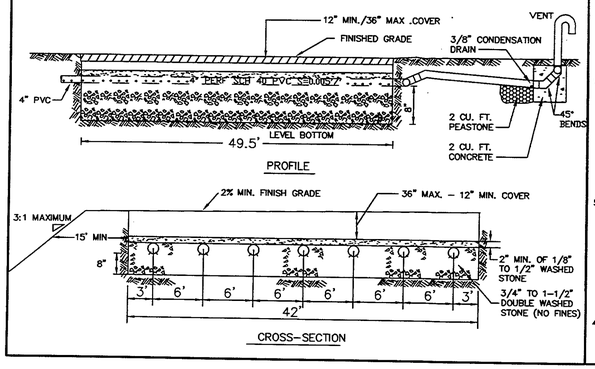
SOIL TEST PIT DATA:

INDICATES PERC. TEST — INDICATES OBSERVED GROUND WATER — INDICATES ESTIMATED SEASONAL HIGH GROUND WATER





LEACHING FIELD DETAIL: NOT TO SCALE

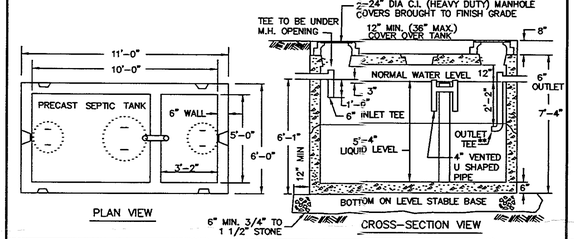


SEPTIC TANK DETAIL: 2,000 GALLON, H-10 LOADING

NOT TO SCALE

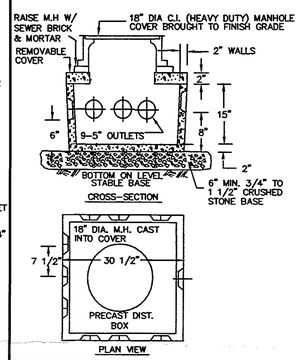
NOTES:
1. SEPTIC TANK SHALL BE STEEL REINFORCED CONCRETE.
2. SEPTIC TANK TO WITHSTAND H-20 LOADING UNLESS UNDER PAVEMENT, DRIVES OR TRAVELED WAYS, WHEREIN H-20 LOADING SHALL APPLY.
3. ALL PIPE CONNECTIONS AND CONCRETE CONSTRUCTION SHALL BE WATERTIGHT.
4. FILL ALL UNUSED KNOCKOUTS WITH MORTAR.
5. INLET AND OUTLET TEES TO BE CAST IRON, SCHED. 40 PVC OR CAST-IN-PLACE CONCRETE. TEES TO BE CENTERED UNDER MANHOLE COVER.
6. RECOMMENDED MANUFACTURER–ROTONDO OR APPROVED EQUAL.

**90° BEND ON OUTLET TEE FOR GAS CONTROL



DISTRIBUTION BOX DETAIL: H-20 LOADING

NOT TO SCALE



NOTES:
1. DIST. BOX TO WITHSTAND H–10 LOADING UNLESS UNDER PAVEMENT, DRIVES OR TRAVELED WAYS WHEREIN H–20 LOADING SHALL APPLY.
2. PROVIDE INLET TEE OR BAFFLE WHERE SLOPE OF PIPE EXCEEDS 0.08 FT./FT OR IN PUMPED SYSTEM.
3. FIRST TWO FEET OF PIPE OUT OF DIST. BOX TO BE LAID LEVEL.
4. RECOMMENDED MANUFACTURER–ROTONDO OR APPROVED EQUAL.
5. ALL PIPE CONNECTIONS AND CONCRETE CONSTRUCTION SHALL BE WATERTIGHT.
6. RAISE MANHOLES TO FINISH GRADE WITH SEWER BRICK AND MORTAR. FULL OUTER MORTAR PARGE TO PROVIDE WATER TIGHT SEAL.
7. FILL ALL UNUSED KNOCKOUTS WITH MORTAR.

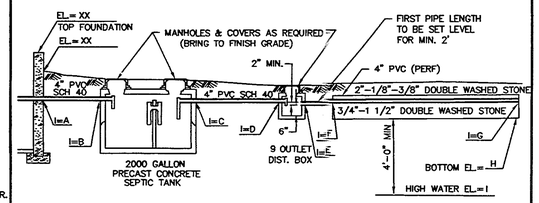
NO. OF OUTLETS: 9

DATUM:

VERTICAL DATUM: ASSUMED

BENCH MARK USED: FINISH FLOOR, ELEV. 63.32

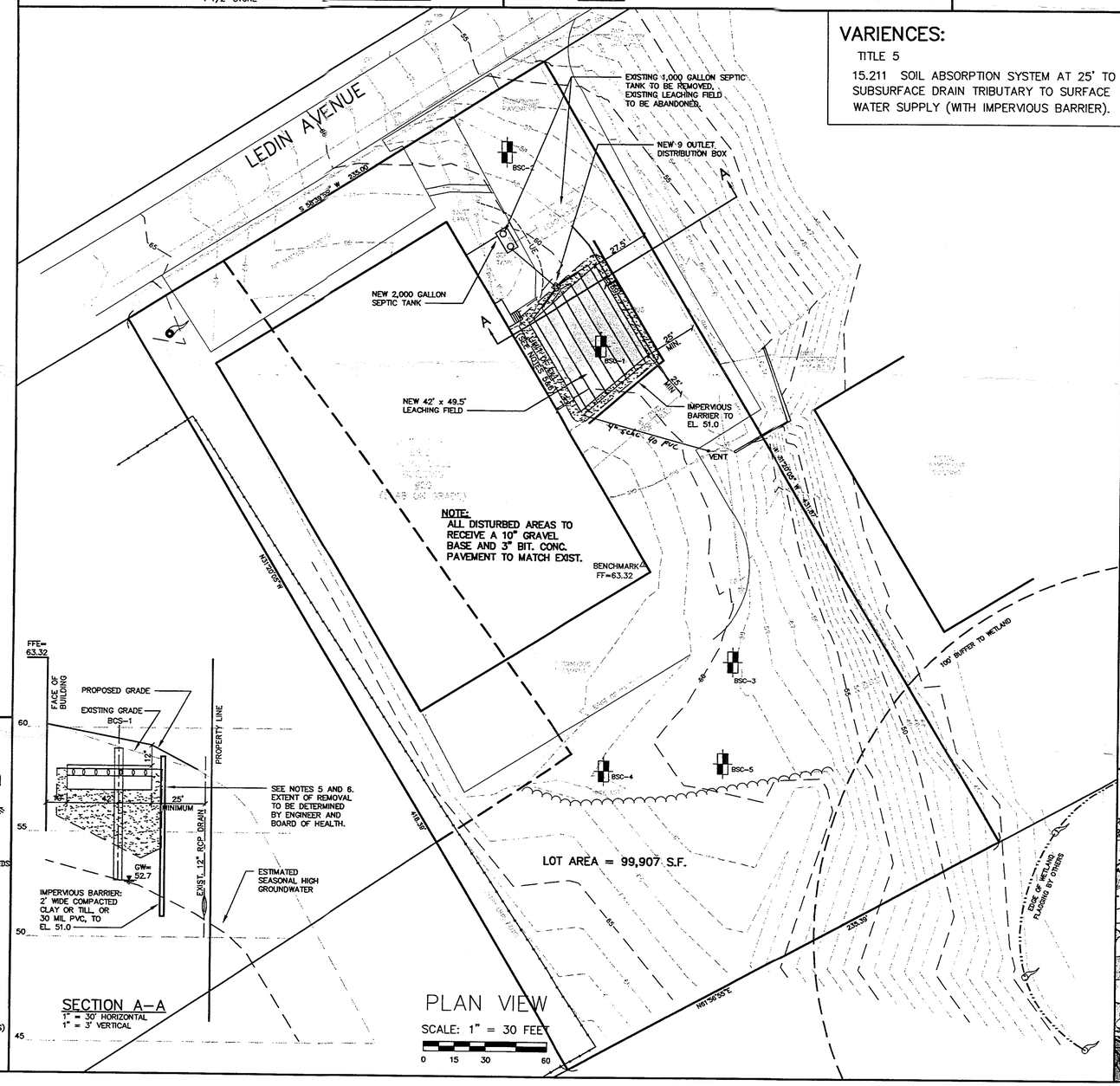
PROFILE: NOT TO SCALE



VARIENCES:

TITLE 5

15.211 SOIL ABSORPTION SYSTEM AT 25' TO SUBSURFACE DRAIN TRIBUTARY TO SURFACE WATER SUPPLY (WITH IMPERVIOUS BARRIER).



INVERT ELEVATIONS:

	FINISHED FIRST FLOOR	63.32
A.	4" INVERT AT BUILDING*	58.6±
B.	4" INVERT AT SEPTIC TANK (IN)	58.31
C.	4" INVERT AT SEPTIC TANK (OUT)	58.06
D.	4" INVERT AT DIST. BOX (IN)	57.88
E.	4" INVERT AT DIST. BOX (OUT)	57.71
	INVERTS AT LEACHING FACILITY:	
F.	4" INVERT AT BEGINNING OF LEACHING FIELD	57.61
G.	4" INVERT AT END OF LEACHING FIELD	57.36
H.	ELEVATION AT BOTTOM OF LEACHING FIELD	56.7
I.	ESTIMATED GROUNDWATER ELEVATION	52.7

*TO BE VERIFIED BY CONTRACTOR

DESIGN CRITERIA:

DESIGN FLOW:

65 EMPLOYEES AT 15 G.P.B./EMP= 975 G.P.D.

REQUIRED SEPTIC TANK:

975 x 200% = 1950 GAL.

SEPTIC TANK PROVIDED: = 2000 GAL.

SIZE OF LEACHING FACILITY REQUIRED:

DESIGN PERC. RATE: 22 MIN./ INCH

LONG TERM APPL. RATE .48 G.P.D/S.F.

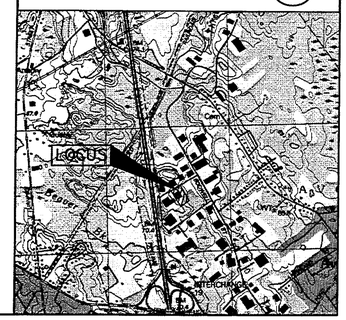
SIZE OF LEACHING FACILITY PROVIDED:

975 GPD/0.48 GPD/SF = 2,032 SF

42' x 49.5' = 2,079 SF

2,079 SF > 2,032 SF

LOCUS PLAN: NO SCALE



REVISIONS		
NO.	DATE	DESCRIPTION
1.	4/23/03	FIELD SIZE

GENERAL NOTES:

1. THIS PLAN IS FOR DESIGN AND CONSTRUCTION OF THE SEWAGE DISPOSAL FACILITY ONLY.
2. ALL CONSTRUCTION METHODS AND MATERIALS SHALL CONFORM TO MASS. D.E.P. TITLE 5 AND LOCAL BOARD OF HEALTH REGULATIONS.
3. ALL PIPES LOCATED UNDER PAVEMENT OR TRAVELED WAY SHALL BE SCHEDULE 40 OR EQUAL.
4. THERE ARE NO KNOWN PRIVATE WELLS LOCATED WITHIN 150 FT. OF THE PROPOSED LEACHING FACILITY NOR ANY KNOWN WELLS PROPOSED WITHIN 150' OF ANY KNOWN LEACHING FACILITY.
5. WITHIN LIMIT OF EXCAVATION REMOVE ALL TOPSOIL, SUBSOIL AND OTHER IMPERVIOUS MATERIAL.
6. REPLACE WITH CLEAN WASHED SAND OR OTHER CLEAN GRANULAR SOILS CONFORMING TO THE FOLLOWING SIEVE ANALYSIS:
   10% (MAX) BY WT. SHALL PASS No. 50 SIEVE
   <10 % OF No. 4 SIEVE SHALL PASS No. 100
   <5 % OF No. 4 SIEVE SHALL PASS No. 200
   UNIFORMITY COEFFICIENT @ No. 4 SIEVE </=6.0
7. EXISTING UTILITIES WHERE SHOWN IN THE DRAWINGS ARE APPROXIMATE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROPERLY LOCATING AND COORDINATING THE PROPOSED CONSTRUCTION ACTIVITY WITH DIG–SAFE AND THE APPLICABLE UTILITY COMPANY AND MAINTAINING THE EXISTING UTILITY SYSTEM IN SERVICE. DIG–SAFE SHALL BE NOTIFIED PER THE STATE OF MASSACHUSETTS STATUTE CHAPTER 82, SECTION 409 AT TEL. 1–888–344–7233. THE ENGINEER DOES NOT GUARANTEE THEIR ACCURACY OR THAT ALL UTILITIES AND SUBSURFACE STRUCTURES ARE SHOWN. LOCATIONS AND ELEVATIONS OF UNDERGROUND UTILITIES TAKEN FROM RECORD PLANS. THE CONTRACTOR SHALL VERIFY SIZE, LOCATION AND INVERTS OF UTILITIES AND STRUCTURES AS REQUIRED PRIOR TO THE START OF CONSTRUCTION.
8. THIS SYSTEM IS NOT DESIGNED FOR THE USE OF A GARBAGE GRINDER. A GARBAGE GRINDER IS NOT RECOMMENDED DUE TO RECOGNIZED ADVERSE IMPACTS TO THE LEACHING FACILITY.

BSC GROUP
384 Washington Street
Norwell, Massachusetts
02061
781 659 7981

PROJECT TITLE:

SEWAGE DISPOSAL SYSTEM REPAIR

20 LEDIN AVENUE AVON MASSACHUSETTS

COMMONWEALTH OF MASSACHUSETTS DAVID J. CRISPIN CIVIL No. 32112 REGISTERED PROFESSIONAL ENGINEER 4-23-03

PREPARED FOR:
BOSTON BRACE
20 LEDIN AVE
AVON, MA 02322

DATE:	APRIL 16, 2003
COMP./DESIGN:	M.F.C.
CHECK:	D.J.C.
DRAWN:	M.F.C.
FIELD:	DS/BC
FILE NO.	6107–SEP.DWG
DWG NO.	4492–01
JOB NO.	4–6107.00
SHEET	1 OF 1

Civil & Environmental Consultants, Inc.

Date 7/22/2021

TEST PIT LOG

TEST PIT NO. TP-1

PROJECT NAME: 20 Ledin Ave Redevelopment
PROJECT NUMBER: 311-399
CEC TECHNICIAN: Jon Connell / Daniel Petrovic
SPECIFICATIONS: N/A
CONTRACTOR: Dowling Corp
EQUIPMENT: Mini Excavator
DATE STARTED: 7/22/2021 **COMPLETED:** 7/22/2021
LOCATION: 20 Ledin Ave, Avon, MA
GROUND WATER LEVELS: Approximately 80" BSG
GROUND SURFACE ELEVATION: ±NA
AT END OF EXCAVATION: 112"
BACKFILL: Backfilled with excavated materials
____ **HOURS AFTER EXCAVATION:** ____

DEPTH (Inches)	MATERIAL DESCRIPTION
	Fill – 0"–40" Sandy Loam Stony (20%), Bouldery (40%) 2.5Y 4/3
12	
24	
36	
48	**C –** 40"–112" Sandy Loam Gravelly (15%) 2.5Y 4/3
60	
72	
84	
96	
108	
120	

Note: No weeping or standing water visually observed in test pit. Mottling observed at 80".

Civil & Environmental Consultants, Inc.

Date 7/22/2021

TEST PIT LOG

TEST PIT NO. TP-2

PROJECT NAME: 20 Ledin Ave Redevelopment
PROJECT NUMBER: 311-399
CEC TECHNICIAN: Jon Connell / Daniel Petrovic
SPECIFICATIONS: N/A
CONTRACTOR: Dowling Corp
EQUIPMENT: Mini Excavator
DATE STARTED: 7/22/2021 **COMPLETED:** 7/22/2021
LOCATION: 20 Ledin Ave, Avon, MA
GROUND WATER LEVELS: Approximately 84" BSG
GROUND SURFACE ELEVATION: ±NA
AT END OF EXCAVATION: 104"
BACKFILL: Backfilled with excavated materials
____ **HOURS AFTER EXCAVATION:**

DEPTH (Inches)	MATERIAL DESCRIPTION
	Fill – 0"–58" Sandy Loam Gravelly (20%) 2.5Y 4/3
12	
24	
36	
48	
60	**C –** 58"–104" Sandy Loam Gravelly (20%), Stony (15%) 2.5Y 4/3
72	
84	
96	
108	

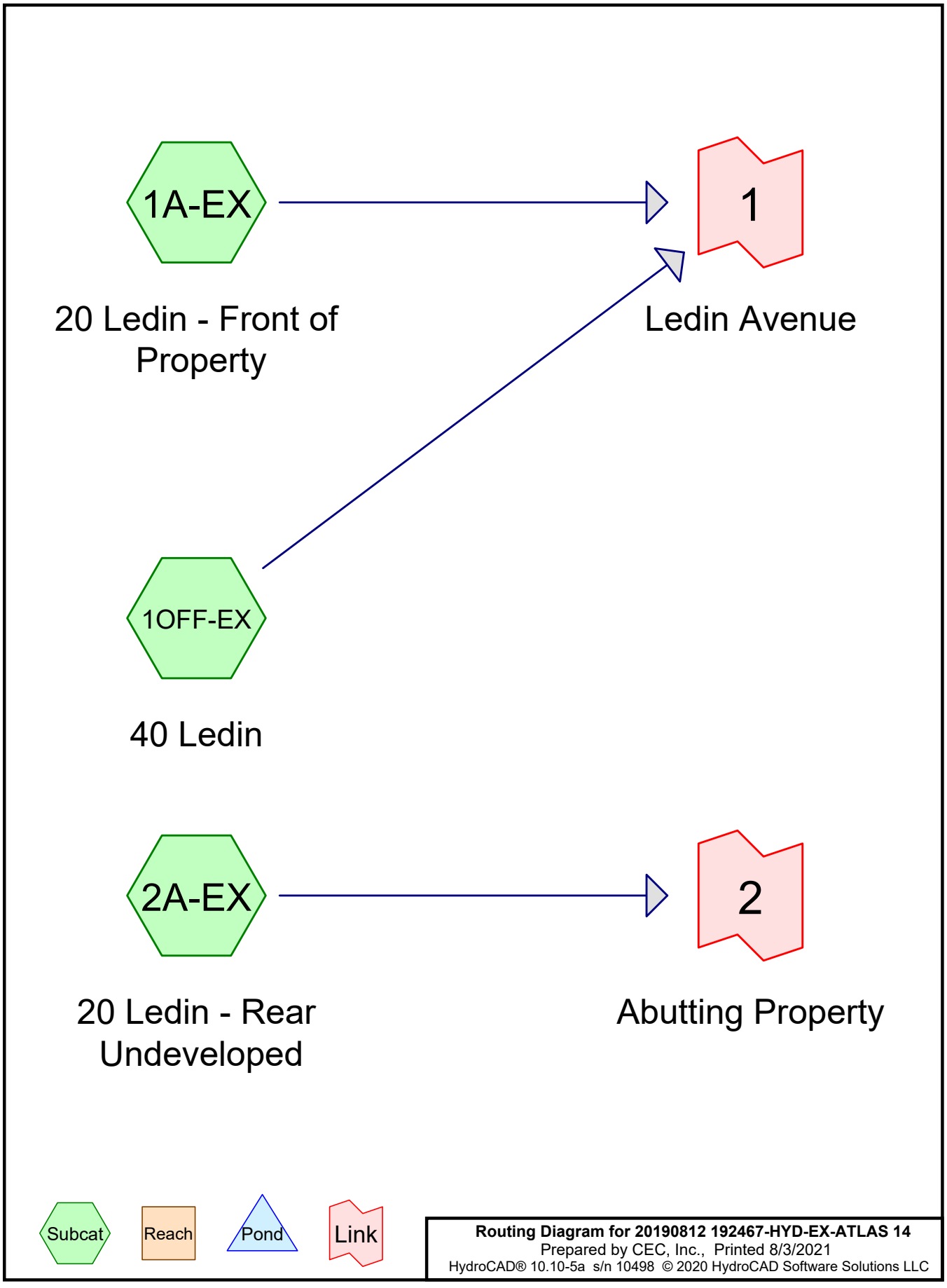
Note: No weeping or standing water visually observed in test pit. Mottling observed at 84".

APPENDIX C

SUPPORTING CALCULATIONS

HydroCAD Drainage Analysis
TSS Removal Calculations
Water Quality Volume and Recharge Calculations
Manufacturer's O&M Procedures
Illicit Discharge Compliance Statement
Mounding Analysis

HydroCAD Drainage Analysis



Routing Diagram for 20190812 192467-HYD-EX-ATLAS 14
Prepared by CEC, Inc., Printed 8/3/2021

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

Subcatchment1A-EX: 20 Ledin - Front of Runoff Area=85,194 sf 63.50% Impervious Runoff Depth>1.88"
Flow Length=530' Tc=11.9 min CN=86 Runoff=3.79 cfs 0.307 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=69,932 sf 95.62% Impervious Runoff Depth>2.88"
Flow Length=656' Tc=6.8 min CN=97 Runoff=5.03 cfs 0.385 af

Subcatchment2A-EX: 20 Ledin - Rear Runoff Area=14,709 sf 0.00% Impervious Runoff Depth>0.47"
Flow Length=186' Slope=0.1100 '/' Tc=6.0 min CN=61 Runoff=0.14 cfs 0.013 af

Link 1: Ledin Avenue Inflow=8.36 cfs 0.692 af
Primary=8.36 cfs 0.692 af

Link 2: Abutting Property Inflow=0.14 cfs 0.013 af
Primary=0.14 cfs 0.013 af

Total Runoff Area = 3.899 ac Runoff Volume = 0.706 af Average Runoff Depth = 2.17"
28.77% Pervious = 1.122 ac 71.23% Impervious = 2.777 ac

Summary for Subcatchment 1A-EX: 20 Ledin - Front of Property

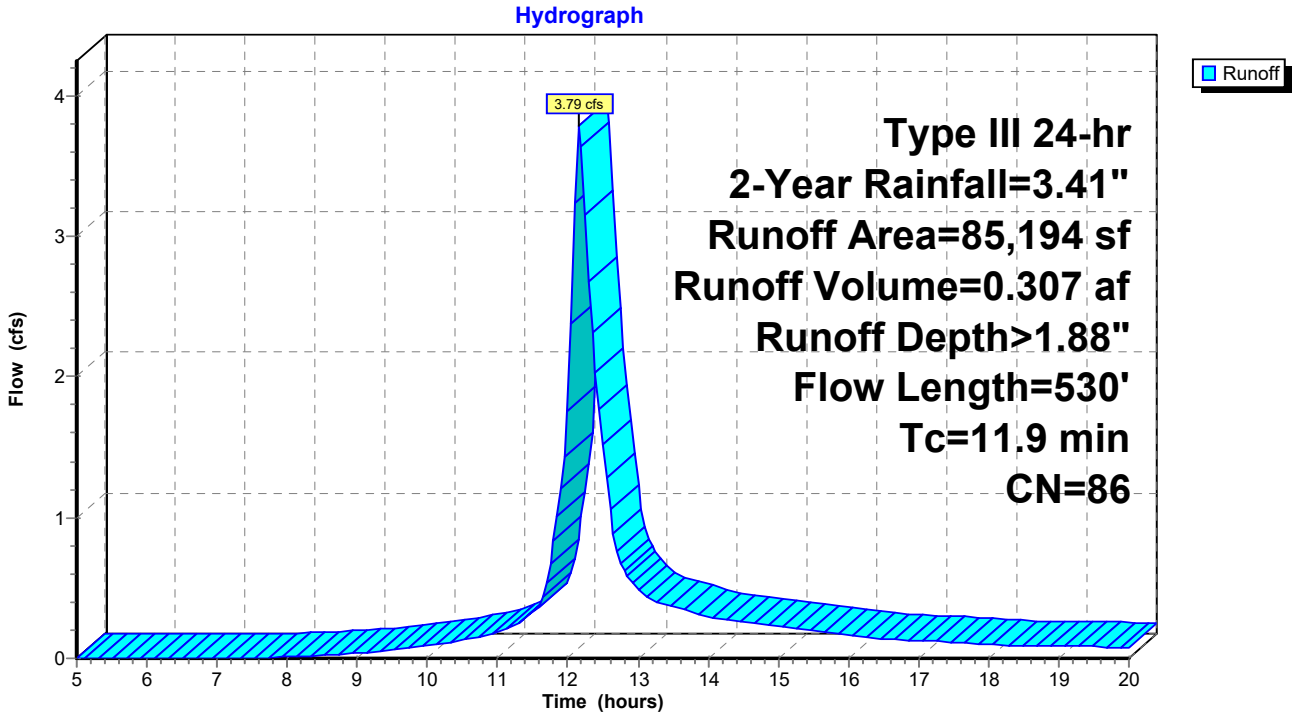
Runoff = 3.79 cfs @ 12.17 hrs, Volume= 0.307 af, Depth> 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.41"

Area (sf)	CN	Description
1,288	96	Gravel surface, HSG B
10,249	69	50-75% Grass cover, Fair, HSG B
28,826	98	Paved parking, HSG B
25,275	98	Roofs, HSG B
19,556	60	Woods, Fair, HSG B
85,194	86	Weighted Average
31,093		36.50% Pervious Area
54,101		63.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.7	159	0.0200	0.71		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
1.2	141	0.0100	2.03		**Shallow Concentrated Flow, grassed/paved area** Paved Kv= 20.3 fps
0.5	180	0.0200	5.93	11.86	**Channel Flow, pavement channel flow** Area= 2.0 sf Perim= 9.0' r= 0.22' n= 0.013 Asphalt, smooth
11.9	530	Total			

Subcatchment 1A-EX: 20 Ledin - Front of Property



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 401% of capacity of segment #2

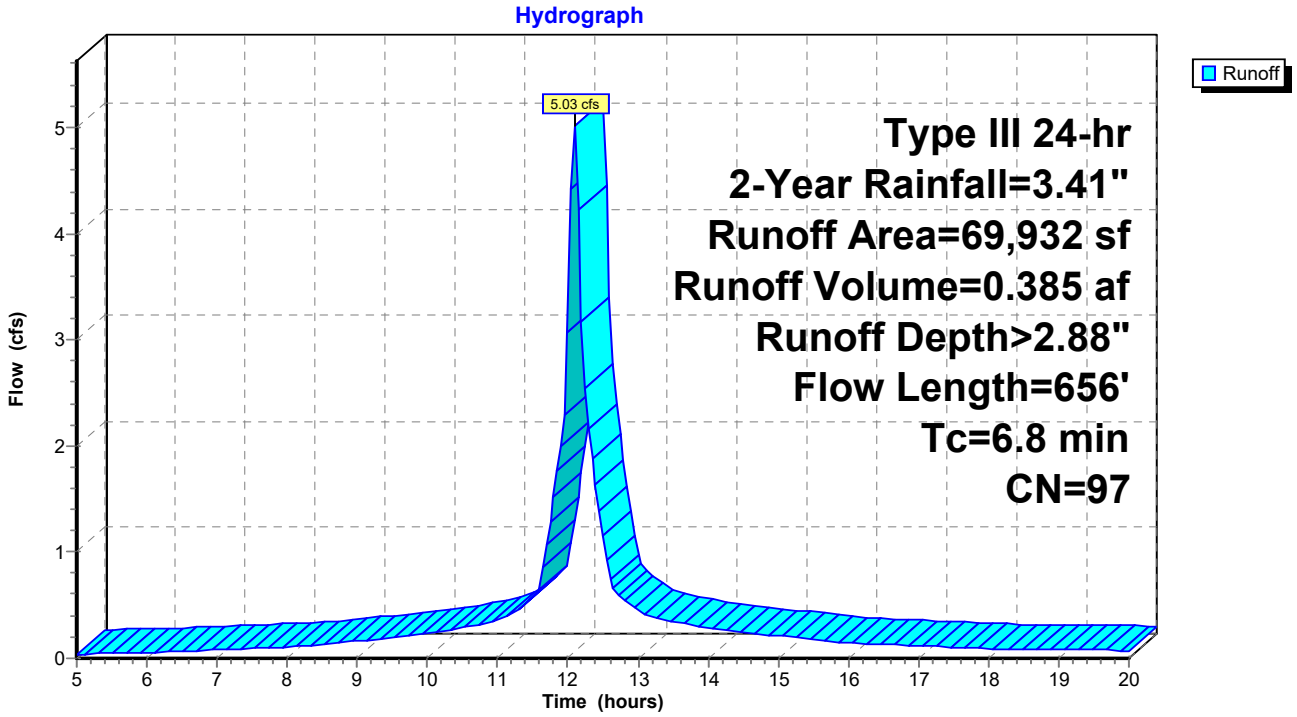
Runoff = 5.03 cfs @ 12.10 hrs, Volume= 0.385 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.41"

Area (sf)	CN	Description
32,231	98	Roofs, HSG B
3,061	79	<50% Grass cover, Poor, HSG B
34,640	98	Paved parking, HSG B
69,932	97	Weighted Average
3,061		4.38% Pervious Area
66,871		95.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

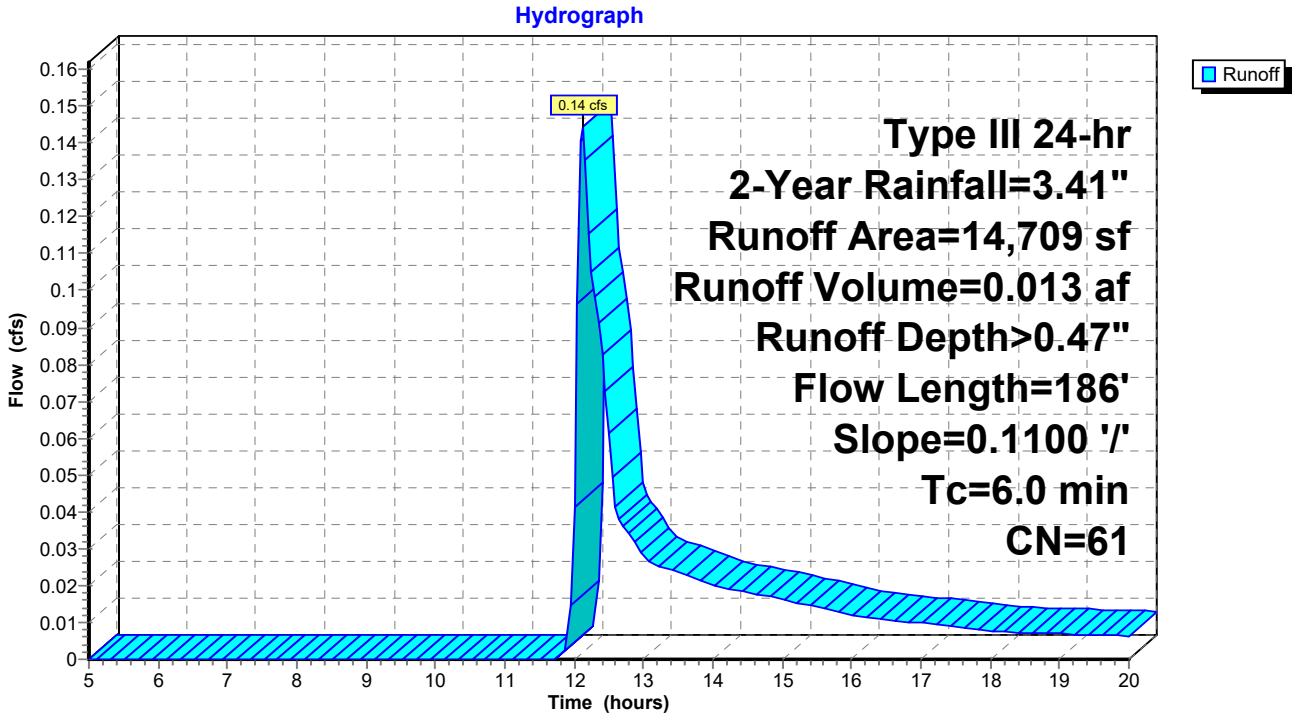
Runoff = 0.14 cfs @ 12.12 hrs, Volume= 0.013 af, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.41"

Area (sf)	CN	Description
14,190	60	Woods, Fair, HSG B
519	79	<50% Grass cover, Poor, HSG B
14,709	61	Weighted Average
14,709		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	186	0.1100	1.66		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
1.9	186	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

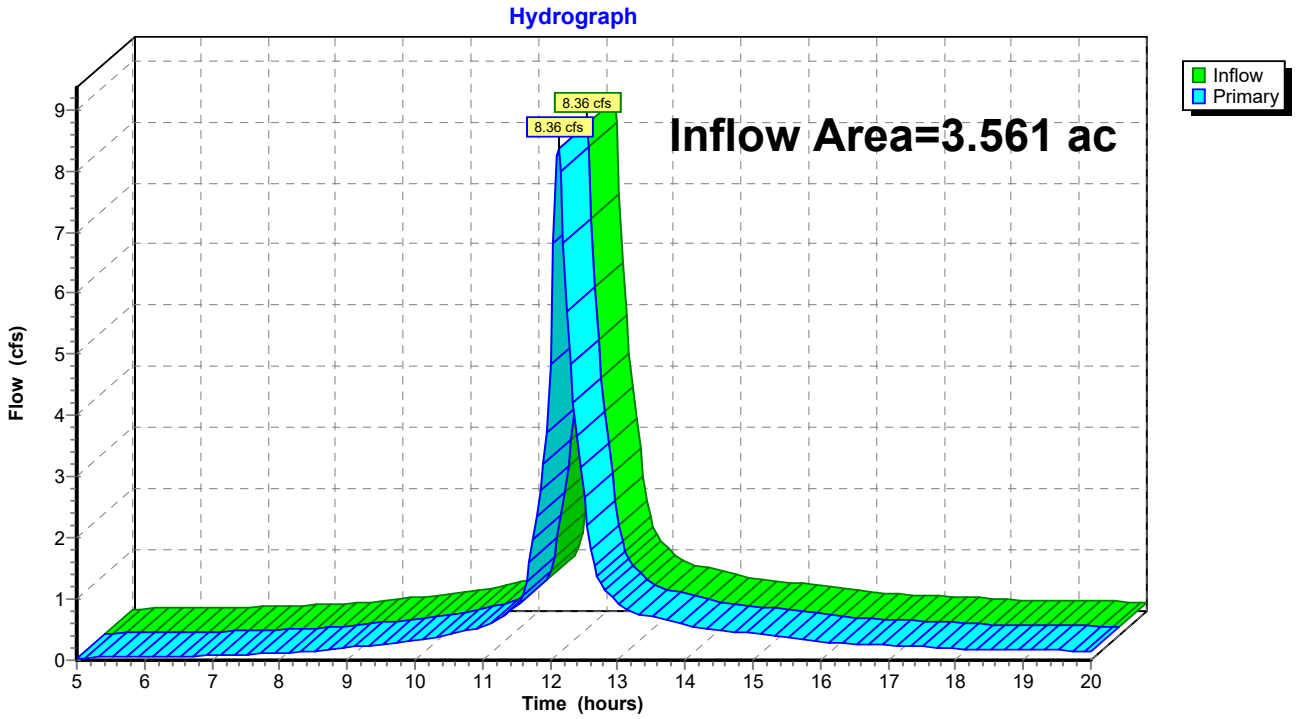


Summary for Link 1: Ledin Avenue

Inflow Area = 3.561 ac, 77.98% Impervious, Inflow Depth > 2.33" for 2-Year event
Inflow = 8.36 cfs @ 12.12 hrs, Volume= 0.692 af
Primary = 8.36 cfs @ 12.12 hrs, Volume= 0.692 af, Atten= 0%, Lag= 0.0 min

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

Link 1: Ledin Avenue

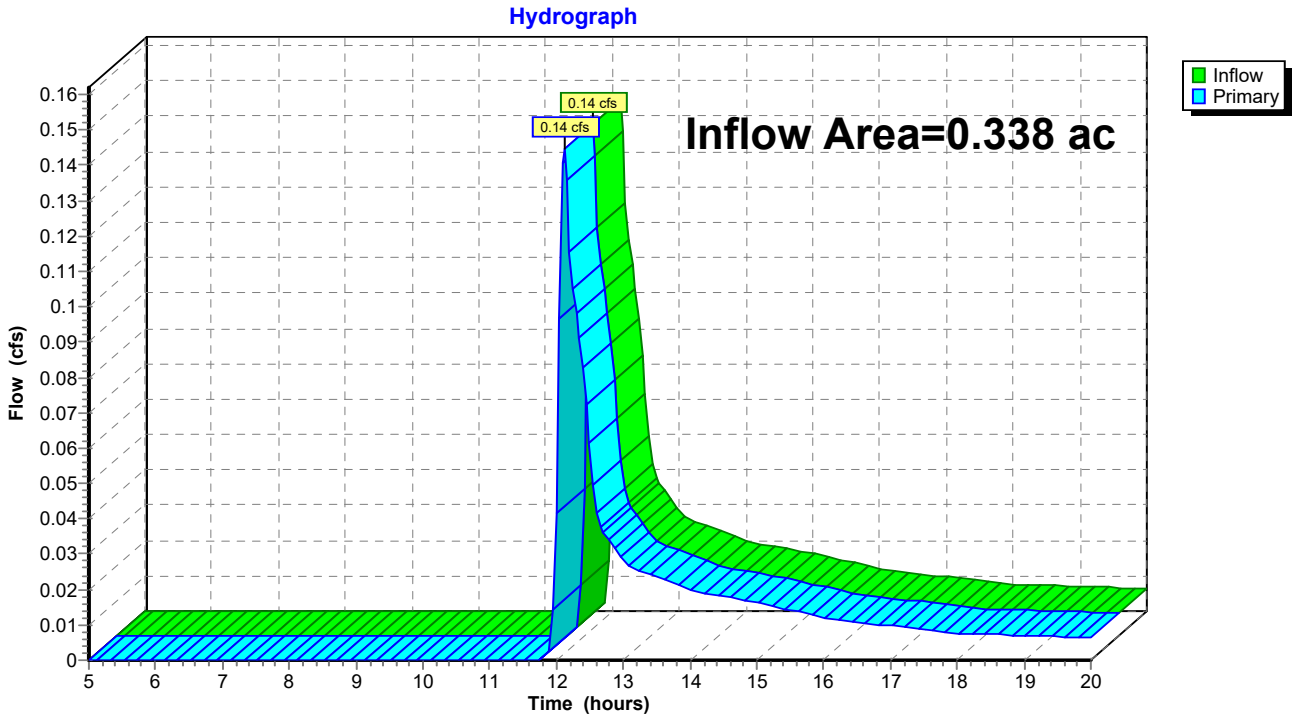


Summary for Link 2: Abutting Property

Inflow Area = 0.338 ac, 0.00% Impervious, Inflow Depth > 0.47" for 2-Year event
Inflow = 0.14 cfs @ 12.12 hrs, Volume= 0.013 af
Primary = 0.14 cfs @ 12.12 hrs, Volume= 0.013 af, Atten= 0%, Lag= 0.0 min

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

Link 2: Abutting Property



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

Subcatchment1A-EX: 20 Ledin - Front of Runoff Area=85,194 sf 63.50% Impervious Runoff Depth>3.45"
Flow Length=530' Tc=11.9 min CN=86 Runoff=6.80 cfs 0.563 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=69,932 sf 95.62% Impervious Runoff Depth>4.54"
Flow Length=656' Tc=6.8 min CN=97 Runoff=7.81 cfs 0.608 af

Subcatchment2A-EX: 20 Ledin - Rear Runoff Area=14,709 sf 0.00% Impervious Runoff Depth>1.36"
Flow Length=186' Slope=0.1100 '/' Tc=6.0 min CN=61 Runoff=0.54 cfs 0.038 af

Link 1: Ledin Avenue Inflow=13.88 cfs 1.170 af
Primary=13.88 cfs 1.170 af

Link 2: Abutting Property Inflow=0.54 cfs 0.038 af
Primary=0.54 cfs 0.038 af

Total Runoff Area = 3.899 ac Runoff Volume = 1.209 af Average Runoff Depth = 3.72"
28.77% Pervious = 1.122 ac 71.23% Impervious = 2.777 ac

Summary for Subcatchment 1A-EX: 20 Ledin - Front of Property

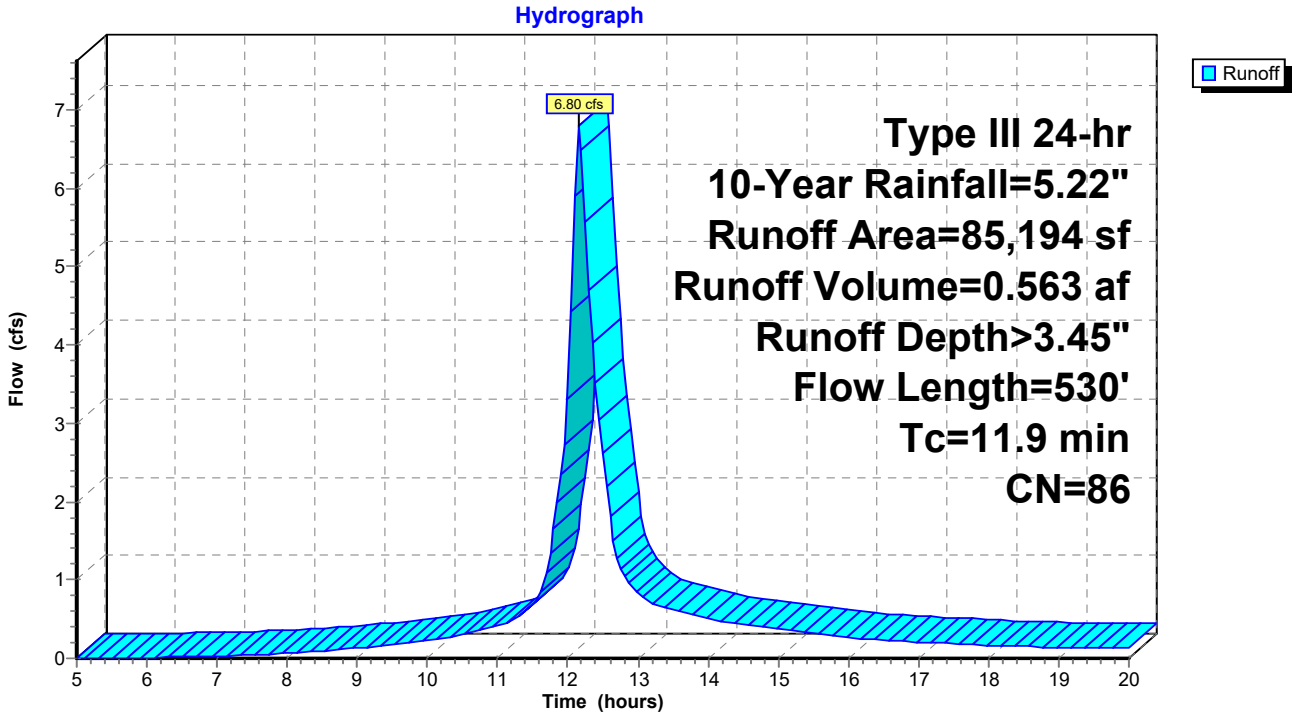
Runoff = 6.80 cfs @ 12.16 hrs, Volume= 0.563 af, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
1,288	96	Gravel surface, HSG B
10,249	69	50-75% Grass cover, Fair, HSG B
28,826	98	Paved parking, HSG B
25,275	98	Roofs, HSG B
19,556	60	Woods, Fair, HSG B
85,194	86	Weighted Average
31,093		36.50% Pervious Area
54,101		63.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.7	159	0.0200	0.71		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
1.2	141	0.0100	2.03		**Shallow Concentrated Flow, grassed/paved area** Paved Kv= 20.3 fps
0.5	180	0.0200	5.93	11.86	**Channel Flow, pavement channel flow** Area= 2.0 sf Perim= 9.0' r= 0.22' n= 0.013 Asphalt, smooth
11.9	530	Total			

Subcatchment 1A-EX: 20 Ledin - Front of Property



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 623% of capacity of segment #2

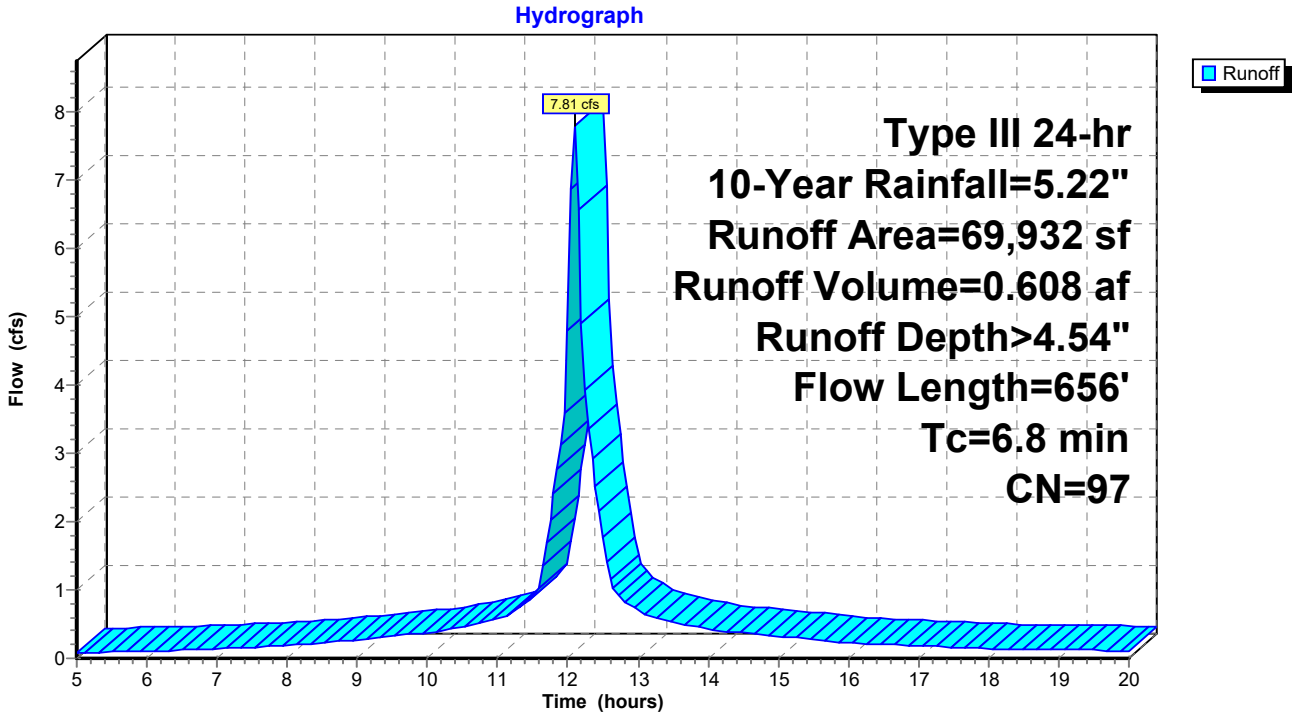
Runoff = 7.81 cfs @ 12.10 hrs, Volume= 0.608 af, Depth> 4.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
32,231	98	Roofs, HSG B
3,061	79	<50% Grass cover, Poor, HSG B
34,640	98	Paved parking, HSG B
69,932	97	Weighted Average
3,061		4.38% Pervious Area
66,871		95.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

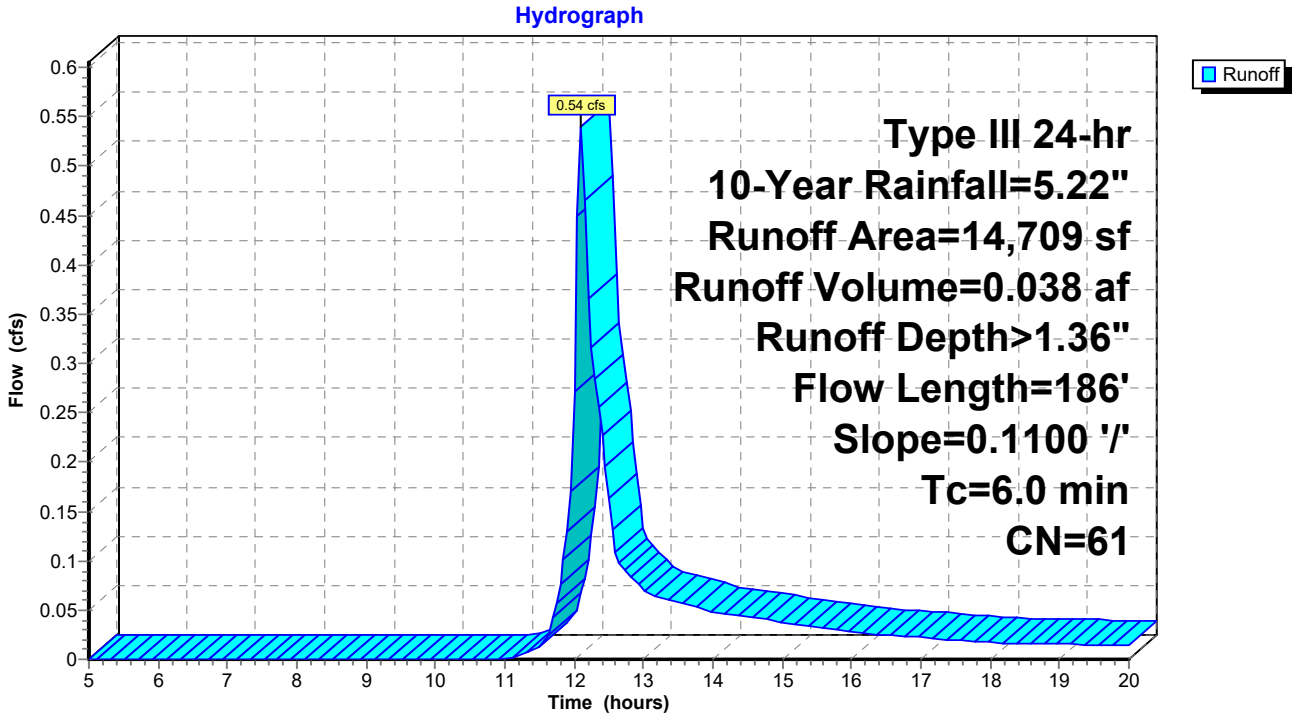
Runoff = 0.54 cfs @ 12.10 hrs, Volume= 0.038 af, Depth> 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.22"

Area (sf)	CN	Description
14,190	60	Woods, Fair, HSG B
519	79	<50% Grass cover, Poor, HSG B
14,709	61	Weighted Average
14,709		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	186	0.1100	1.66		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
1.9	186	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

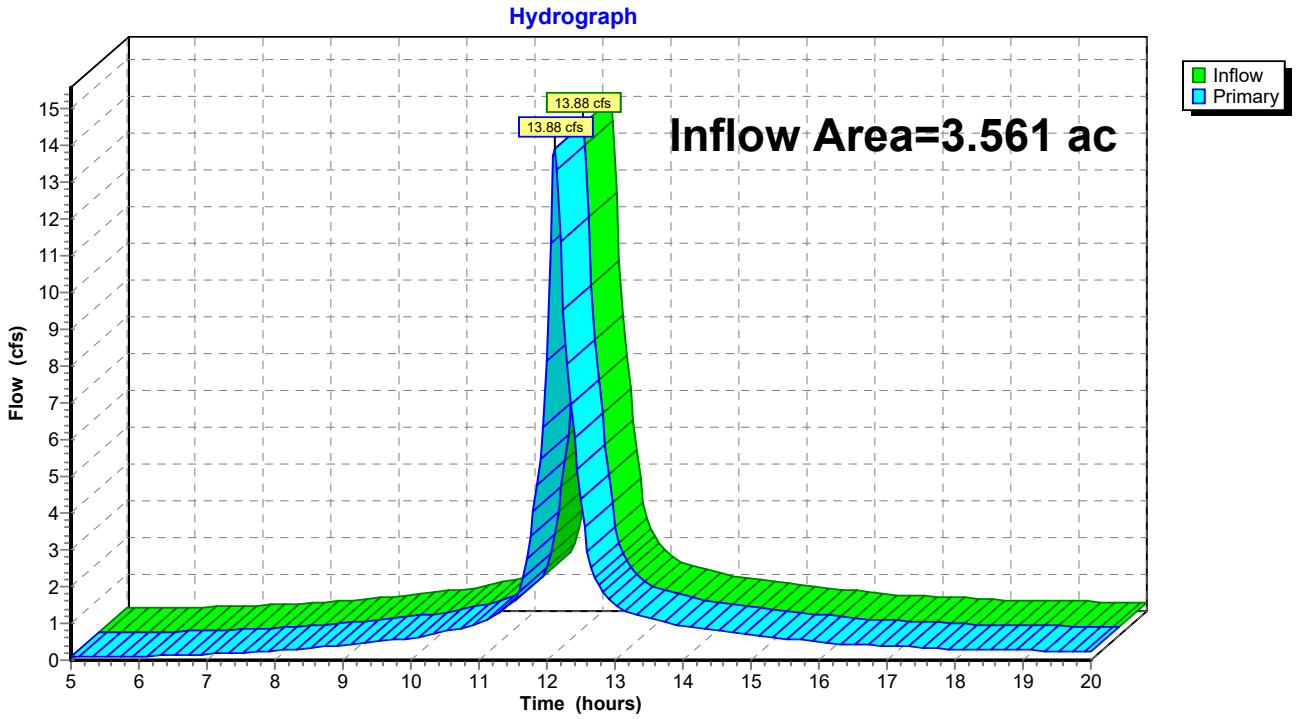


Summary for Link 1: Ledin Avenue

Inflow Area = 3.561 ac, 77.98% Impervious, Inflow Depth > 3.94" for 10-Year event
Inflow = 13.88 cfs @ 12.12 hrs, Volume= 1.170 af
Primary = 13.88 cfs @ 12.12 hrs, Volume= 1.170 af, Atten= 0%, Lag= 0.0 min

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

Link 1: Ledin Avenue

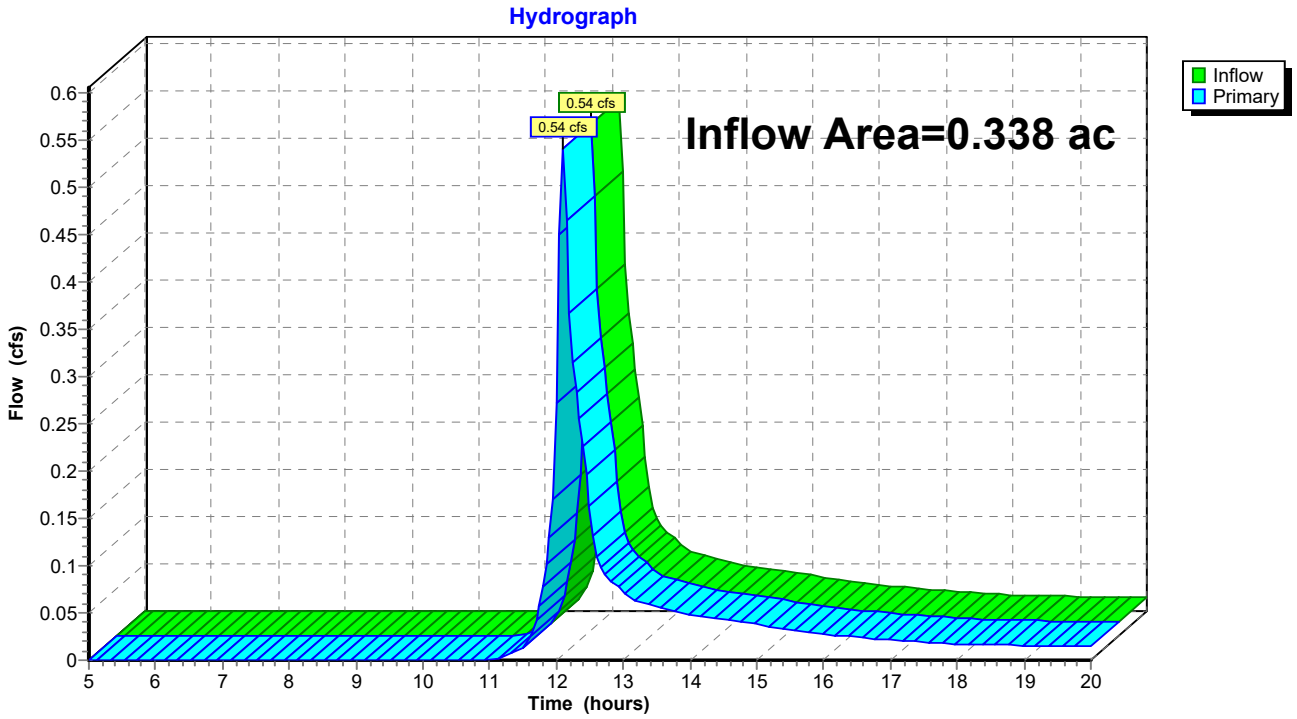


Summary for Link 2: Abutting Property

Inflow Area = 0.338 ac, 0.00% Impervious, Inflow Depth > 1.36" for 10-Year event
Inflow = 0.54 cfs @ 12.10 hrs, Volume= 0.038 af
Primary = 0.54 cfs @ 12.10 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

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

Link 2: Abutting Property



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

Subcatchment1A-EX: 20 Ledin - Front of Runoff Area=85,194 sf 63.50% Impervious Runoff Depth>4.47"
Flow Length=530' Tc=11.9 min CN=86 Runoff=8.70 cfs 0.728 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=69,932 sf 95.62% Impervious Runoff Depth>5.58"
Flow Length=656' Tc=6.8 min CN=97 Runoff=9.54 cfs 0.746 af

Subcatchment2A-EX: 20 Ledin - Rear Runoff Area=14,709 sf 0.00% Impervious Runoff Depth>2.05"
Flow Length=186' Slope=0.1100 '/' Tc=6.0 min CN=61 Runoff=0.84 cfs 0.058 af

Link 1: Ledin Avenue Inflow=17.34 cfs 1.475 af
Primary=17.34 cfs 1.475 af

Link 2: Abutting Property Inflow=0.84 cfs 0.058 af
Primary=0.84 cfs 0.058 af

Total Runoff Area = 3.899 ac Runoff Volume = 1.532 af Average Runoff Depth = 4.72"
28.77% Pervious = 1.122 ac 71.23% Impervious = 2.777 ac

Summary for Subcatchment 1A-EX: 20 Ledin - Front of Property

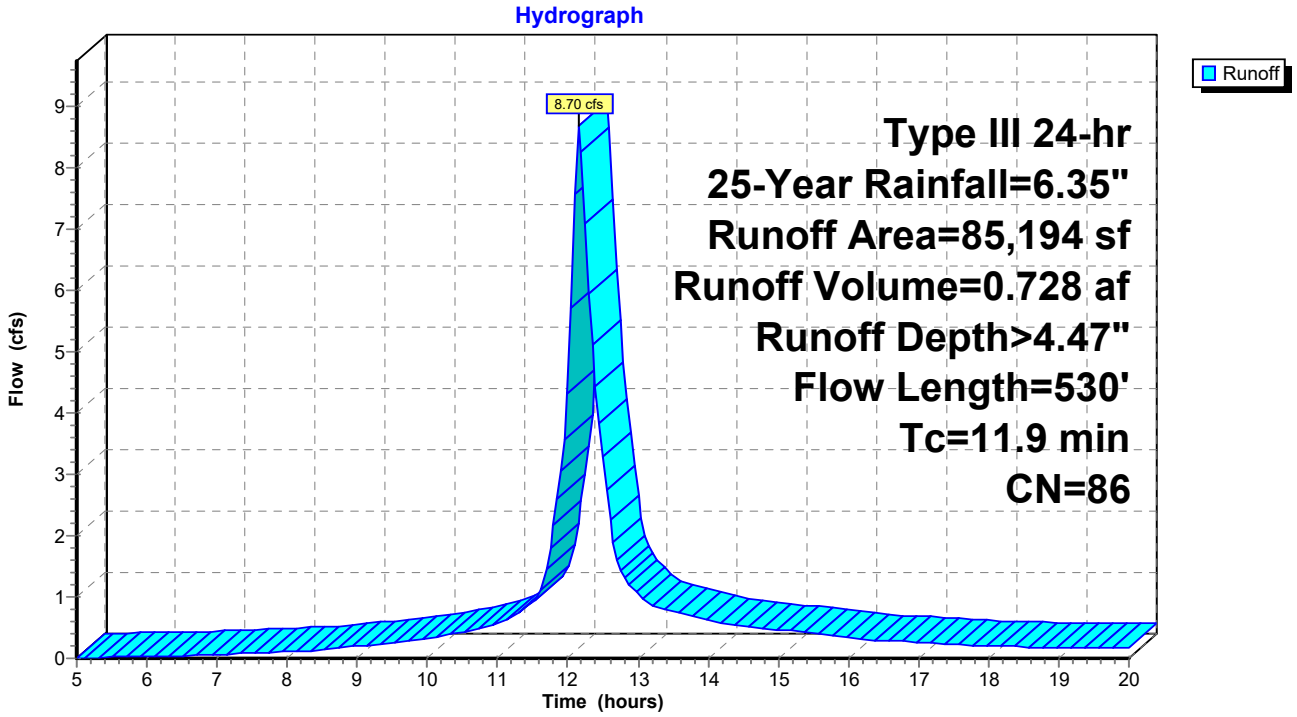
Runoff = 8.70 cfs @ 12.16 hrs, Volume= 0.728 af, Depth> 4.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
1,288	96	Gravel surface, HSG B
10,249	69	50-75% Grass cover, Fair, HSG B
28,826	98	Paved parking, HSG B
25,275	98	Roofs, HSG B
19,556	60	Woods, Fair, HSG B
85,194	86	Weighted Average
31,093		36.50% Pervious Area
54,101		63.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.7	159	0.0200	0.71		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
1.2	141	0.0100	2.03		**Shallow Concentrated Flow, grassed/paved area** Paved Kv= 20.3 fps
0.5	180	0.0200	5.93	11.86	**Channel Flow, pavement channel flow** Area= 2.0 sf Perim= 9.0' r= 0.22' n= 0.013 Asphalt, smooth
11.9	530	Total			

Subcatchment 1A-EX: 20 Ledin - Front of Property



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 761% of capacity of segment #2

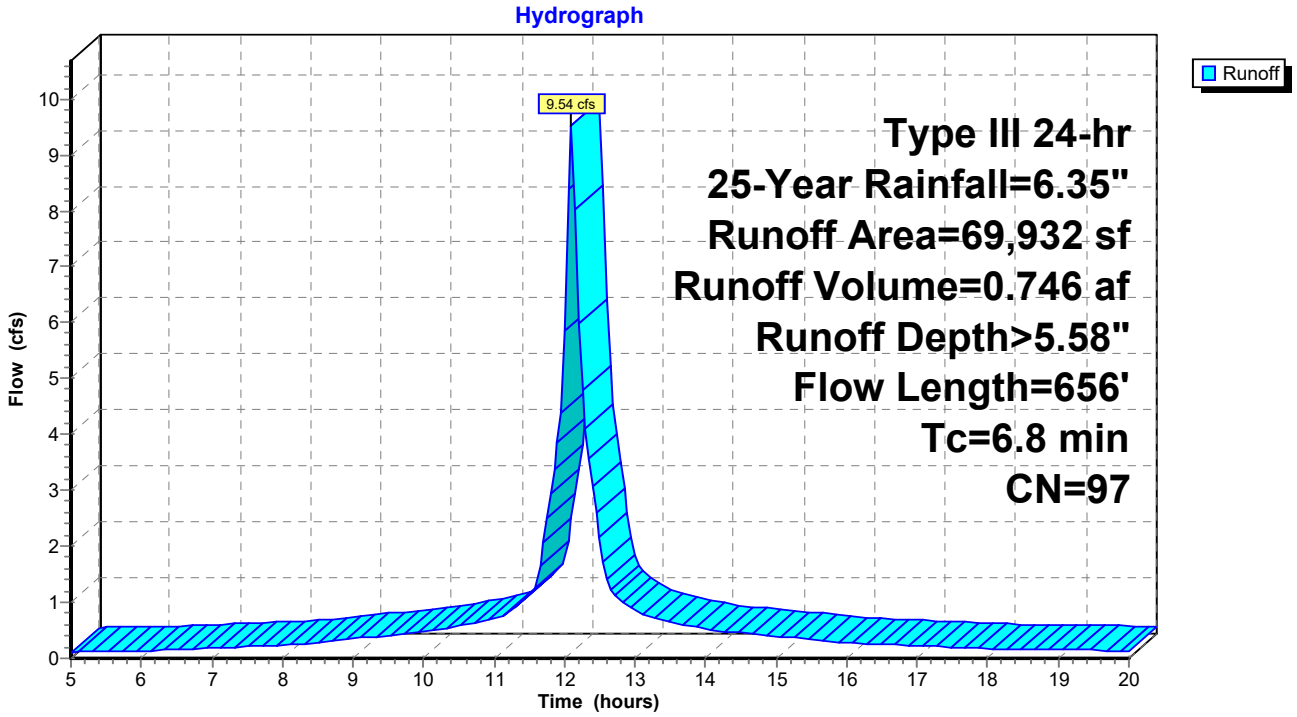
Runoff = 9.54 cfs @ 12.10 hrs, Volume= 0.746 af, Depth> 5.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
32,231	98	Roofs, HSG B
3,061	79	<50% Grass cover, Poor, HSG B
34,640	98	Paved parking, HSG B
69,932	97	Weighted Average
3,061		4.38% Pervious Area
66,871		95.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

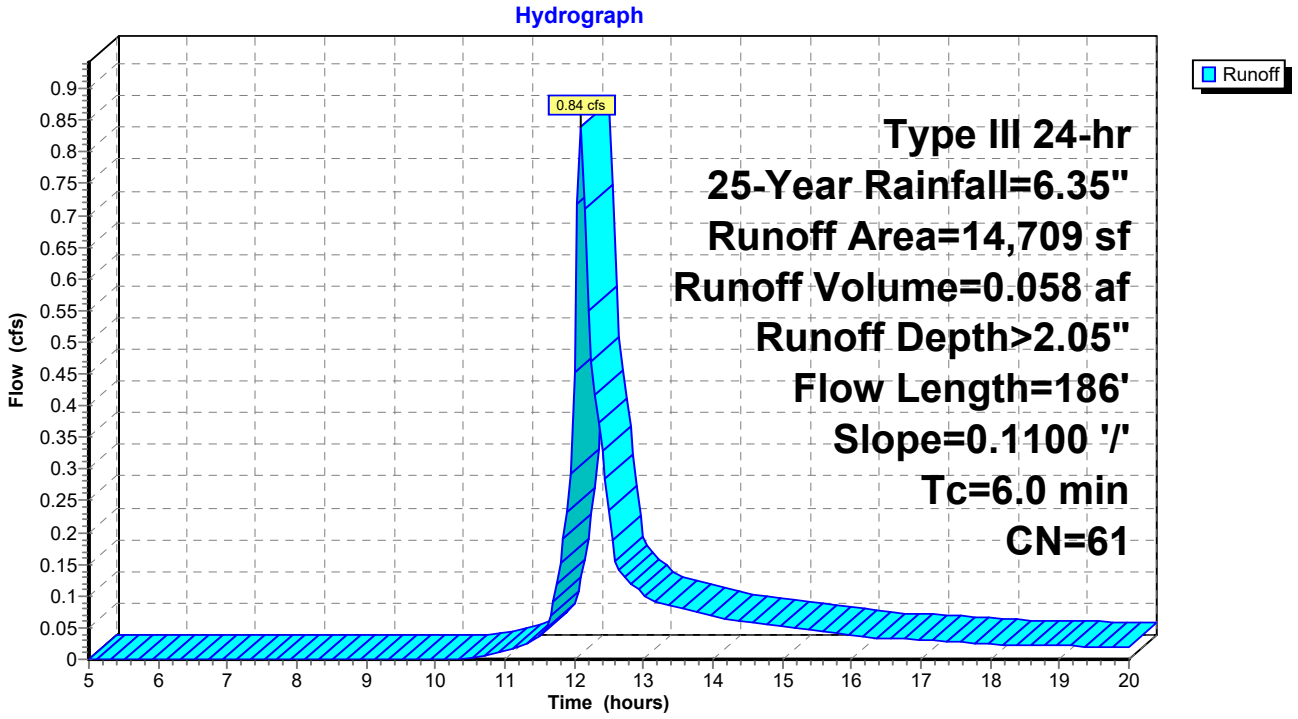
Runoff = 0.84 cfs @ 12.10 hrs, Volume= 0.058 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-Year Rainfall=6.35"

Area (sf)	CN	Description
14,190	60	Woods, Fair, HSG B
519	79	<50% Grass cover, Poor, HSG B
14,709	61	Weighted Average
14,709		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	186	0.1100	1.66		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
1.9	186	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

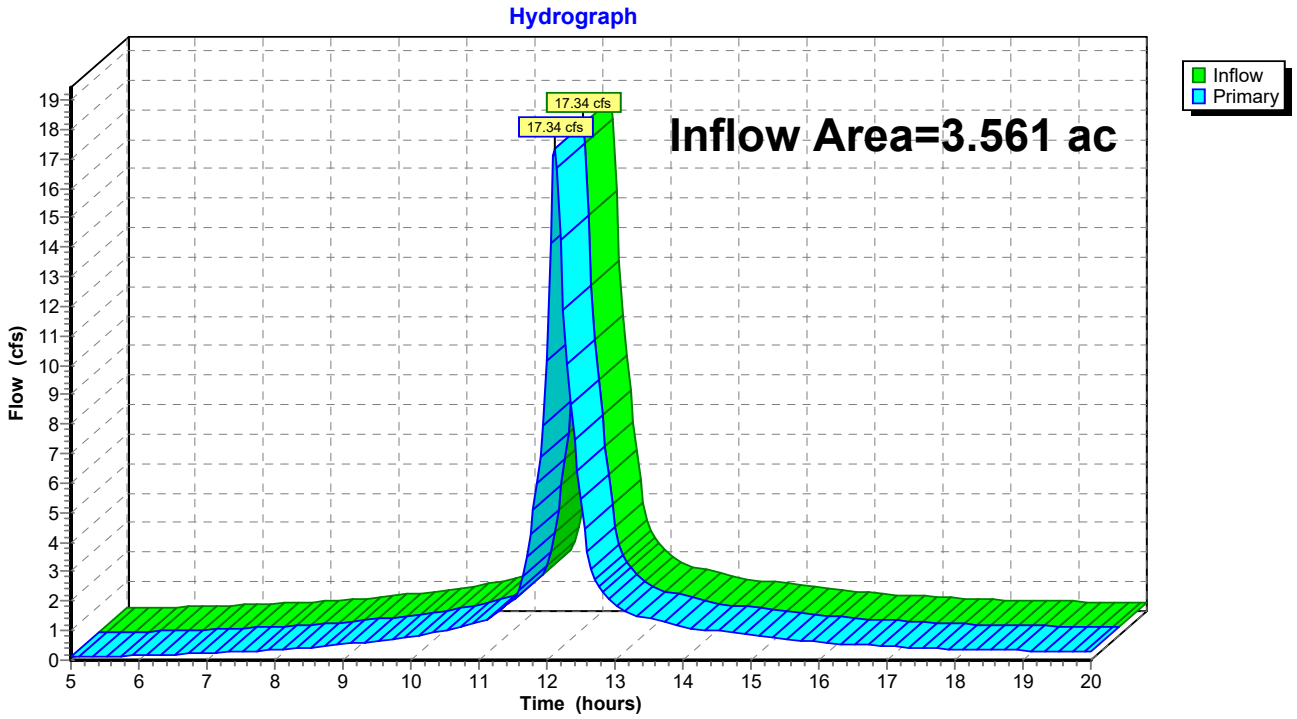


Summary for Link 1: Ledin Avenue

Inflow Area = 3.561 ac, 77.98% Impervious, Inflow Depth > 4.97" for 25-Year event
Inflow = 17.34 cfs @ 12.12 hrs, Volume= 1.475 af
Primary = 17.34 cfs @ 12.12 hrs, Volume= 1.475 af, Atten= 0%, Lag= 0.0 min

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

Link 1: Ledin Avenue

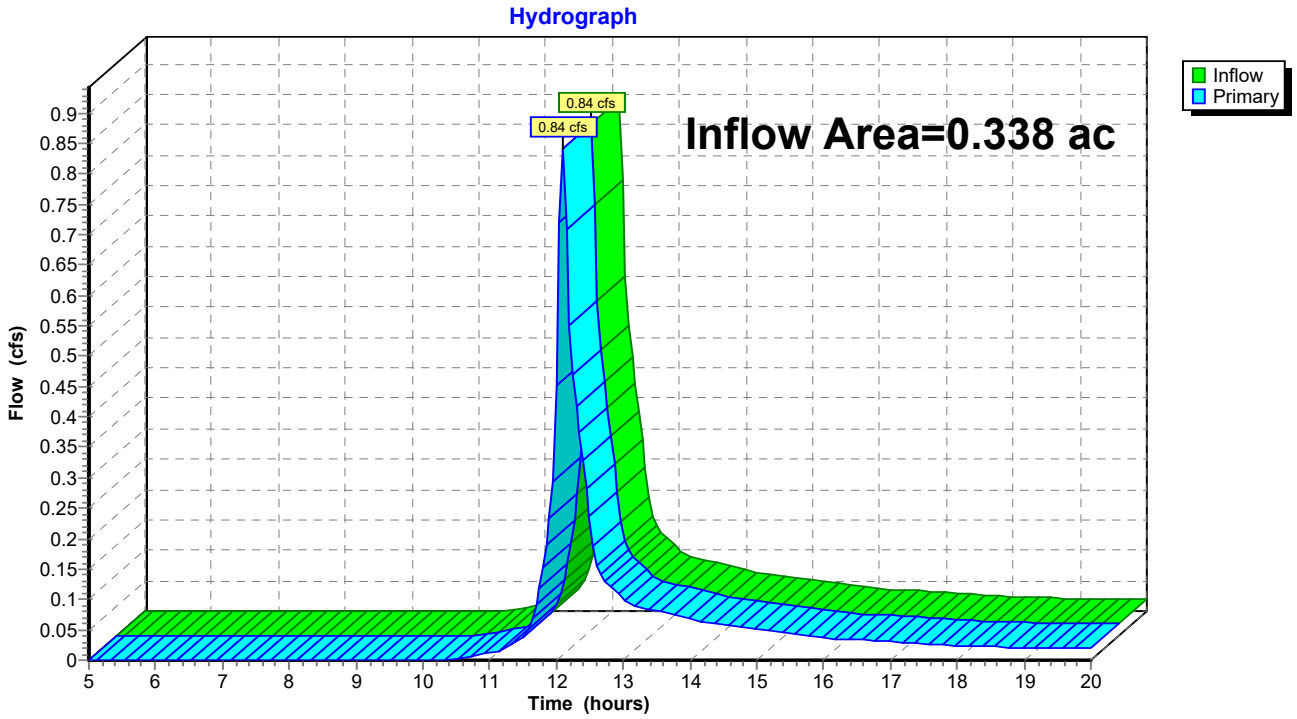


Summary for Link 2: Abutting Property

Inflow Area = 0.338 ac, 0.00% Impervious, Inflow Depth > 2.05" for 25-Year event
Inflow = 0.84 cfs @ 12.10 hrs, Volume= 0.058 af
Primary = 0.84 cfs @ 12.10 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

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

Link 2: Abutting Property



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

Subcatchment1A-EX: 20 Ledin - Front of Runoff Area=85,194 sf 63.50% Impervious Runoff Depth>6.07"
Flow Length=530' Tc=11.9 min CN=86 Runoff=11.62 cfs 0.989 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=69,932 sf 95.62% Impervious Runoff Depth>7.17"
Flow Length=656' Tc=6.8 min CN=97 Runoff=12.20 cfs 0.960 af

Subcatchment2A-EX: 20 Ledin - Rear Runoff Area=14,709 sf 0.00% Impervious Runoff Depth>3.25"
Flow Length=186' Slope=0.1100 '/' Tc=6.0 min CN=61 Runoff=1.35 cfs 0.091 af

Link 1: Ledin Avenue Inflow=22.68 cfs 1.948 af
Primary=22.68 cfs 1.948 af

Link 2: Abutting Property Inflow=1.35 cfs 0.091 af
Primary=1.35 cfs 0.091 af

Total Runoff Area = 3.899 ac Runoff Volume = 2.040 af Average Runoff Depth = 6.28"
28.77% Pervious = 1.122 ac 71.23% Impervious = 2.777 ac

Summary for Subcatchment 1A-EX: 20 Ledin - Front of Property

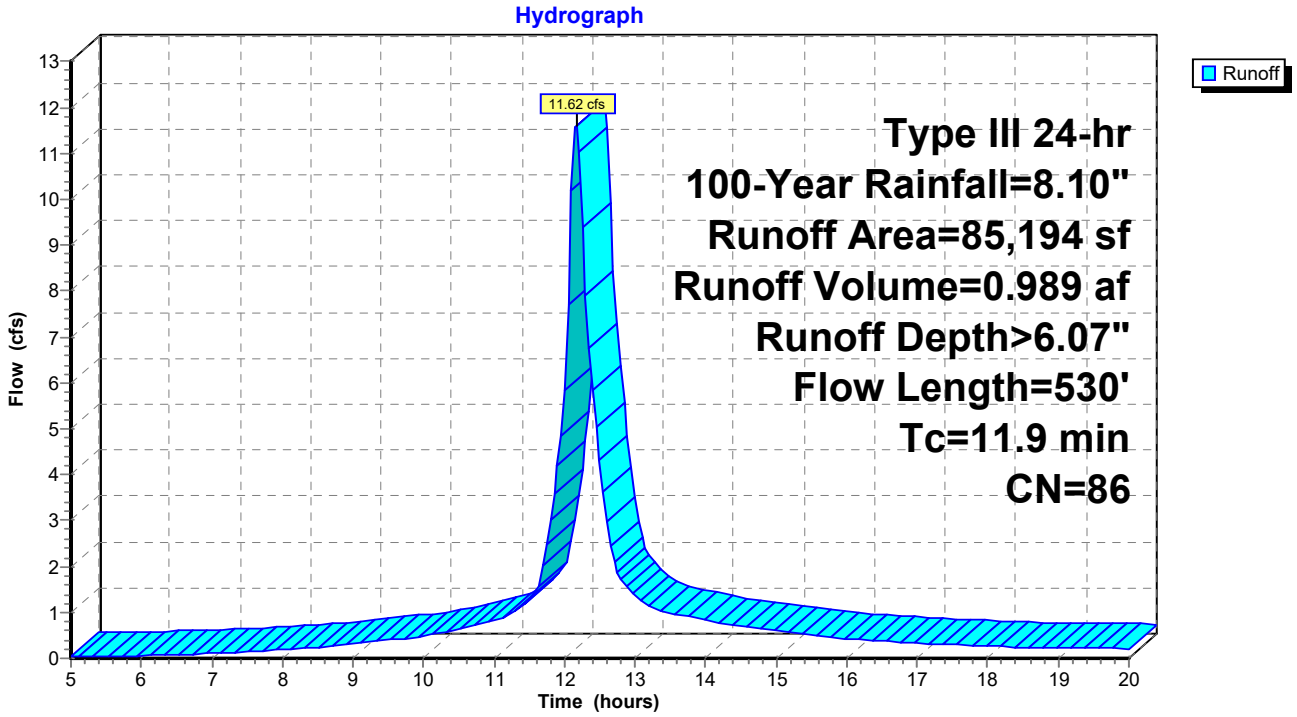
Runoff = 11.62 cfs @ 12.16 hrs, Volume= 0.989 af, Depth> 6.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.10"

Area (sf)	CN	Description
1,288	96	Gravel surface, HSG B
10,249	69	50-75% Grass cover, Fair, HSG B
28,826	98	Paved parking, HSG B
25,275	98	Roofs, HSG B
19,556	60	Woods, Fair, HSG B
85,194	86	Weighted Average
31,093		36.50% Pervious Area
54,101		63.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.5	50	0.1000	0.13		**Sheet Flow, Woods** Woods: Light underbrush n= 0.400 P2= 3.20"
3.7	159	0.0200	0.71		**Shallow Concentrated Flow, Woods** Woodland Kv= 5.0 fps
1.2	141	0.0100	2.03		**Shallow Concentrated Flow, grassed/paved area** Paved Kv= 20.3 fps
0.5	180	0.0200	5.93	11.86	**Channel Flow, pavement channel flow** Area= 2.0 sf Perim= 9.0' r= 0.22' n= 0.013 Asphalt, smooth
11.9	530	Total			

Subcatchment 1A-EX: 20 Ledin - Front of Property



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 973% of capacity of segment #2

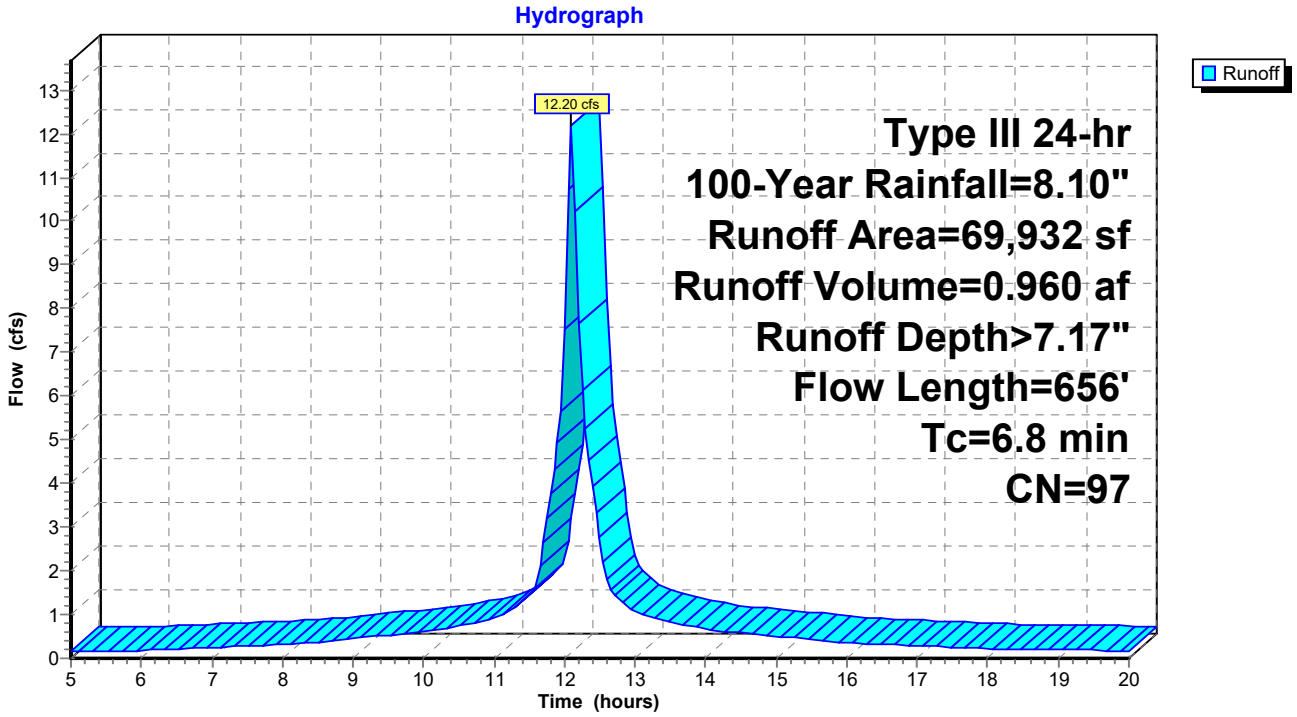
Runoff = 12.20 cfs @ 12.10 hrs, Volume= 0.960 af, Depth> 7.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.10"

Area (sf)	CN	Description
32,231	98	Roofs, HSG B
3,061	79	<50% Grass cover, Poor, HSG B
34,640	98	Paved parking, HSG B
69,932	97	Weighted Average
3,061		4.38% Pervious Area
66,871		95.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

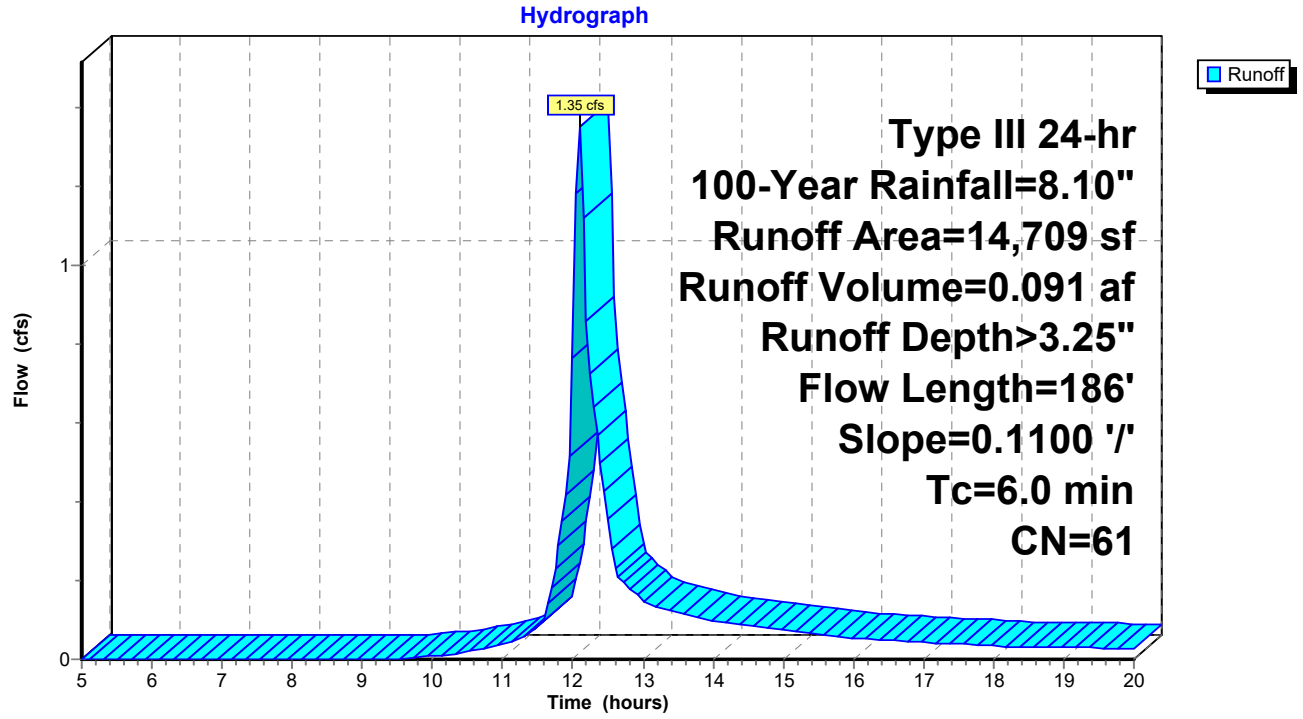
Runoff = 1.35 cfs @ 12.10 hrs, Volume= 0.091 af, Depth> 3.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.10"

Area (sf)	CN	Description
14,190	60	Woods, Fair, HSG B
519	79	<50% Grass cover, Poor, HSG B
14,709	61	Weighted Average
14,709		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	186	0.1100	1.66		**Shallow Concentrated Flow, Wooded Area** Woodland Kv= 5.0 fps
1.9	186	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2A-EX: 20 Ledin - Rear Undeveloped

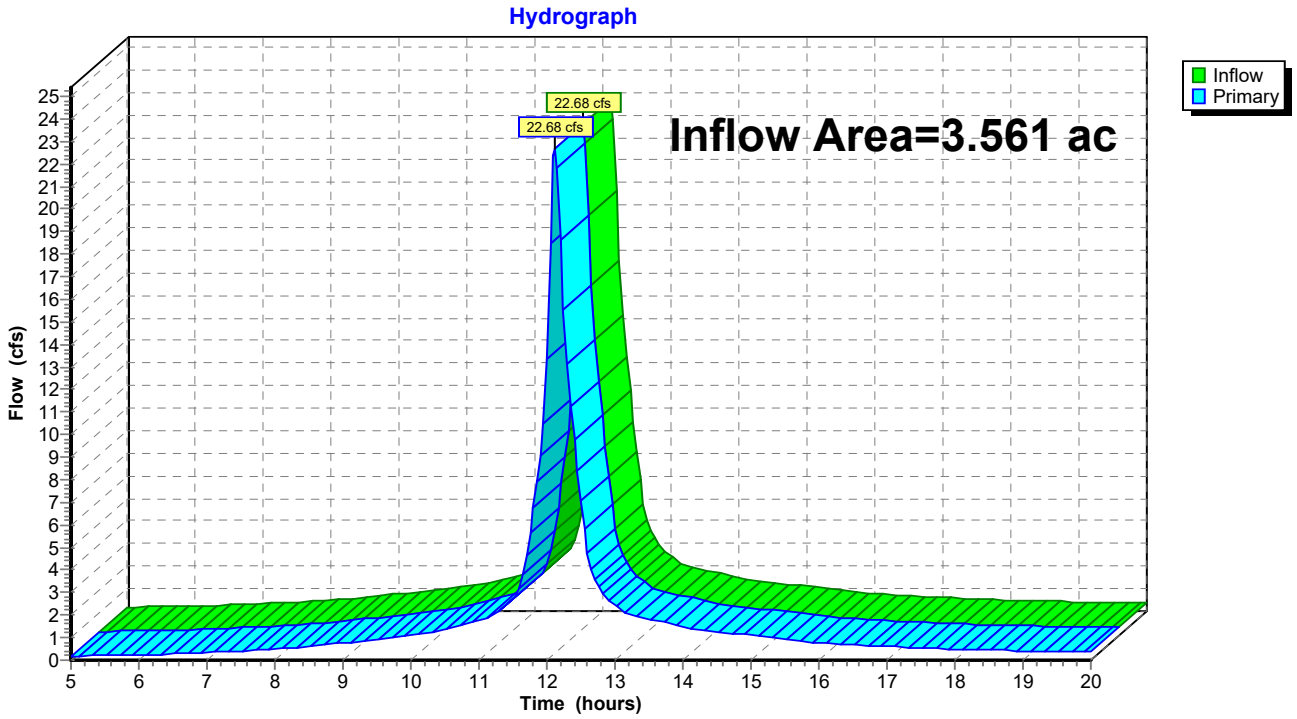


Summary for Link 1: Ledin Avenue

Inflow Area = 3.561 ac, 77.98% Impervious, Inflow Depth > 6.57" for 100-Year event
Inflow = 22.68 cfs @ 12.12 hrs, Volume= 1.948 af
Primary = 22.68 cfs @ 12.12 hrs, Volume= 1.948 af, Atten= 0%, Lag= 0.0 min

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

Link 1: Ledin Avenue

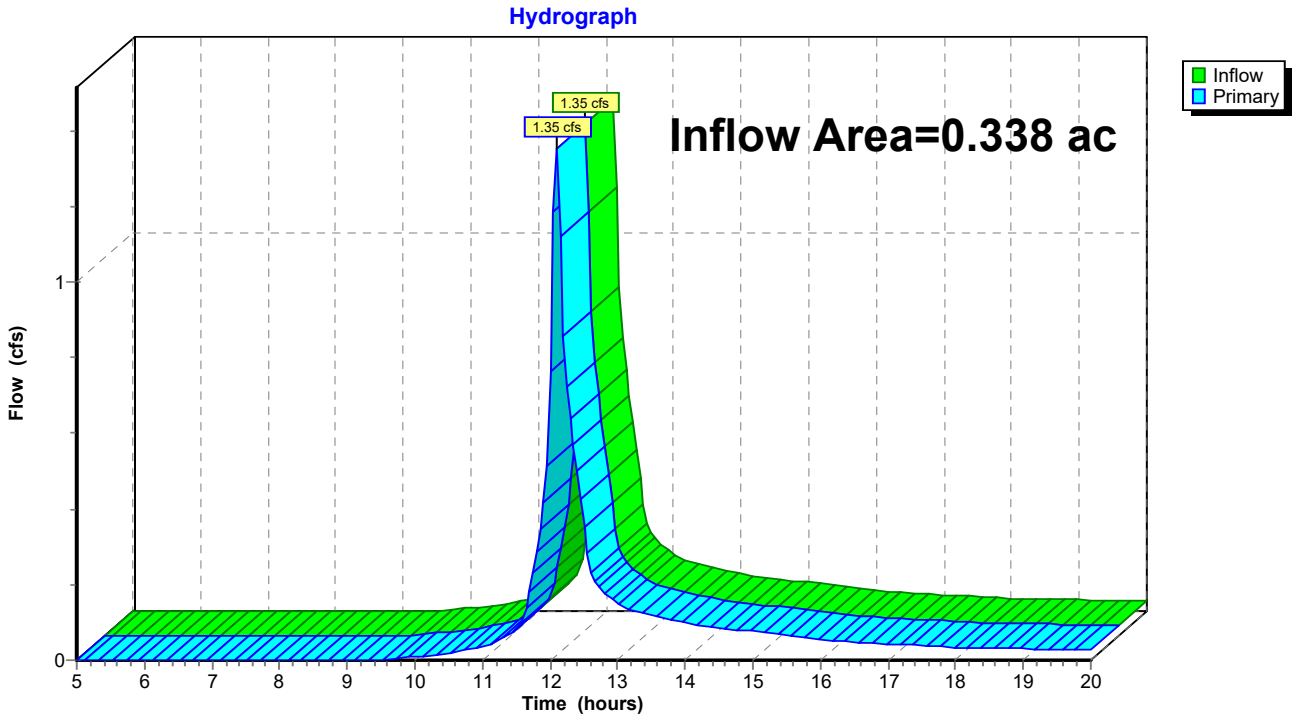


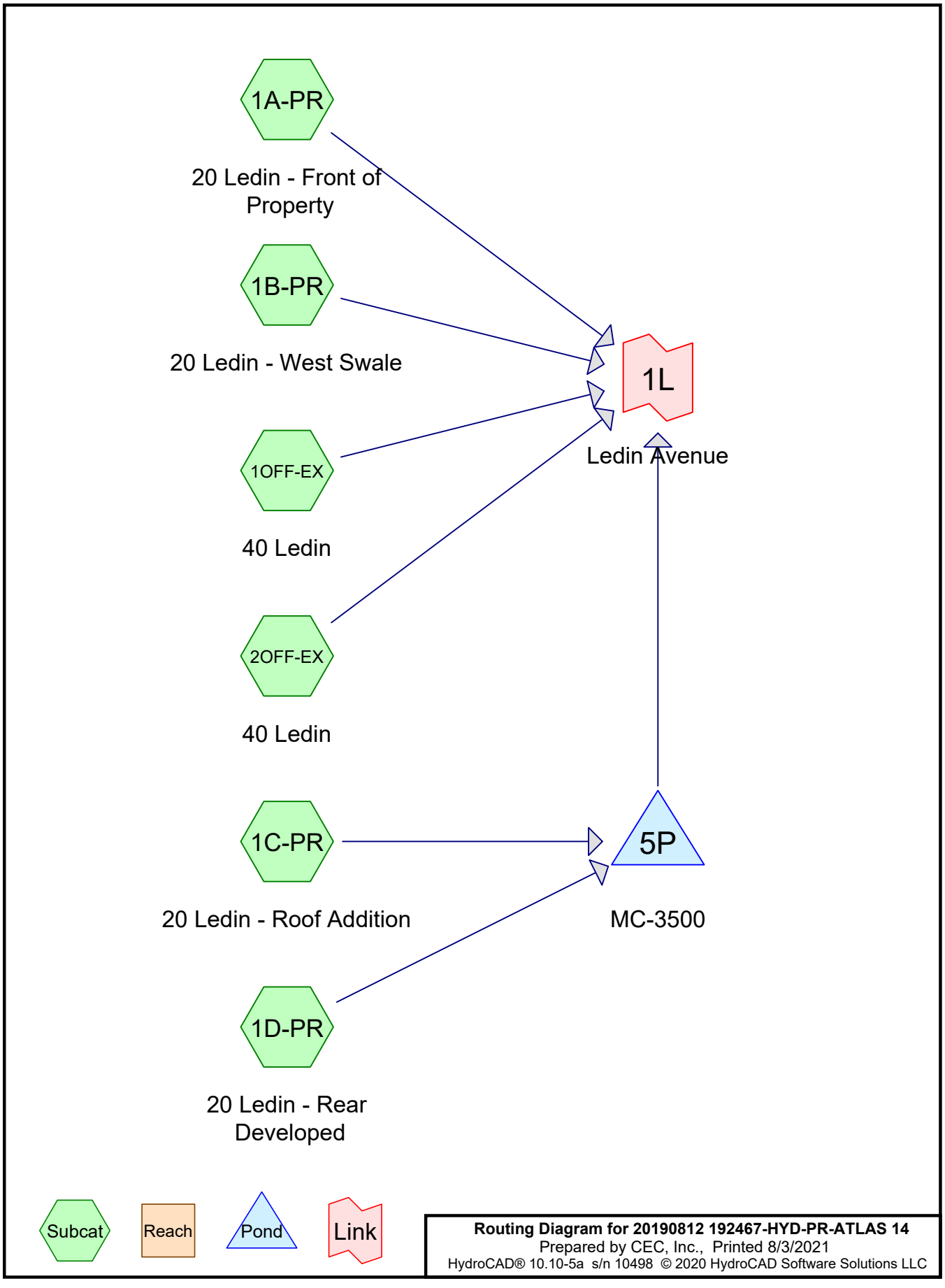
Summary for Link 2: Abutting Property

Inflow Area = 0.338 ac, 0.00% Impervious, Inflow Depth > 3.25" for 100-Year event
Inflow = 1.35 cfs @ 12.10 hrs, Volume= 0.091 af
Primary = 1.35 cfs @ 12.10 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min

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

Link 2: Abutting Property





Routing Diagram for 20190812 192467-HYD-PR-ATLAS 14
Prepared by CEC, Inc., Printed 8/3/2021

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

Subcatchment1A-PR: 20 Ledin - Front of Runoff Area=27,547 sf 80.69% Impervious Runoff Depth>2.75"
Flow Length=275' Tc=6.0 min CN=94 Runoff=1.90 cfs 0.145 af

Subcatchment1B-PR: 20 Ledin - West Runoff Area=7,160 sf 15.82% Impervious Runoff Depth>1.18"
Flow Length=151' Slope=0.0200 '/' Tc=6.0 min CN=74 Runoff=0.21 cfs 0.016 af

Subcatchment1C-PR: 20 Ledin - Roof Runoff Area=42,421 sf 100.00% Impervious Runoff Depth>3.17"
Flow Length=279' Tc=6.0 min CN=98 Runoff=3.15 cfs 0.258 af

Subcatchment1D-PR: 20 Ledin - Rear Runoff Area=21,766 sf 94.58% Impervious Runoff Depth>2.95"
Flow Length=112' Tc=6.0 min CN=96 Runoff=1.57 cfs 0.123 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=45,932 sf 100.00% Impervious Runoff Depth>3.17"
Flow Length=656' Tc=6.8 min CN=98 Runoff=3.35 cfs 0.279 af

Subcatchment2OFF-EX: 40 Ledin Runoff Area=26,056 sf 85.16% Impervious Runoff Depth>2.85"
Flow Length=470' Tc=6.0 min CN=95 Runoff=1.84 cfs 0.142 af

Pond 5P: MC-3500 Peak Elev=238.19' Storage=6,932 cf Inflow=4.72 cfs 0.381 af
Discarded=0.09 cfs 0.136 af Primary=1.03 cfs 0.192 af Outflow=1.12 cfs 0.328 af

Link 1L: Ledin Avenue Inflow=8.01 cfs 0.774 af
Primary=8.01 cfs 0.774 af

Total Runoff Area = 3.923 ac Runoff Volume = 0.962 af Average Runoff Depth = 2.94"
9.59% Pervious = 0.376 ac 90.41% Impervious = 3.547 ac

Summary for Subcatchment 1A-PR: 20 Ledin - Front of Property

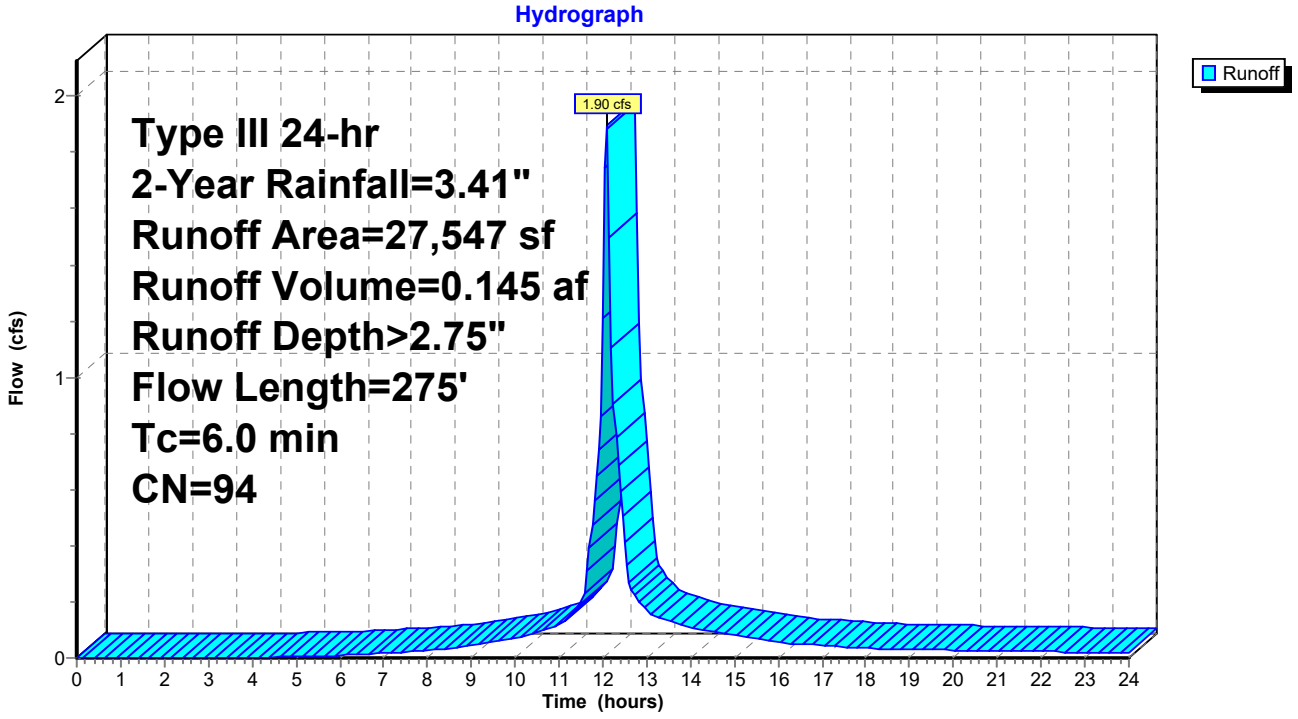
Runoff = 1.90 cfs @ 12.09 hrs, Volume= 0.145 af, Depth> 2.75"

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-Year Rainfall=3.41"

Area (sf)	CN	Description
1,289	96	Gravel surface, HSG B
4,029	69	50-75% Grass cover, Fair, HSG B
22,229	98	Paved parking, HSG B
27,547	94	Weighted Average
5,318		19.31% Pervious Area
22,229		80.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	29	0.0340	0.11		**Sheet Flow, Grassed Area** Grass: Dense n= 0.240 P2= 3.20"
0.2	39	0.0500	3.60		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	207	0.0500	4.54		**Shallow Concentrated Flow, Front Parking Area and Road** Paved Kv= 20.3 fps
5.3	275	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1A-PR: 20 Ledin - Front of Property



Summary for Subcatchment 1B-PR: 20 Ledin - West Swale

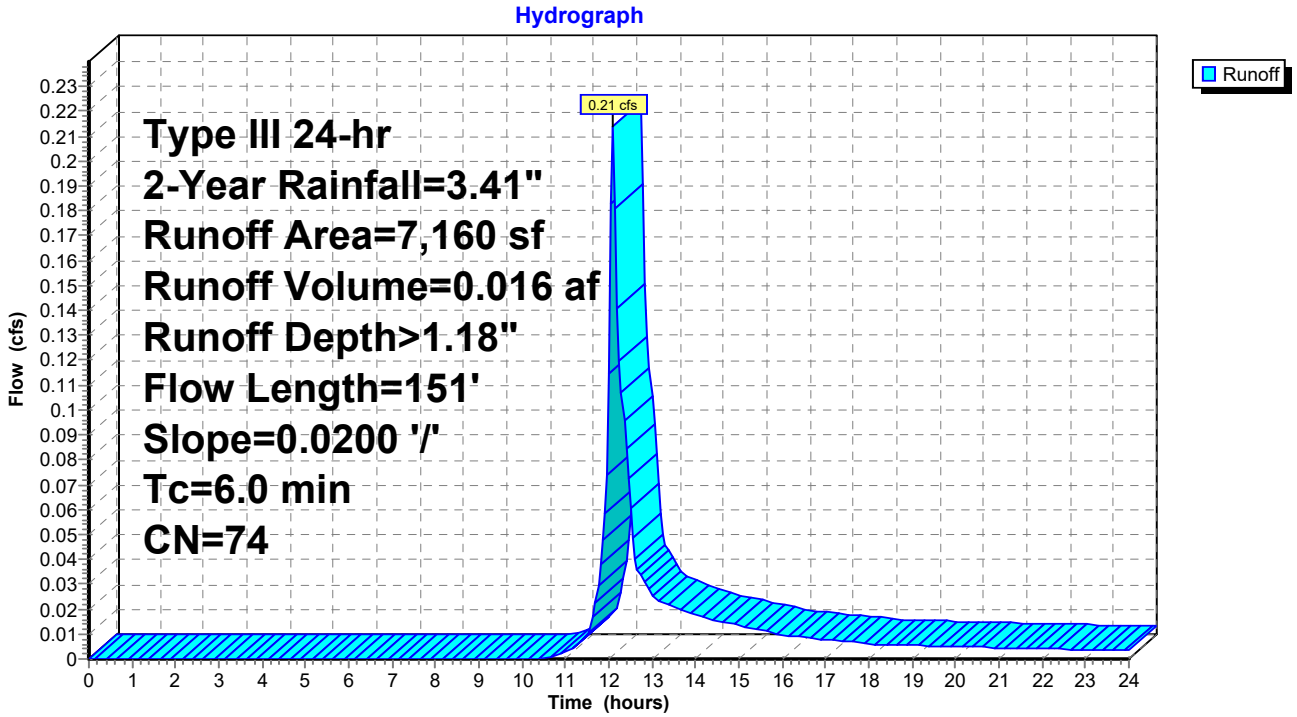
Runoff = 0.21 cfs @ 12.10 hrs, Volume= 0.016 af, Depth> 1.18"

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-Year Rainfall=3.41"

Area (sf)	CN	Description
6,027	69	50-75% Grass cover, Fair, HSG B
1,133	98	Paved parking, HSG B
7,160	74	Weighted Average
6,027		84.18% Pervious Area
1,133		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
2.5	151	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: 20 Ledin - West Swale



Summary for Subcatchment 1C-PR: 20 Ledin - Roof Addition

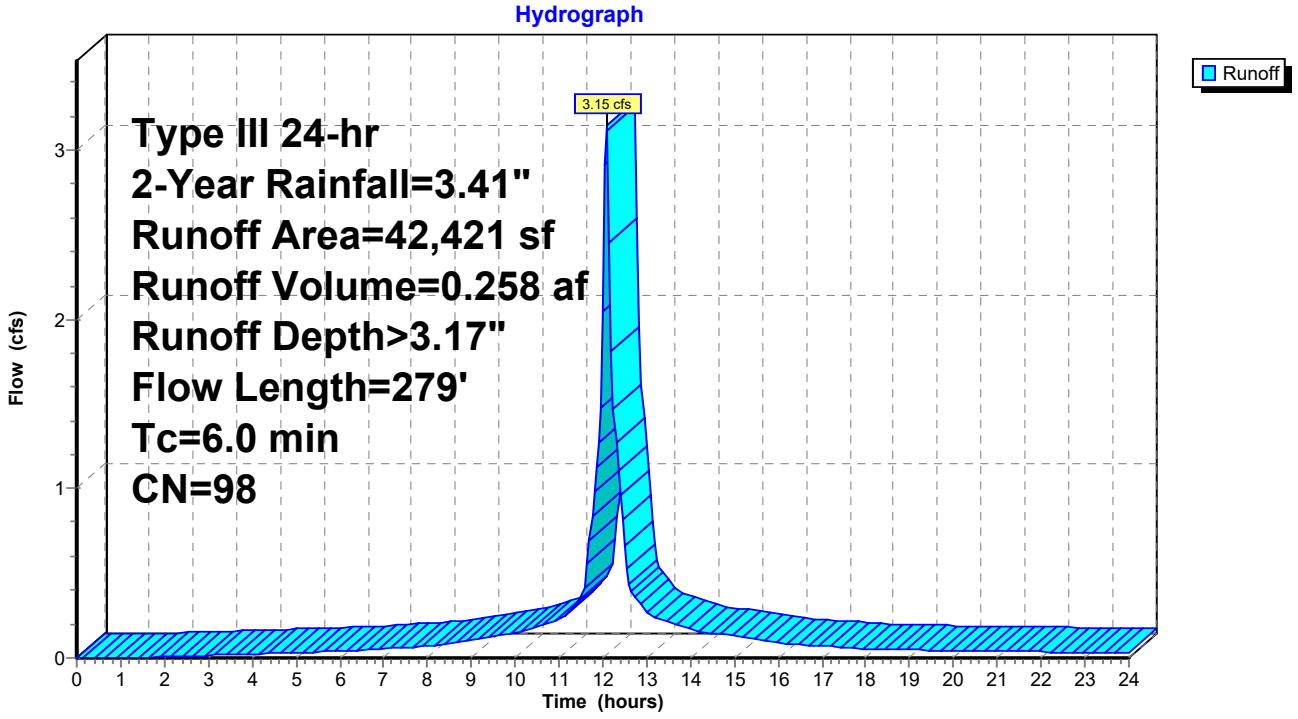
Runoff = 3.15 cfs @ 12.09 hrs, Volume= 0.258 af, Depth> 3.17"

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-Year Rainfall=3.41"

Area (sf)	CN	Description
24,112	98	Roofs, HSG B
18,309	98	Roofs, HSG B
42,421	98	Weighted Average
42,421		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	196	0.0100	1.19		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.0	40	0.9900	44.78	15.63	**Pipe Channel, Gutter** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.010 PVC, smooth interior
0.1	43	0.0250	9.32	7.32	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.8	279	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1C-PR: 20 Ledin - Roof Addition



Summary for Subcatchment 1D-PR: 20 Ledin - Rear Developed

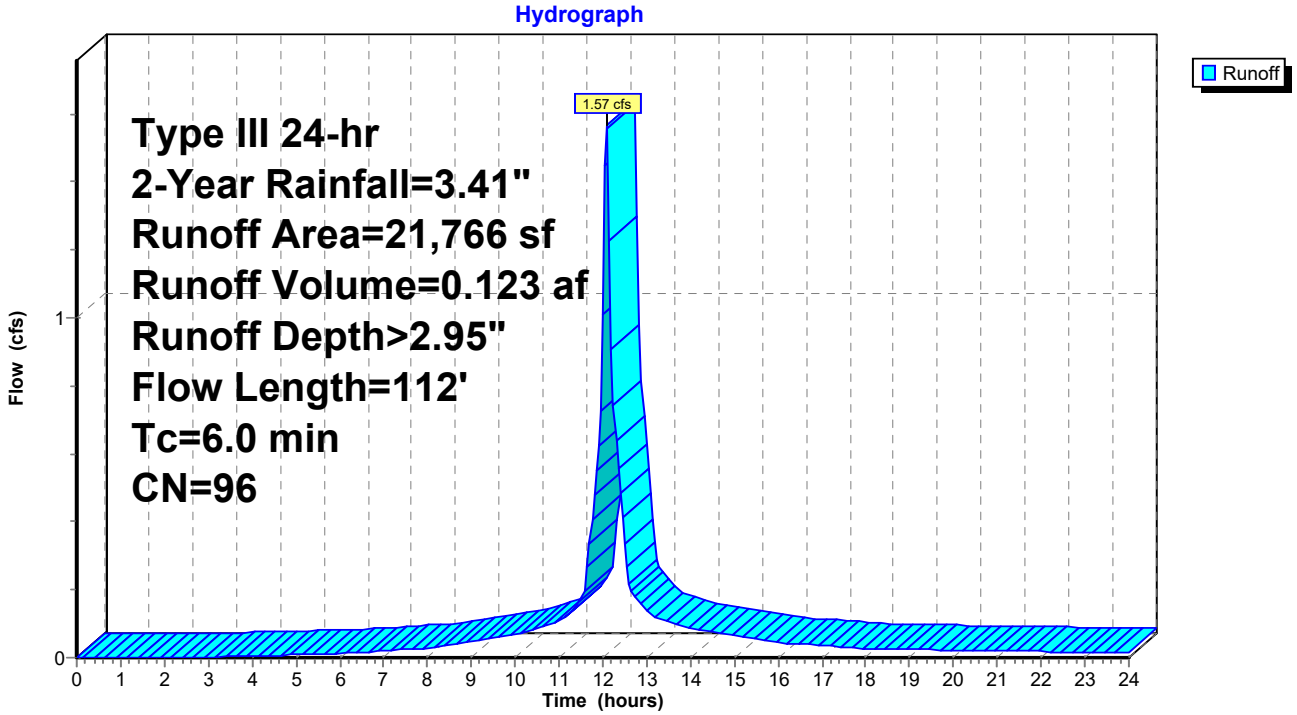
Runoff = 1.57 cfs @ 12.09 hrs, Volume= 0.123 af, Depth> 2.95"

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-Year Rainfall=3.41"

Area (sf)	CN	Description
1,179	69	50-75% Grass cover, Fair, HSG B
20,587	98	Paved parking, HSG B
21,766	96	Weighted Average
1,179		5.42% Pervious Area
20,587		94.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	25	0.1600	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.5	25	0.0100	0.79		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.5	62	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.4	112	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: 20 Ledin - Rear Developed



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 267% of capacity of segment #2

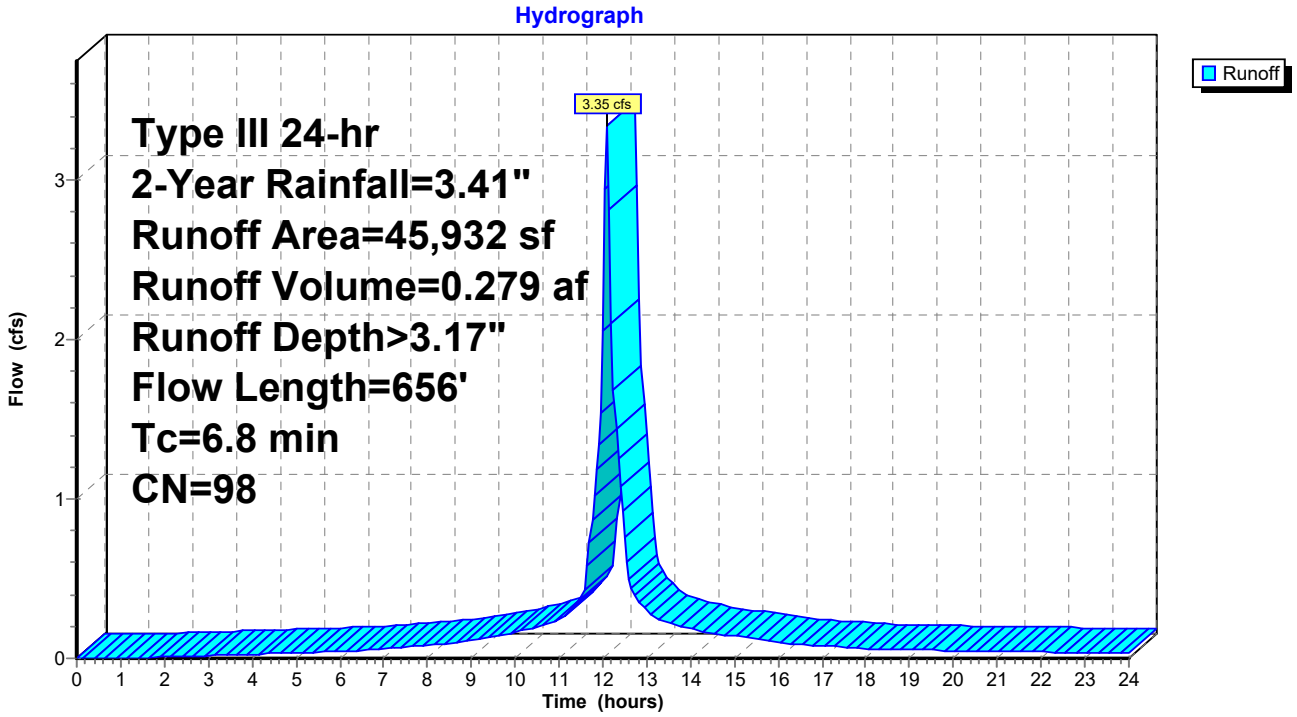
Runoff = 3.35 cfs @ 12.10 hrs, Volume= 0.279 af, Depth> 3.17"

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-Year Rainfall=3.41"

Area (sf)	CN	Description
18,549	98	Roofs, HSG B
27,383	98	Paved parking, HSG B
45,932	98	Weighted Average
45,932		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2OFF-EX: 40 Ledin

[47] Hint: Peak is 147% of capacity of segment #2

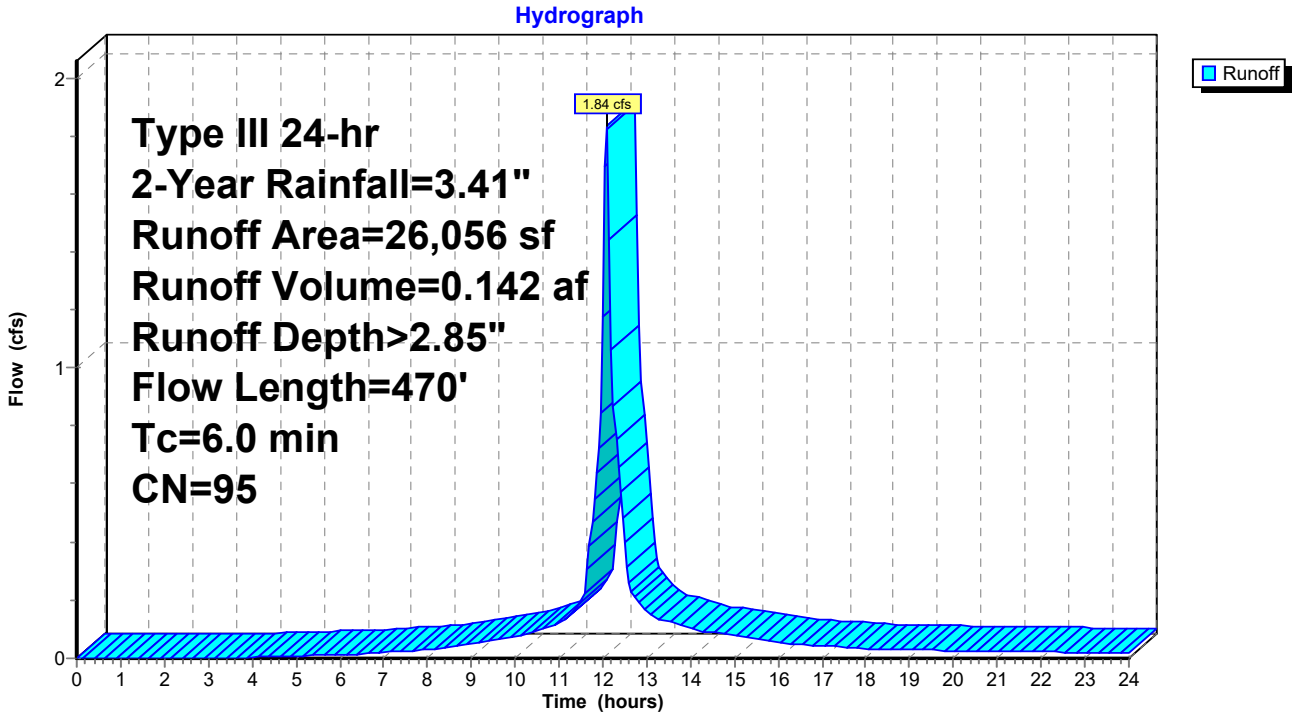
Runoff = 1.84 cfs @ 12.09 hrs, Volume= 0.142 af, Depth> 2.85"

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 2-Year Rainfall=3.41"

Area (sf)	CN	Description
13,682	98	Roofs, HSG B
3,867	79	<50% Grass cover, Poor, HSG B
8,507	98	Paved parking, HSG B
26,056	95	Weighted Average
3,867		14.84% Pervious Area
22,189		85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	145	0.0100	1.12		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
1.4	295	0.0300	3.52		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
3.6	470	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2OFF-EX: 40 Ledin



Summary for Pond 5P: MC-3500

Inflow Area = 1.474 ac, 98.16% Impervious, Inflow Depth > 3.10" for 2-Year event
Inflow = 4.72 cfs @ 12.09 hrs, Volume= 0.381 af
Outflow = 1.12 cfs @ 12.47 hrs, Volume= 0.328 af, Atten= 76%, Lag= 23.2 min
Discarded = 0.09 cfs @ 7.70 hrs, Volume= 0.136 af
Primary = 1.03 cfs @ 12.47 hrs, Volume= 0.192 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 238.19' @ 12.47 hrs Surf.Area= 3,694 sf Storage= 6,932 cf

Plug-Flow detention time= 139.7 min calculated for 0.328 af (86% of inflow)
Center-of-Mass det. time= 78.7 min (838.9 - 760.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	235.50'	5,217 cf	**58.58'W x 63.06'L x 5.50'H Field A** 20,318 cf Overall - 7,275 cf Embedded = 13,043 cf x 40.0% Voids
#2A	236.25'	7,275 cf	**ADS_StormTech MC-3500 d +Cap**x 64 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 64 Chambers in 8 Rows Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf
		12,493 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	235.00'	**18.0" Round Culvert** L= 5.0' Ke= 1.000 Inlet / Outlet Invert= 235.00' / 234.80' S= 0.0400 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf
#2	Device 1	240.50'	**4.0' 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
#3	Device 1	238.50'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	236.75'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	235.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 7.70 hrs HW=235.56' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=1.03 cfs @ 12.47 hrs HW=238.19' (Free Discharge)
└**1=Culvert** (Passes 1.03 cfs of 9.97 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Orifice Controls 1.03 cfs @ 5.25 fps)

Pond 5P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

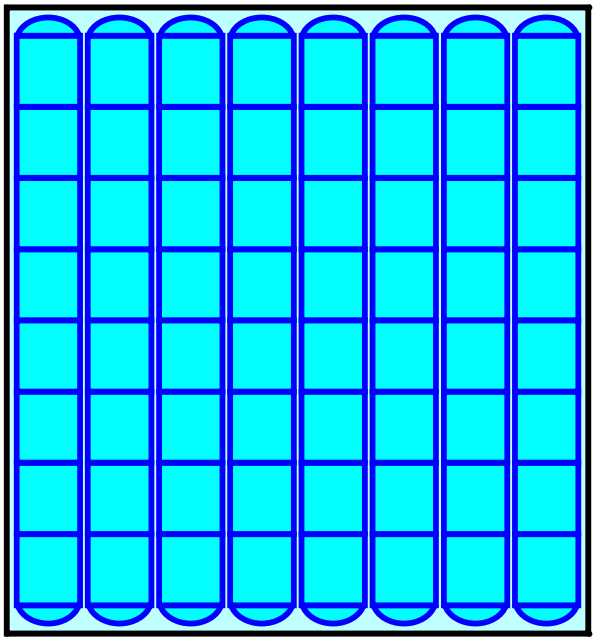
8 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 61.06' Row Length +12.0" End Stone x 2 = 63.06' Base Length
8 Rows x 77.0" Wide + 9.0" Spacing x 7 + 12.0" Side Stone x 2 = 58.58' Base Width
9.0" Stone Base + 45.0" Chamber Height + 12.0" Stone Cover = 5.50' Field Height

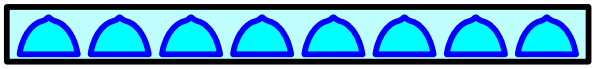
64 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 8 Rows = 7,275.3 cf Chamber Storage

20,318.5 cf Field - 7,275.3 cf Chambers = 13,043.1 cf Stone x 40.0% Voids = 5,217.3 cf Stone Storage

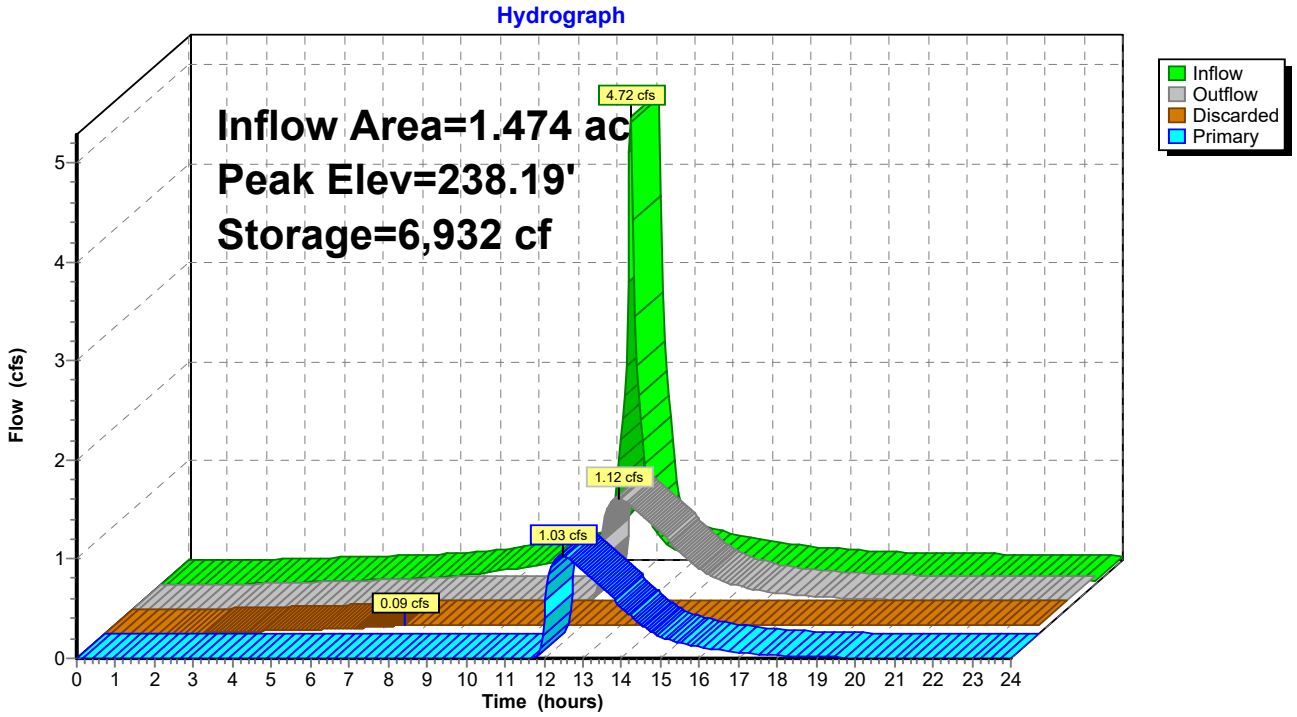
Chamber Storage + Stone Storage = 12,492.6 cf = 0.287 af
Overall Storage Efficiency = 61.5%
Overall System Size = 63.06' x 58.58' x 5.50'

64 Chambers
752.5 cy Field
483.1 cy Stone

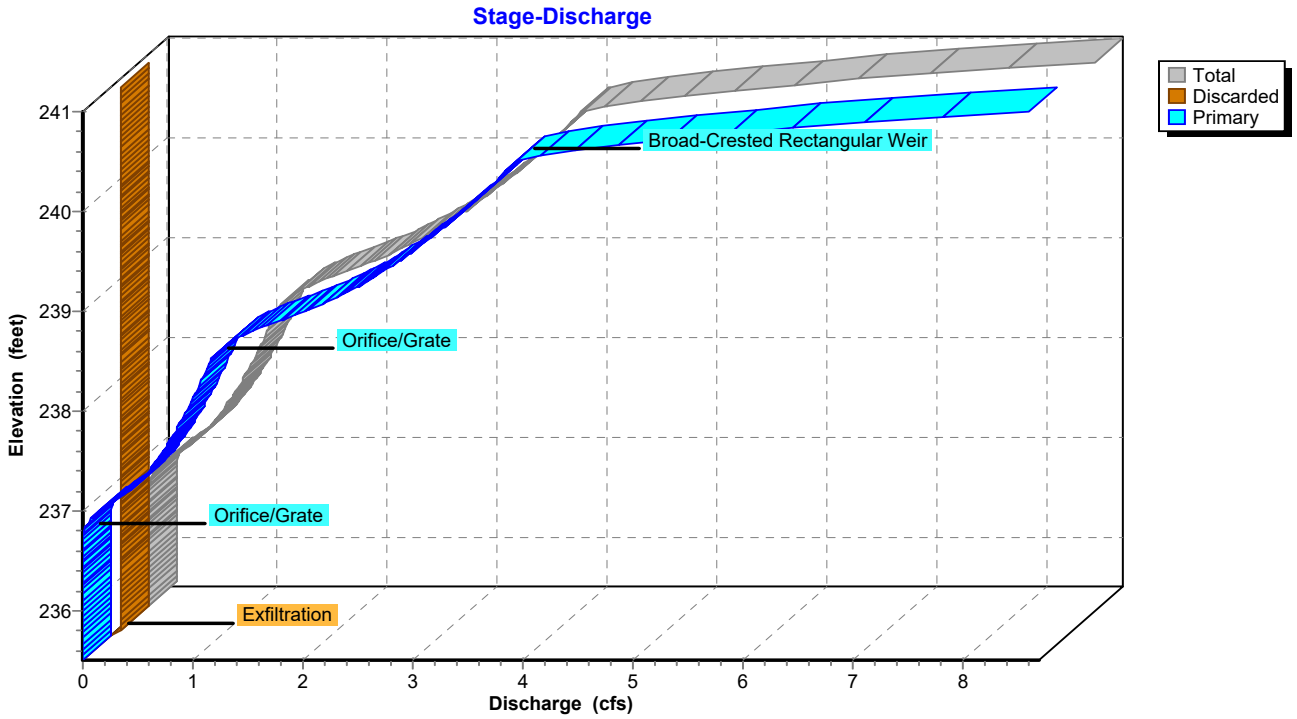




Pond 5P: MC-3500



Pond 5P: MC-3500



Stage-Area-Storage for Pond 5P: MC-3500

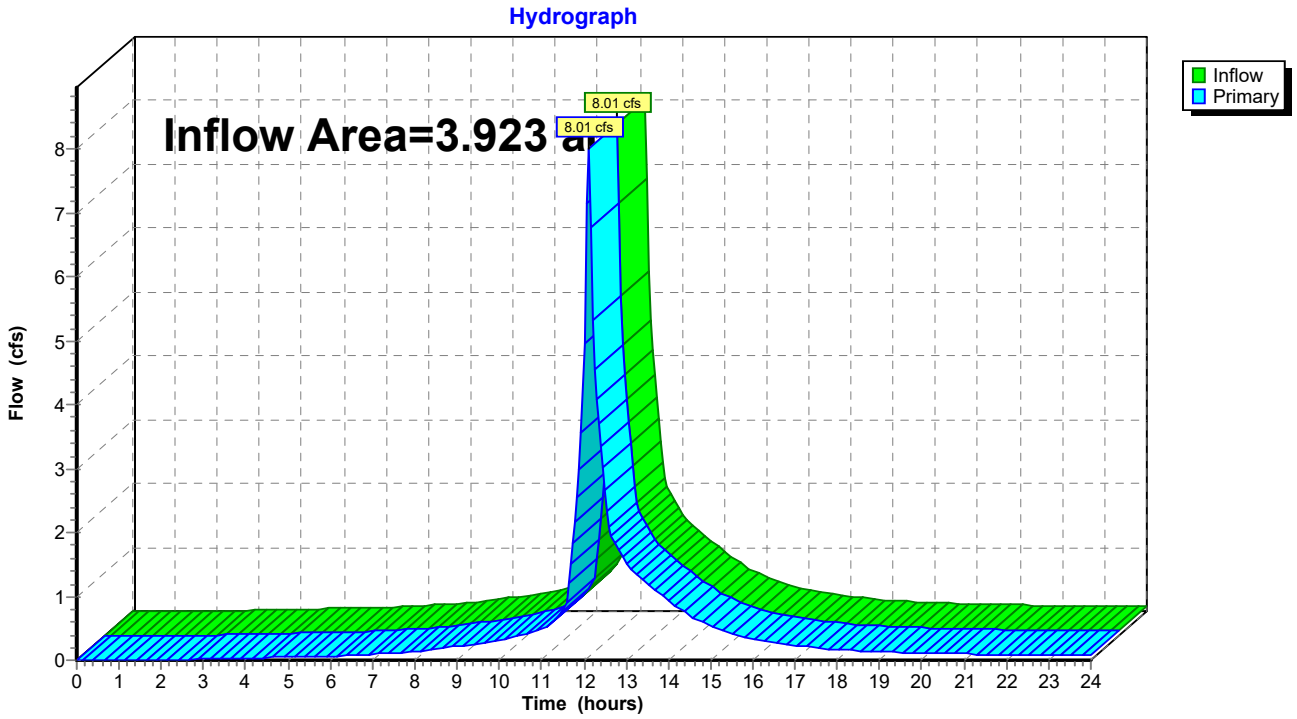
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
235.50	**3,694**	0
235.60	3,694	148
235.70	3,694	296
235.80	3,694	443
235.90	3,694	591
236.00	3,694	739
236.10	3,694	887
236.20	3,694	1,034
236.30	3,694	1,266
236.40	3,694	1,579
236.50	3,694	1,892
236.60	3,694	2,203
236.70	3,694	2,514
236.80	3,694	2,822
236.90	3,694	3,130
237.00	3,694	3,436
237.10	3,694	3,740
237.20	3,694	4,043
237.30	3,694	4,344
237.40	3,694	4,643
237.50	3,694	4,941
237.60	3,694	5,236
237.70	3,694	5,528
237.80	3,694	5,818
237.90	3,694	6,106
238.00	3,694	6,391
238.10	3,694	6,673
238.20	3,694	6,952
238.30	3,694	7,228
238.40	3,694	7,501
238.50	3,694	7,769
238.60	3,694	8,034
238.70	3,694	8,294
238.80	3,694	8,550
238.90	3,694	8,800
239.00	3,694	9,046
239.10	3,694	9,285
239.20	3,694	9,518
239.30	3,694	9,744
239.40	3,694	9,962
239.50	3,694	10,169
239.60	3,694	10,363
239.70	3,694	10,540
239.80	3,694	10,705
239.90	3,694	10,864
240.00	3,694	11,015
240.10	3,694	11,163
240.20	3,694	11,310
240.30	3,694	11,458
240.40	3,694	11,606
240.50	3,694	11,754
240.60	3,694	11,901
240.70	3,694	12,049
240.80	3,694	12,197
240.90	3,694	12,345
241.00	3,694	**12,493**

Summary for Link 1L: Ledin Avenue

Inflow Area = 3.923 ac, 90.41% Impervious, Inflow Depth > 2.37" for 2-Year event
Inflow = 8.01 cfs @ 12.10 hrs, Volume= 0.774 af
Primary = 8.01 cfs @ 12.10 hrs, Volume= 0.774 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: Ledin Avenue



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

Subcatchment1A-PR: 20 Ledin - Front of Runoff Area=27,547 sf 80.69% Impervious Runoff Depth>4.52"
Flow Length=275' Tc=6.0 min CN=94 Runoff=3.04 cfs 0.238 af

Subcatchment1B-PR: 20 Ledin - West Runoff Area=7,160 sf 15.82% Impervious Runoff Depth>2.54"
Flow Length=151' Slope=0.0200 '/' Tc=6.0 min CN=74 Runoff=0.48 cfs 0.035 af

Subcatchment1C-PR: 20 Ledin - Roof Runoff Area=42,421 sf 100.00% Impervious Runoff Depth>4.98"
Flow Length=279' Tc=6.0 min CN=98 Runoff=4.86 cfs 0.404 af

Subcatchment1D-PR: 20 Ledin - Rear Runoff Area=21,766 sf 94.58% Impervious Runoff Depth>4.75"
Flow Length=112' Tc=6.0 min CN=96 Runoff=2.46 cfs 0.198 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=45,932 sf 100.00% Impervious Runoff Depth>4.98"
Flow Length=656' Tc=6.8 min CN=98 Runoff=5.16 cfs 0.438 af

Subcatchment2OFF-EX: 40 Ledin Runoff Area=26,056 sf 85.16% Impervious Runoff Depth>4.63"
Flow Length=470' Tc=6.0 min CN=95 Runoff=2.91 cfs 0.231 af

Pond 5P: MC-3500 Peak Elev=239.34' Storage=9,839 cf Inflow=7.31 cfs 0.602 af
Discarded=0.09 cfs 0.149 af Primary=2.65 cfs 0.390 af Outflow=2.73 cfs 0.539 af

Link 1L: Ledin Avenue Inflow=12.84 cfs 1.332 af
Primary=12.84 cfs 1.332 af

Total Runoff Area = 3.923 ac Runoff Volume = 1.543 af Average Runoff Depth = 4.72"
9.59% Pervious = 0.376 ac 90.41% Impervious = 3.547 ac

Summary for Subcatchment 1A-PR: 20 Ledin - Front of Property

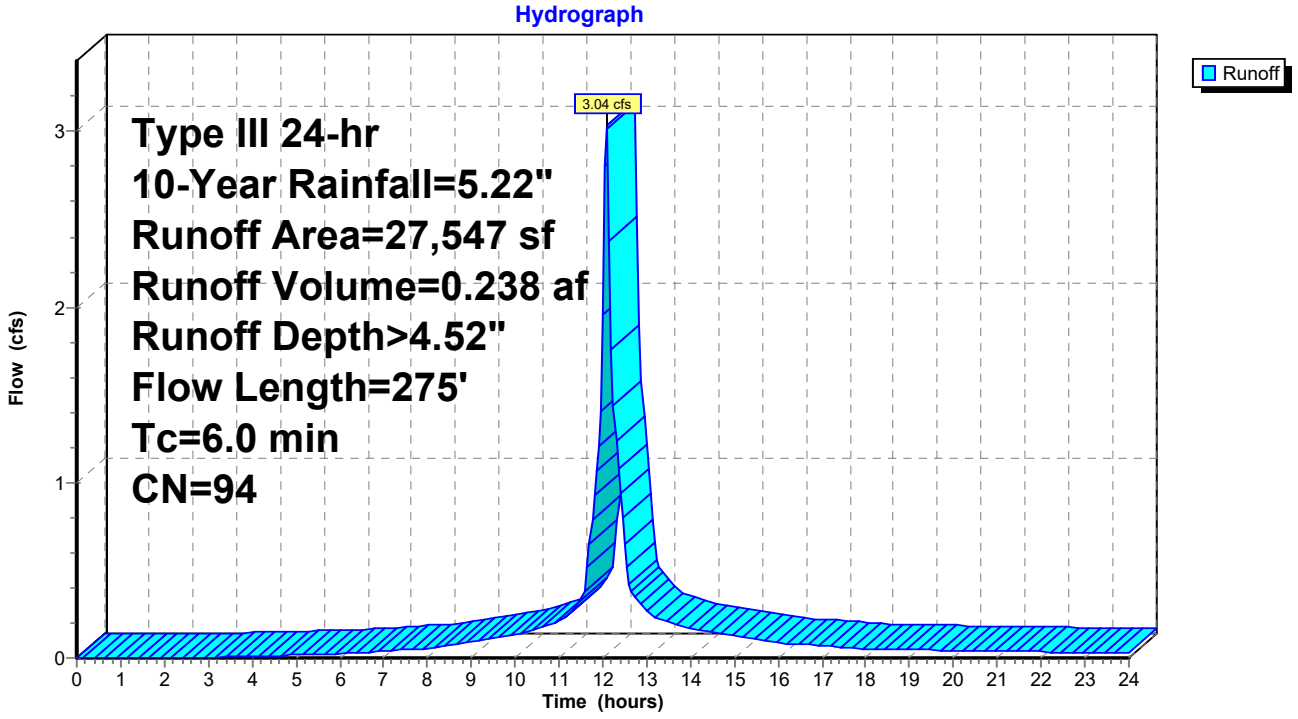
Runoff = 3.04 cfs @ 12.09 hrs, Volume= 0.238 af, Depth> 4.52"

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-Year Rainfall=5.22"

Area (sf)	CN	Description
1,289	96	Gravel surface, HSG B
4,029	69	50-75% Grass cover, Fair, HSG B
22,229	98	Paved parking, HSG B
27,547	94	Weighted Average
5,318		19.31% Pervious Area
22,229		80.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	29	0.0340	0.11		**Sheet Flow, Grassed Area** Grass: Dense n= 0.240 P2= 3.20"
0.2	39	0.0500	3.60		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	207	0.0500	4.54		**Shallow Concentrated Flow, Front Parking Area and Road** Paved Kv= 20.3 fps
5.3	275	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1A-PR: 20 Ledin - Front of Property



Summary for Subcatchment 1B-PR: 20 Ledin - West Swale

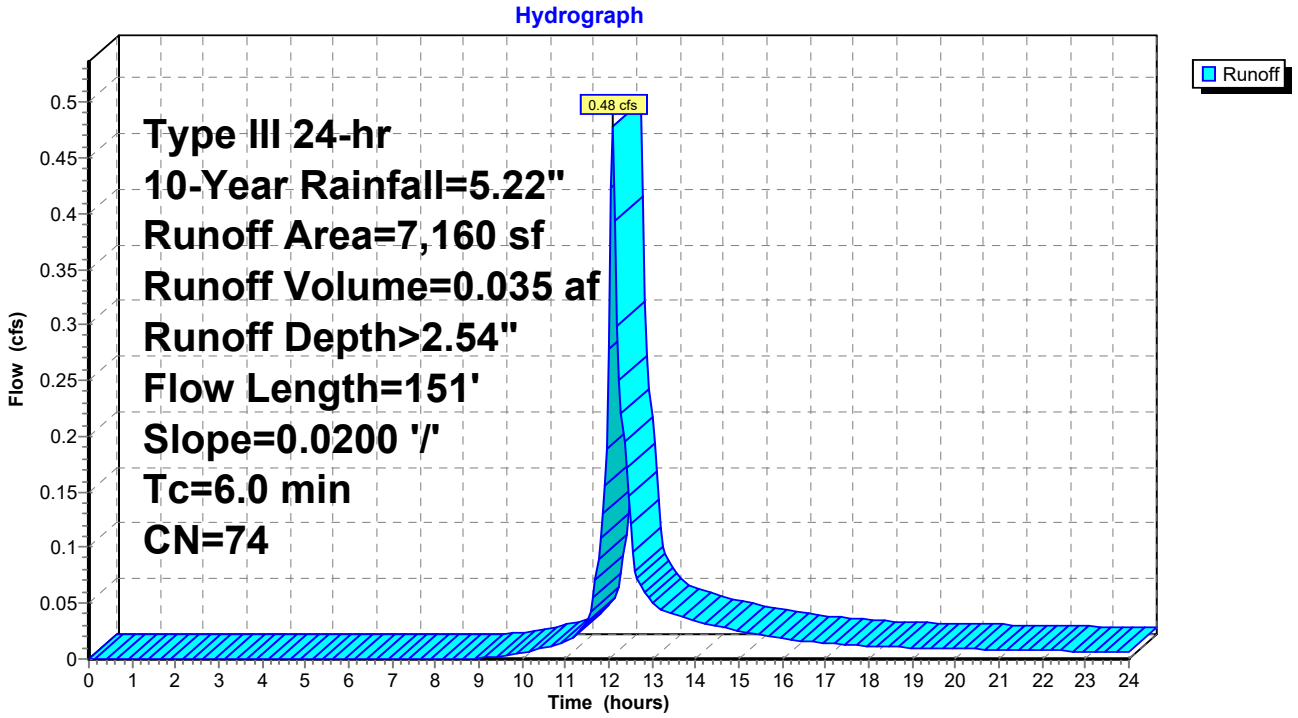
Runoff = 0.48 cfs @ 12.09 hrs, Volume= 0.035 af, Depth> 2.54"

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-Year Rainfall=5.22"

Area (sf)	CN	Description
6,027	69	50-75% Grass cover, Fair, HSG B
1,133	98	Paved parking, HSG B
7,160	74	Weighted Average
6,027		84.18% Pervious Area
1,133		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
2.5	151	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: 20 Ledin - West Swale



Summary for Subcatchment 1C-PR: 20 Ledin - Roof Addition

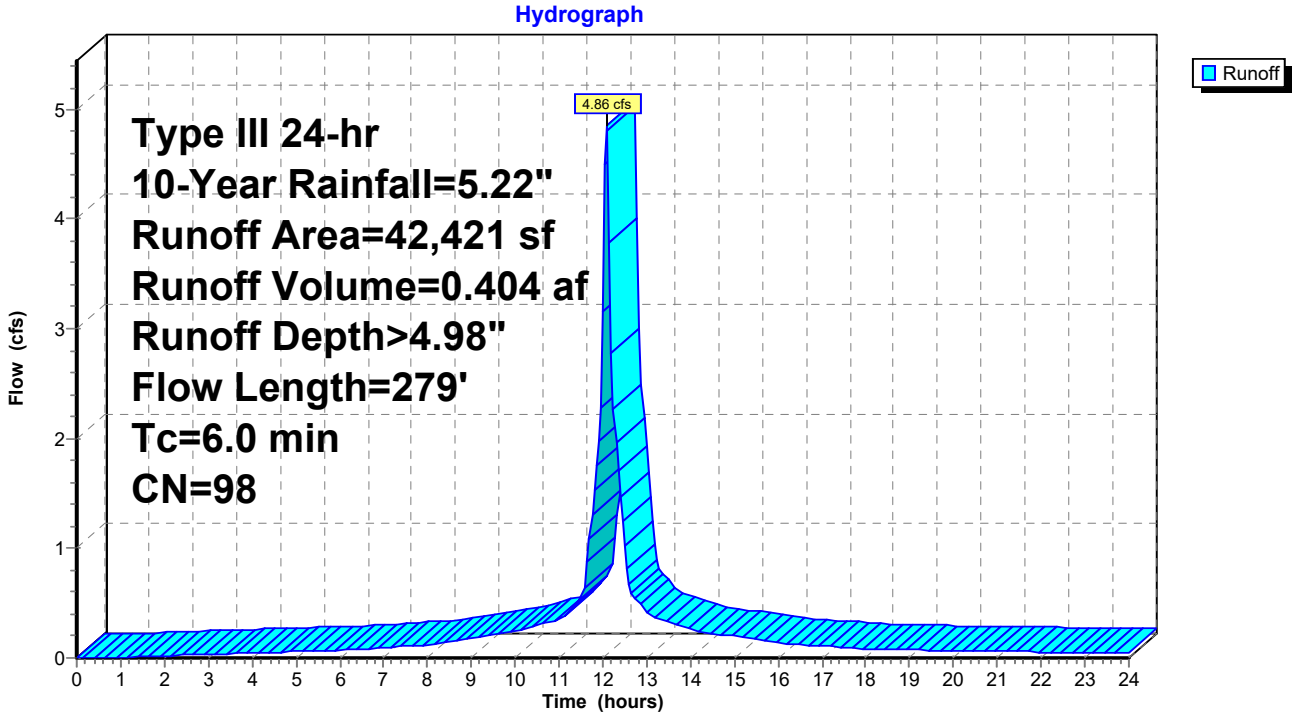
Runoff = 4.86 cfs @ 12.09 hrs, Volume= 0.404 af, Depth> 4.98"

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-Year Rainfall=5.22"

Area (sf)	CN	Description
24,112	98	Roofs, HSG B
18,309	98	Roofs, HSG B
42,421	98	Weighted Average
42,421		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	196	0.0100	1.19		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.0	40	0.9900	44.78	15.63	**Pipe Channel, Gutter** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.010 PVC, smooth interior
0.1	43	0.0250	9.32	7.32	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.8	279	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1C-PR: 20 Ledin - Roof Addition



Summary for Subcatchment 1D-PR: 20 Ledin - Rear Developed

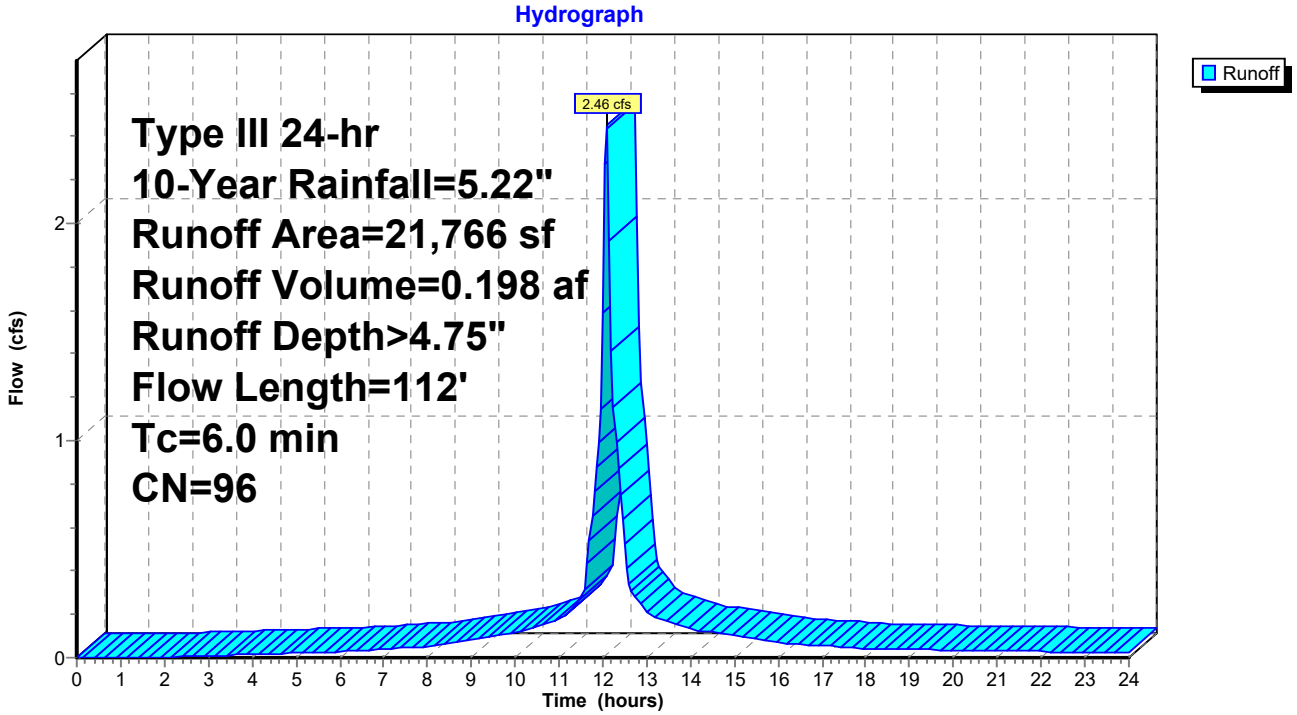
Runoff = 2.46 cfs @ 12.09 hrs, Volume= 0.198 af, Depth> 4.75"

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-Year Rainfall=5.22"

Area (sf)	CN	Description
1,179	69	50-75% Grass cover, Fair, HSG B
20,587	98	Paved parking, HSG B
21,766	96	Weighted Average
1,179		5.42% Pervious Area
20,587		94.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	25	0.1600	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.5	25	0.0100	0.79		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.5	62	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.4	112	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: 20 Ledin - Rear Developed



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 412% of capacity of segment #2

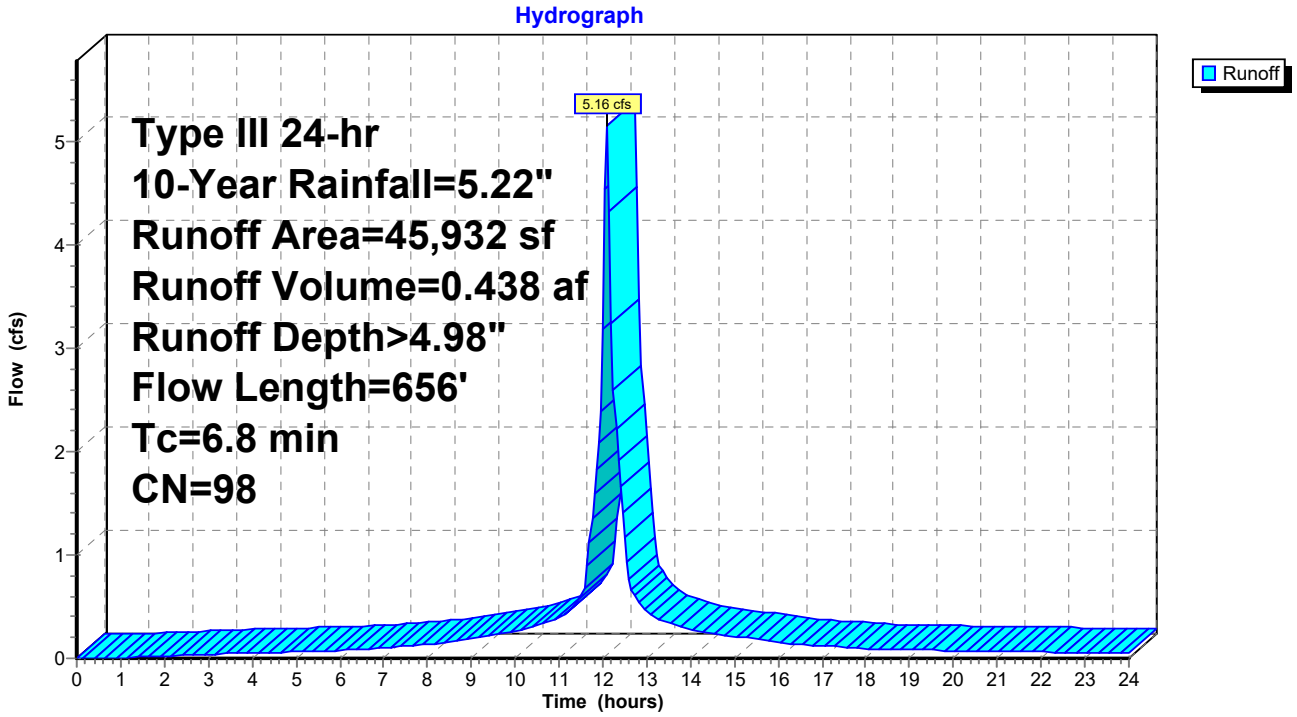
Runoff = 5.16 cfs @ 12.10 hrs, Volume= 0.438 af, Depth> 4.98"

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-Year Rainfall=5.22"

Area (sf)	CN	Description
18,549	98	Roofs, HSG B
27,383	98	Paved parking, HSG B
45,932	98	Weighted Average
45,932		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2OFF-EX: 40 Ledin

[47] Hint: Peak is 232% of capacity of segment #2

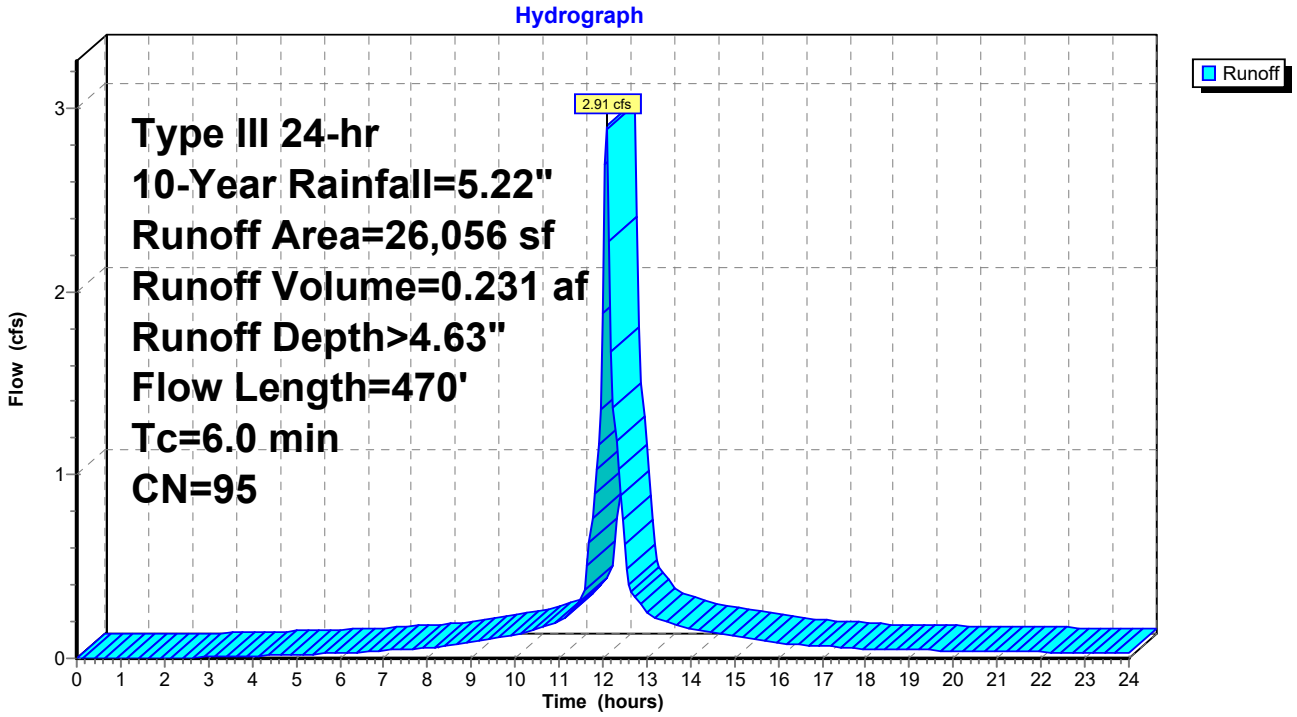
Runoff = 2.91 cfs @ 12.09 hrs, Volume= 0.231 af, Depth> 4.63"

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 10-Year Rainfall=5.22"

Area (sf)	CN	Description
13,682	98	Roofs, HSG B
3,867	79	<50% Grass cover, Poor, HSG B
8,507	98	Paved parking, HSG B
26,056	95	Weighted Average
3,867		14.84% Pervious Area
22,189		85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	145	0.0100	1.12		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
1.4	295	0.0300	3.52		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
3.6	470	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2OFF-EX: 40 Ledin



Summary for Pond 5P: MC-3500

Inflow Area = 1.474 ac, 98.16% Impervious, Inflow Depth > 4.90" for 10-Year event
Inflow = 7.31 cfs @ 12.09 hrs, Volume= 0.602 af
Outflow = 2.73 cfs @ 12.33 hrs, Volume= 0.539 af, Atten= 63%, Lag= 14.6 min
Discarded = 0.09 cfs @ 5.75 hrs, Volume= 0.149 af
Primary = 2.65 cfs @ 12.33 hrs, Volume= 0.390 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 239.34' @ 12.33 hrs Surf.Area= 3,694 sf Storage= 9,839 cf

Plug-Flow detention time= 117.2 min calculated for 0.538 af (89% of inflow)
Center-of-Mass det. time= 67.0 min (818.5 - 751.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	235.50'	5,217 cf	**58.58'W x 63.06'L x 5.50'H Field A** 20,318 cf Overall - 7,275 cf Embedded = 13,043 cf x 40.0% Voids
#2A	236.25'	7,275 cf	**ADS_StormTech MC-3500 d +Cap**x 64 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 64 Chambers in 8 Rows Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf
		12,493 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	235.00'	**18.0" Round Culvert** L= 5.0' Ke= 1.000 Inlet / Outlet Invert= 235.00' / 234.80' S= 0.0400 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf
#2	Device 1	240.50'	**4.0' 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
#3	Device 1	238.50'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	236.75'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	235.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 5.75 hrs HW=235.56' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=2.64 cfs @ 12.33 hrs HW=239.34' (Free Discharge)
└**1=Culvert** (Passes 2.64 cfs of 12.09 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Orifice Controls 1.20 cfs @ 3.43 fps)
  └**4=Orifice/Grate** (Orifice Controls 1.45 cfs @ 7.36 fps)

Pond 5P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech® MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

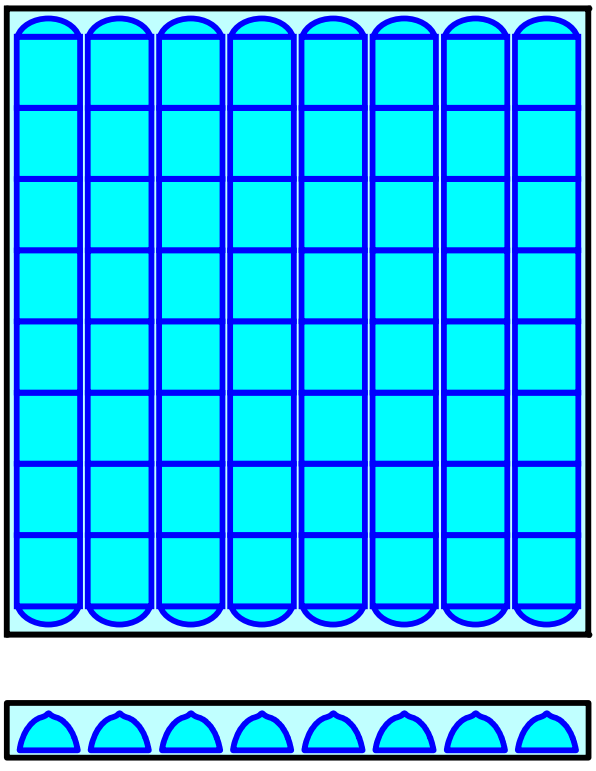
8 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 61.06' Row Length +12.0" End Stone x 2 = 63.06' Base Length
8 Rows x 77.0" Wide + 9.0" Spacing x 7 + 12.0" Side Stone x 2 = 58.58' Base Width
9.0" Stone Base + 45.0" Chamber Height + 12.0" Stone Cover = 5.50' Field Height

64 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 8 Rows = 7,275.3 cf Chamber Storage

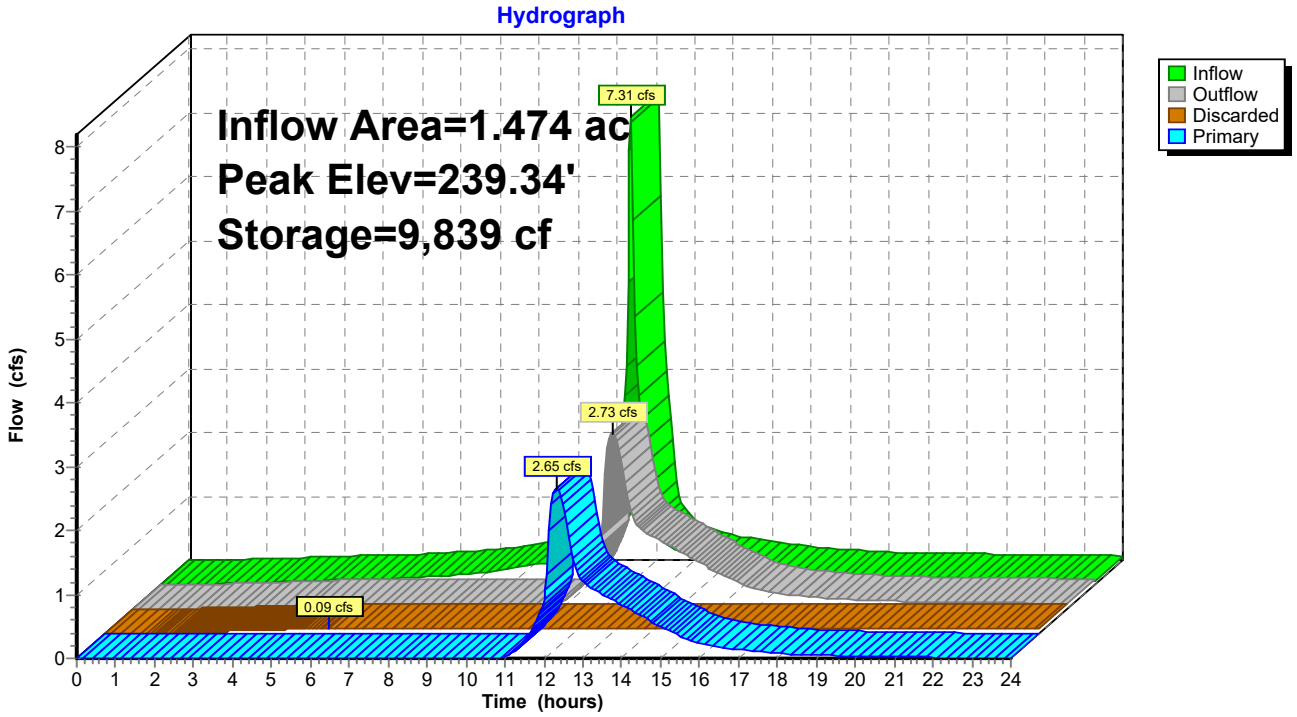
20,318.5 cf Field - 7,275.3 cf Chambers = 13,043.1 cf Stone x 40.0% Voids = 5,217.3 cf Stone Storage

Chamber Storage + Stone Storage = 12,492.6 cf = 0.287 af
Overall Storage Efficiency = 61.5%
Overall System Size = 63.06' x 58.58' x 5.50'

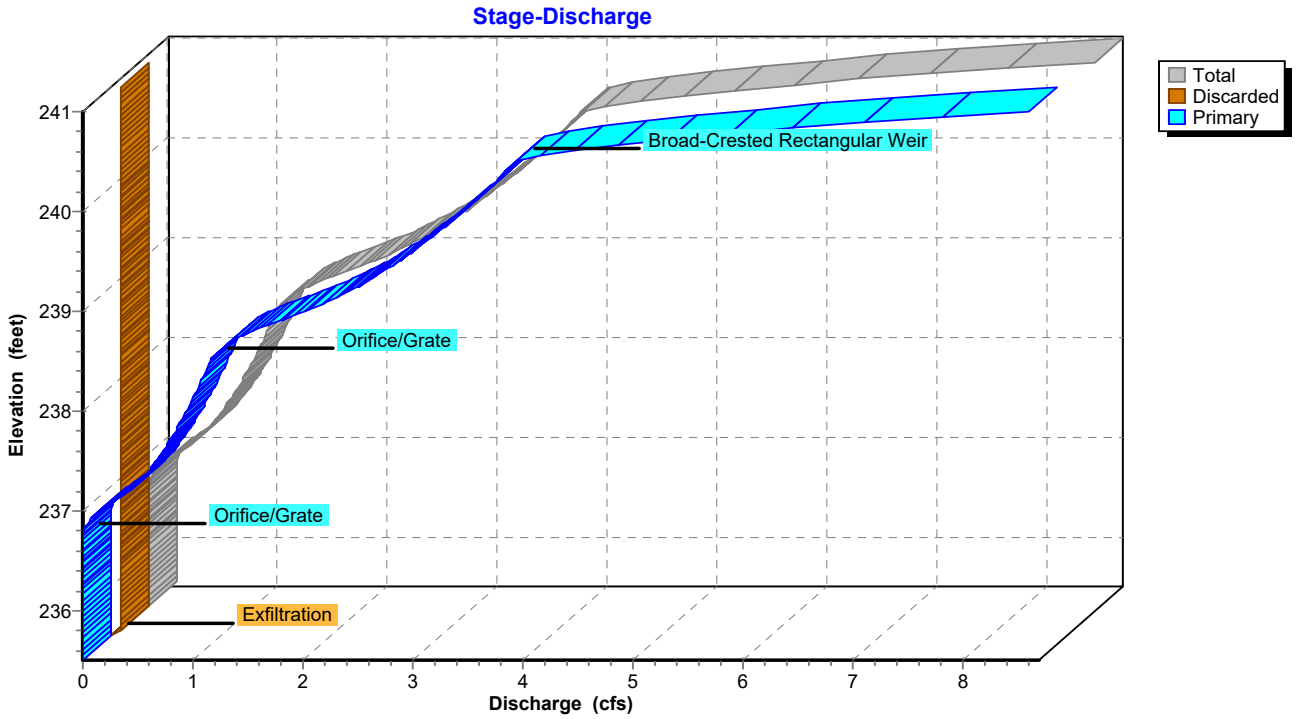
64 Chambers
752.5 cy Field
483.1 cy Stone



Pond 5P: MC-3500



Pond 5P: MC-3500



Stage-Area-Storage for Pond 5P: MC-3500

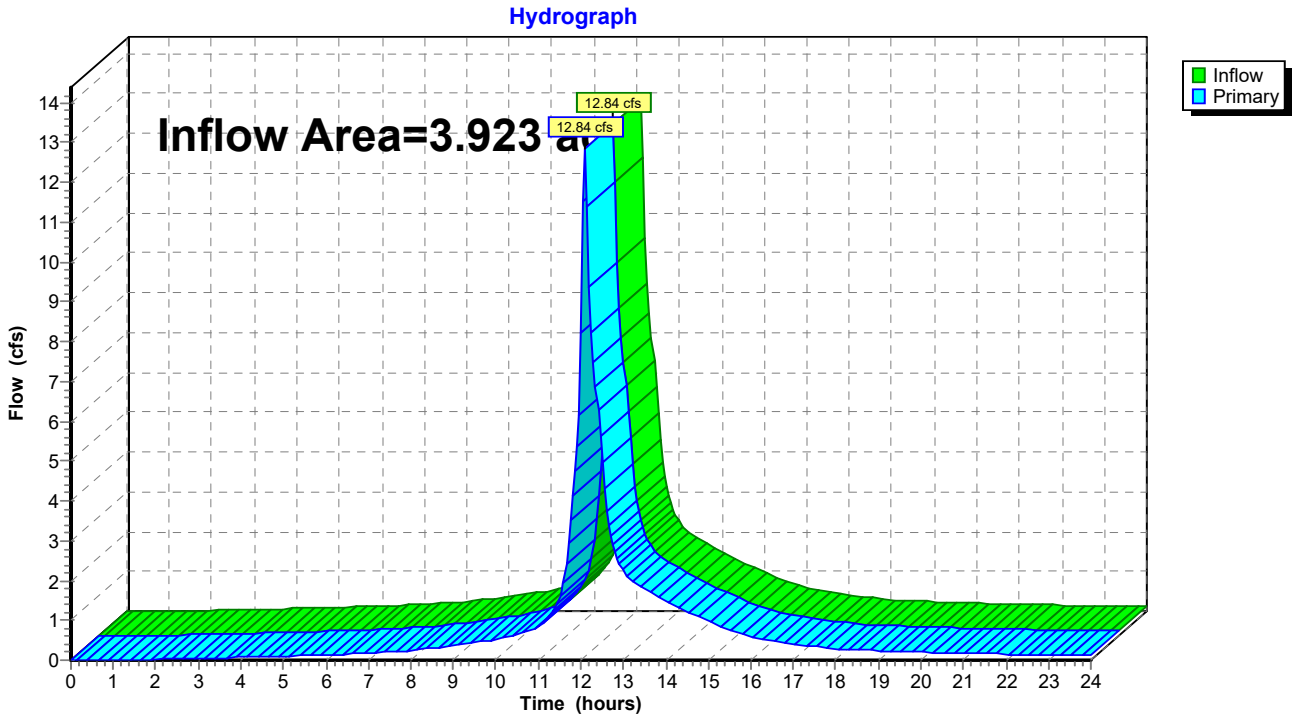
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
235.50	**3,694**	0
235.60	3,694	148
235.70	3,694	296
235.80	3,694	443
235.90	3,694	591
236.00	3,694	739
236.10	3,694	887
236.20	3,694	1,034
236.30	3,694	1,266
236.40	3,694	1,579
236.50	3,694	1,892
236.60	3,694	2,203
236.70	3,694	2,514
236.80	3,694	2,822
236.90	3,694	3,130
237.00	3,694	3,436
237.10	3,694	3,740
237.20	3,694	4,043
237.30	3,694	4,344
237.40	3,694	4,643
237.50	3,694	4,941
237.60	3,694	5,236
237.70	3,694	5,528
237.80	3,694	5,818
237.90	3,694	6,106
238.00	3,694	6,391
238.10	3,694	6,673
238.20	3,694	6,952
238.30	3,694	7,228
238.40	3,694	7,501
238.50	3,694	7,769
238.60	3,694	8,034
238.70	3,694	8,294
238.80	3,694	8,550
238.90	3,694	8,800
239.00	3,694	9,046
239.10	3,694	9,285
239.20	3,694	9,518
239.30	3,694	9,744
239.40	3,694	9,962
239.50	3,694	10,169
239.60	3,694	10,363
239.70	3,694	10,540
239.80	3,694	10,705
239.90	3,694	10,864
240.00	3,694	11,015
240.10	3,694	11,163
240.20	3,694	11,310
240.30	3,694	11,458
240.40	3,694	11,606
240.50	3,694	11,754
240.60	3,694	11,901
240.70	3,694	12,049
240.80	3,694	12,197
240.90	3,694	12,345
241.00	3,694	**12,493**

Summary for Link 1L: Ledin Avenue

Inflow Area = 3.923 ac, 90.41% Impervious, Inflow Depth > 4.07" for 10-Year event
Inflow = 12.84 cfs @ 12.10 hrs, Volume= 1.332 af
Primary = 12.84 cfs @ 12.10 hrs, Volume= 1.332 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: Ledin Avenue



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

Subcatchment1A-PR: 20 Ledin - Front of Runoff Area=27,547 sf 80.69% Impervious Runoff Depth>5.64"
Flow Length=275' Tc=6.0 min CN=94 Runoff=3.74 cfs 0.297 af

Subcatchment1B-PR: 20 Ledin - West Runoff Area=7,160 sf 15.82% Impervious Runoff Depth>3.48"
Flow Length=151' Slope=0.0200 '/' Tc=6.0 min CN=74 Runoff=0.66 cfs 0.048 af

Subcatchment1C-PR: 20 Ledin - Roof Runoff Area=42,421 sf 100.00% Impervious Runoff Depth>6.11"
Flow Length=279' Tc=6.0 min CN=98 Runoff=5.92 cfs 0.496 af

Subcatchment1D-PR: 20 Ledin - Rear Runoff Area=21,766 sf 94.58% Impervious Runoff Depth>5.87"
Flow Length=112' Tc=6.0 min CN=96 Runoff=3.01 cfs 0.245 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=45,932 sf 100.00% Impervious Runoff Depth>6.11"
Flow Length=656' Tc=6.8 min CN=98 Runoff=6.29 cfs 0.537 af

Subcatchment2OFF-EX: 40 Ledin Runoff Area=26,056 sf 85.16% Impervious Runoff Depth>5.76"
Flow Length=470' Tc=6.0 min CN=95 Runoff=3.57 cfs 0.287 af

Pond 5P: MC-3500 Peak Elev=240.15' Storage=11,234 cf Inflow=8.93 cfs 0.740 af
Discarded=0.09 cfs 0.154 af Primary=3.60 cfs 0.520 af Outflow=3.69 cfs 0.675 af

Link 1L: Ledin Avenue Inflow=16.69 cfs 1.689 af
Primary=16.69 cfs 1.689 af

Total Runoff Area = 3.923 ac Runoff Volume = 1.909 af Average Runoff Depth = 5.84"
9.59% Pervious = 0.376 ac 90.41% Impervious = 3.547 ac

Summary for Subcatchment 1A-PR: 20 Ledin - Front of Property

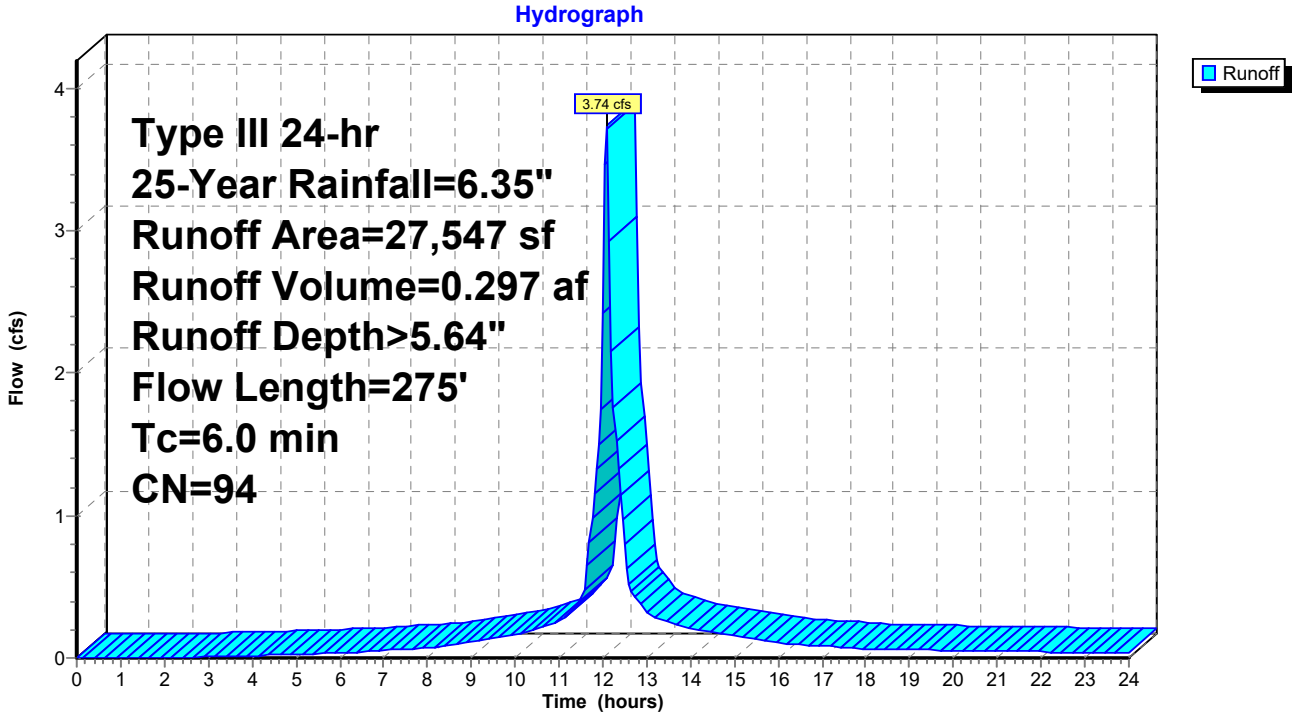
Runoff = 3.74 cfs @ 12.09 hrs, Volume= 0.297 af, Depth> 5.64"

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-Year Rainfall=6.35"

Area (sf)	CN	Description
1,289	96	Gravel surface, HSG B
4,029	69	50-75% Grass cover, Fair, HSG B
22,229	98	Paved parking, HSG B
27,547	94	Weighted Average
5,318		19.31% Pervious Area
22,229		80.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	29	0.0340	0.11		**Sheet Flow, Grassed Area** Grass: Dense n= 0.240 P2= 3.20"
0.2	39	0.0500	3.60		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	207	0.0500	4.54		**Shallow Concentrated Flow, Front Parking Area and Road** Paved Kv= 20.3 fps
5.3	275	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1A-PR: 20 Ledin - Front of Property



Summary for Subcatchment 1B-PR: 20 Ledin - West Swale

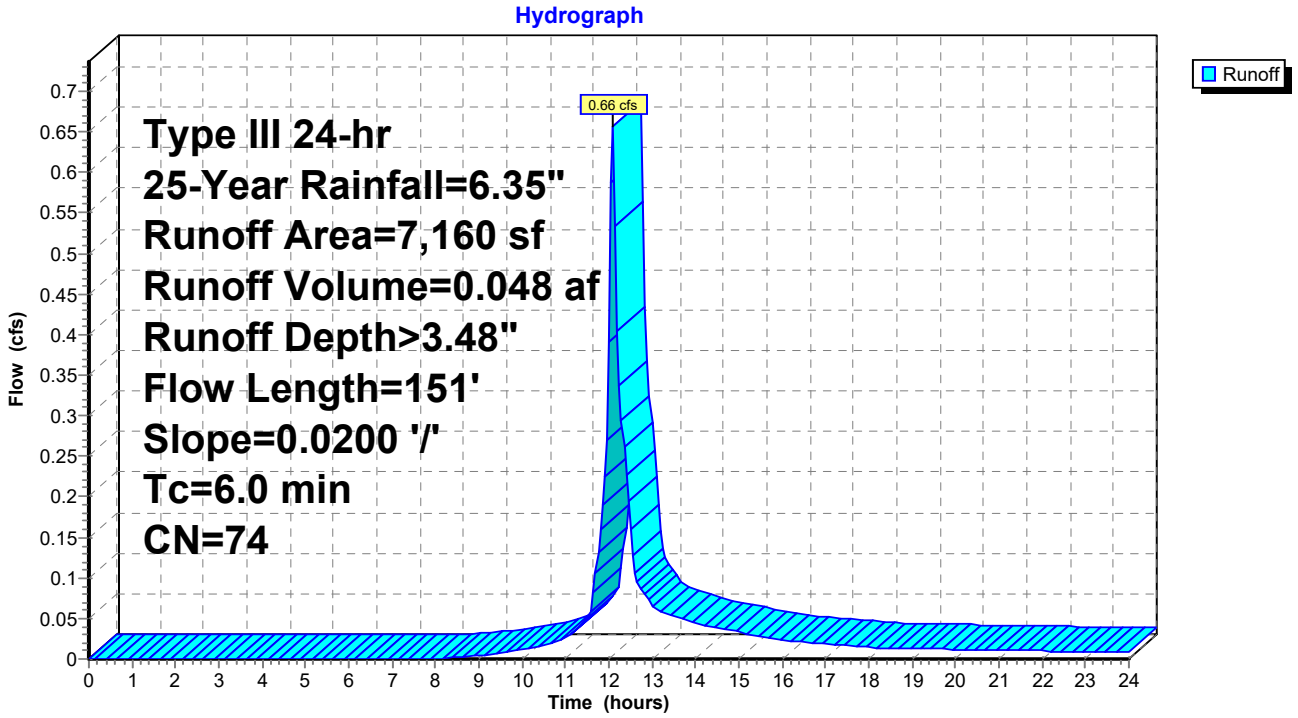
Runoff = 0.66 cfs @ 12.09 hrs, Volume= 0.048 af, Depth> 3.48"

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-Year Rainfall=6.35"

Area (sf)	CN	Description
6,027	69	50-75% Grass cover, Fair, HSG B
1,133	98	Paved parking, HSG B
7,160	74	Weighted Average
6,027		84.18% Pervious Area
1,133		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
2.5	151	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: 20 Ledin - West Swale



Summary for Subcatchment 1C-PR: 20 Ledin - Roof Addition

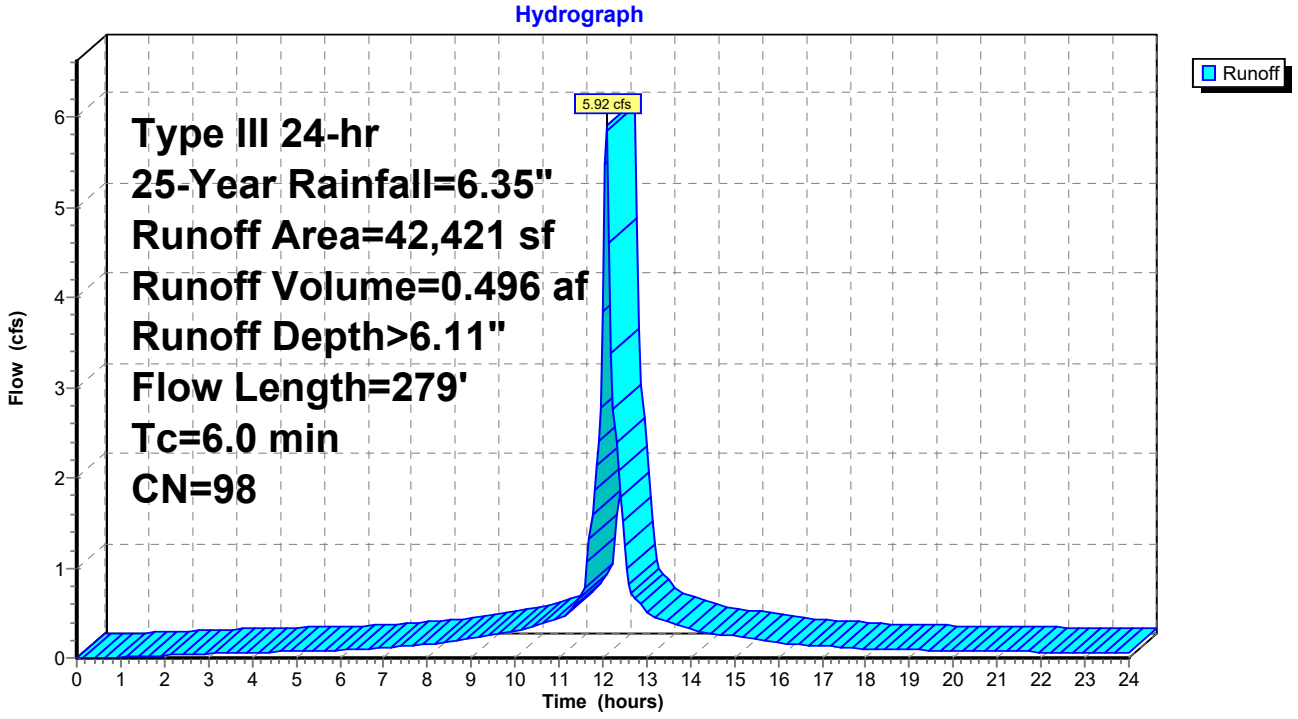
Runoff = 5.92 cfs @ 12.09 hrs, Volume= 0.496 af, Depth> 6.11"

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-Year Rainfall=6.35"

Area (sf)	CN	Description
24,112	98	Roofs, HSG B
18,309	98	Roofs, HSG B
42,421	98	Weighted Average
42,421		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	196	0.0100	1.19		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.0	40	0.9900	44.78	15.63	**Pipe Channel, Gutter** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.010 PVC, smooth interior
0.1	43	0.0250	9.32	7.32	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.8	279	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1C-PR: 20 Ledin - Roof Addition



Summary for Subcatchment 1D-PR: 20 Ledin - Rear Developed

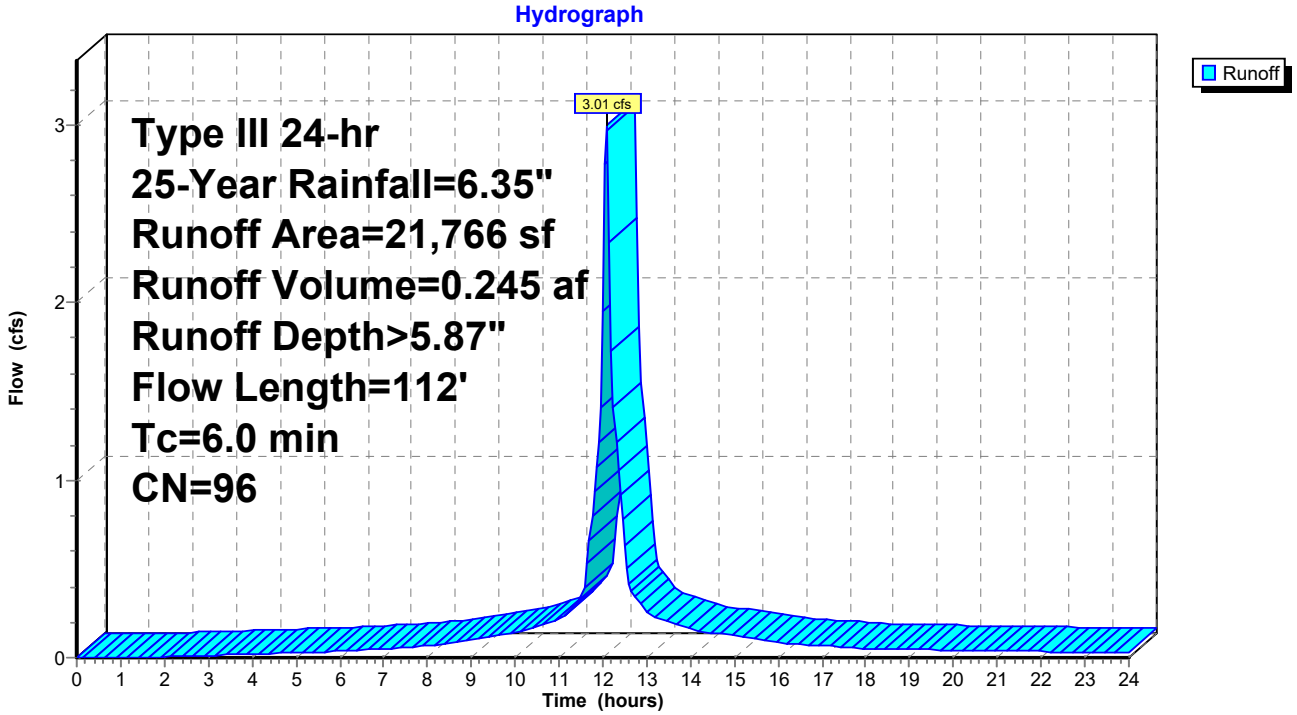
Runoff = 3.01 cfs @ 12.09 hrs, Volume= 0.245 af, Depth> 5.87"

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 25-Year Rainfall=6.35"

Area (sf)	CN	Description
1,179	69	50-75% Grass cover, Fair, HSG B
20,587	98	Paved parking, HSG B
21,766	96	Weighted Average
1,179		5.42% Pervious Area
20,587		94.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	25	0.1600	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.5	25	0.0100	0.79		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.5	62	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.4	112	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: 20 Ledin - Rear Developed



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 502% of capacity of segment #2

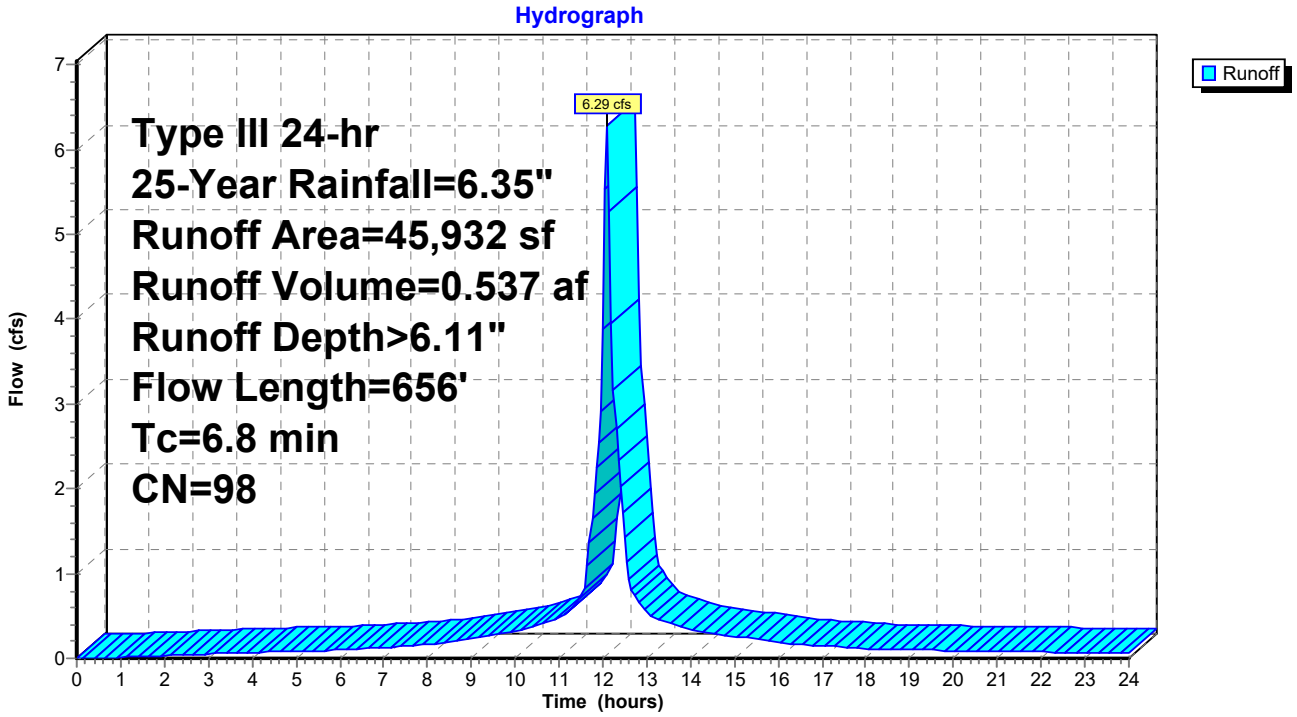
Runoff = 6.29 cfs @ 12.10 hrs, Volume= 0.537 af, Depth> 6.11"

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-Year Rainfall=6.35"

Area (sf)	CN	Description
18,549	98	Roofs, HSG B
27,383	98	Paved parking, HSG B
45,932	98	Weighted Average
45,932		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2OFF-EX: 40 Ledin

[47] Hint: Peak is 285% of capacity of segment #2

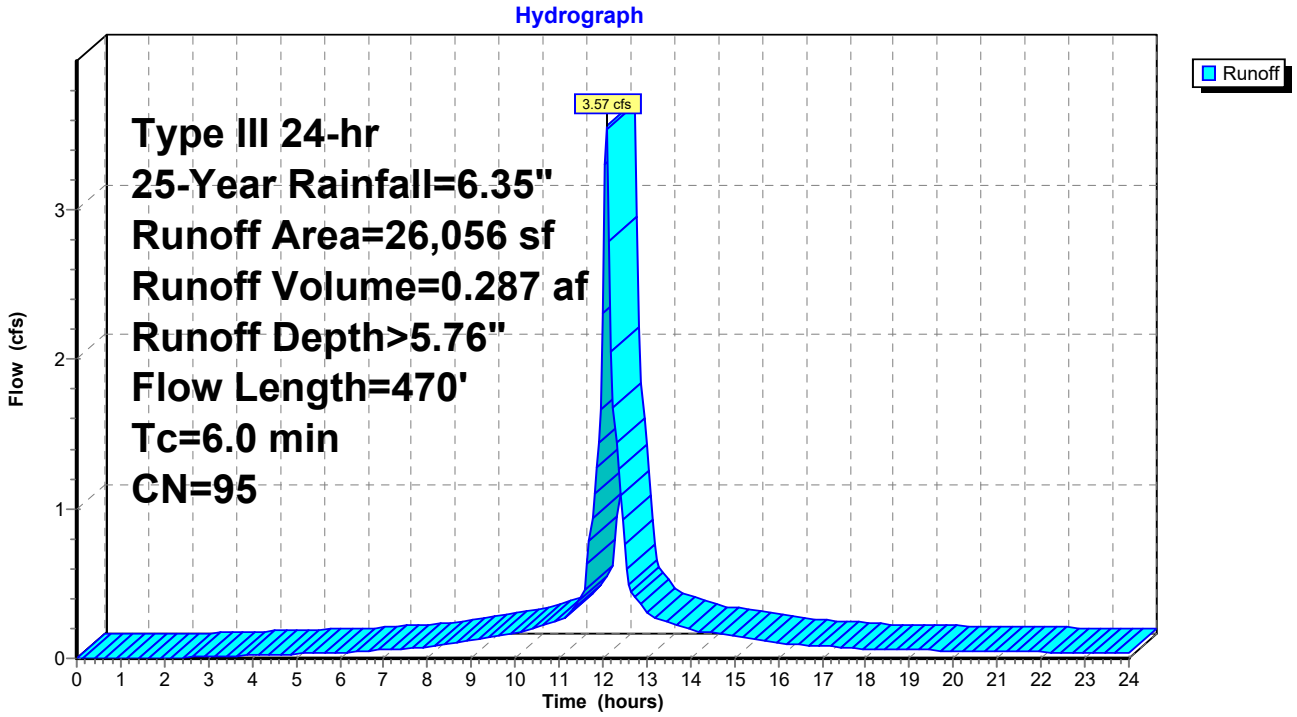
Runoff = 3.57 cfs @ 12.09 hrs, Volume= 0.287 af, Depth> 5.76"

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-Year Rainfall=6.35"

Area (sf)	CN	Description
13,682	98	Roofs, HSG B
3,867	79	<50% Grass cover, Poor, HSG B
8,507	98	Paved parking, HSG B
26,056	95	Weighted Average
3,867		14.84% Pervious Area
22,189		85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	145	0.0100	1.12		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
1.4	295	0.0300	3.52		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
3.6	470	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2OFF-EX: 40 Ledin



Summary for Pond 5P: MC-3500

Inflow Area = 1.474 ac, 98.16% Impervious, Inflow Depth > 6.03" for 25-Year event
Inflow = 8.93 cfs @ 12.09 hrs, Volume= 0.740 af
Outflow = 3.69 cfs @ 12.30 hrs, Volume= 0.675 af, Atten= 59%, Lag= 12.5 min
Discarded = 0.09 cfs @ 4.45 hrs, Volume= 0.154 af
Primary = 3.60 cfs @ 12.30 hrs, Volume= 0.520 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 240.15' @ 12.30 hrs Surf.Area= 3,694 sf Storage= 11,234 cf

Plug-Flow detention time= 109.2 min calculated for 0.675 af (91% of inflow)
Center-of-Mass det. time= 63.6 min (811.7 - 748.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	235.50'	5,217 cf	**58.58'W x 63.06'L x 5.50'H Field A** 20,318 cf Overall - 7,275 cf Embedded = 13,043 cf x 40.0% Voids
#2A	236.25'	7,275 cf	**ADS_StormTech MC-3500 d +Cap**x 64 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 64 Chambers in 8 Rows Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf
		12,493 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	235.00'	**18.0" Round Culvert** L= 5.0' Ke= 1.000 Inlet / Outlet Invert= 235.00' / 234.80' S= 0.0400 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf
#2	Device 1	240.50'	**4.0' 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
#3	Device 1	238.50'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	236.75'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	235.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 4.45 hrs HW=235.56' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=3.60 cfs @ 12.30 hrs HW=240.15' (Free Discharge)
└**1=Culvert** (Passes 3.60 cfs of 13.38 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Orifice Controls 1.93 cfs @ 5.52 fps)
  └**4=Orifice/Grate** (Orifice Controls 1.68 cfs @ 8.54 fps)

Pond 5P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech®MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

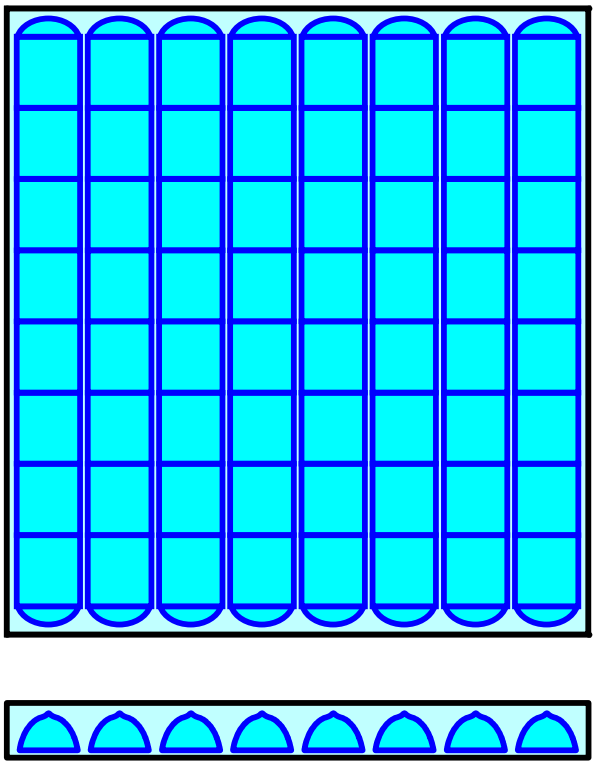
8 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 61.06' Row Length +12.0" End Stone x 2 = 63.06' Base Length
8 Rows x 77.0" Wide + 9.0" Spacing x 7 + 12.0" Side Stone x 2 = 58.58' Base Width
9.0" Stone Base + 45.0" Chamber Height + 12.0" Stone Cover = 5.50' Field Height

64 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 8 Rows = 7,275.3 cf Chamber Storage

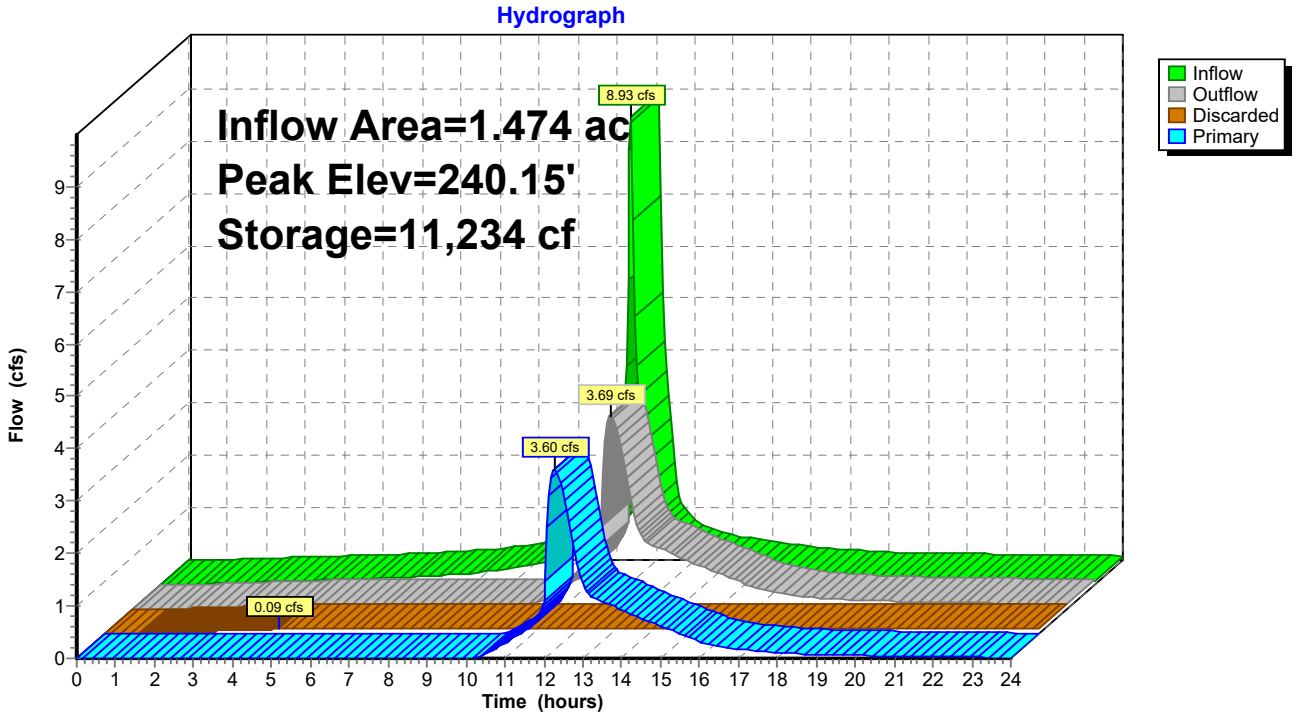
20,318.5 cf Field - 7,275.3 cf Chambers = 13,043.1 cf Stone x 40.0% Voids = 5,217.3 cf Stone Storage

Chamber Storage + Stone Storage = 12,492.6 cf = 0.287 af
Overall Storage Efficiency = 61.5%
Overall System Size = 63.06' x 58.58' x 5.50'

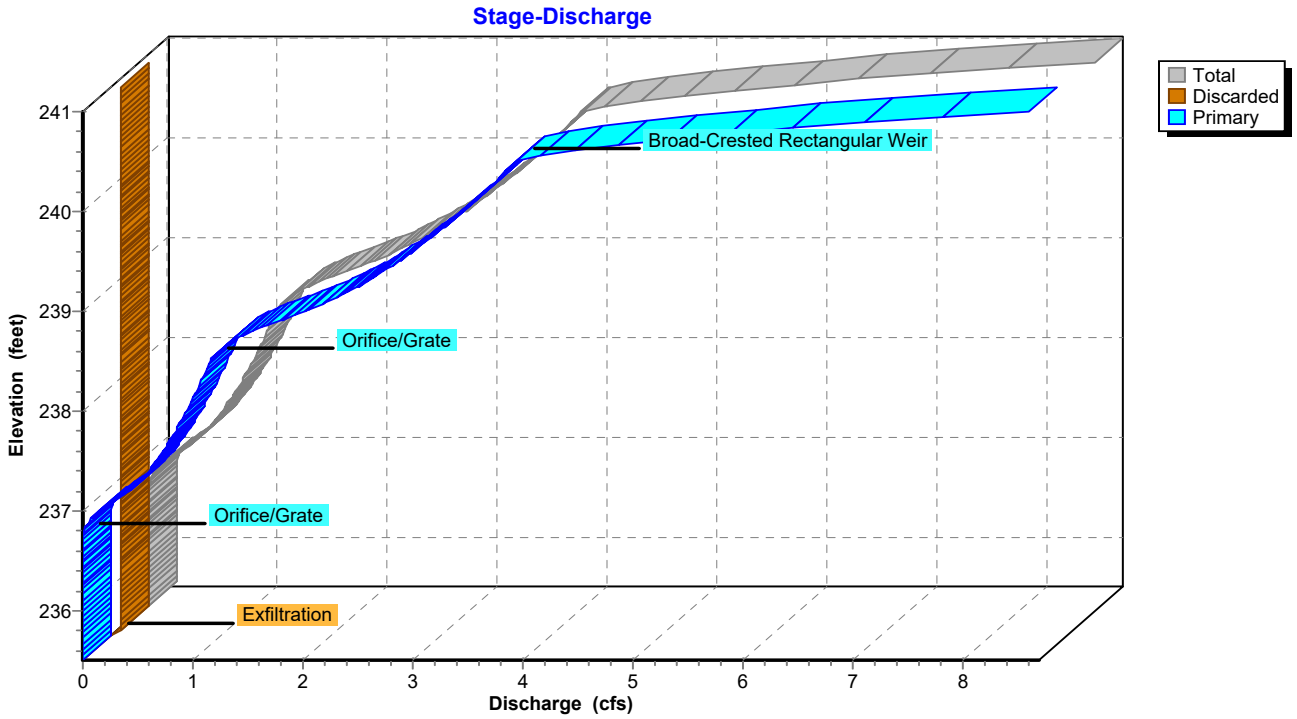
64 Chambers
752.5 cy Field
483.1 cy Stone



Pond 5P: MC-3500



Pond 5P: MC-3500



Stage-Area-Storage for Pond 5P: MC-3500

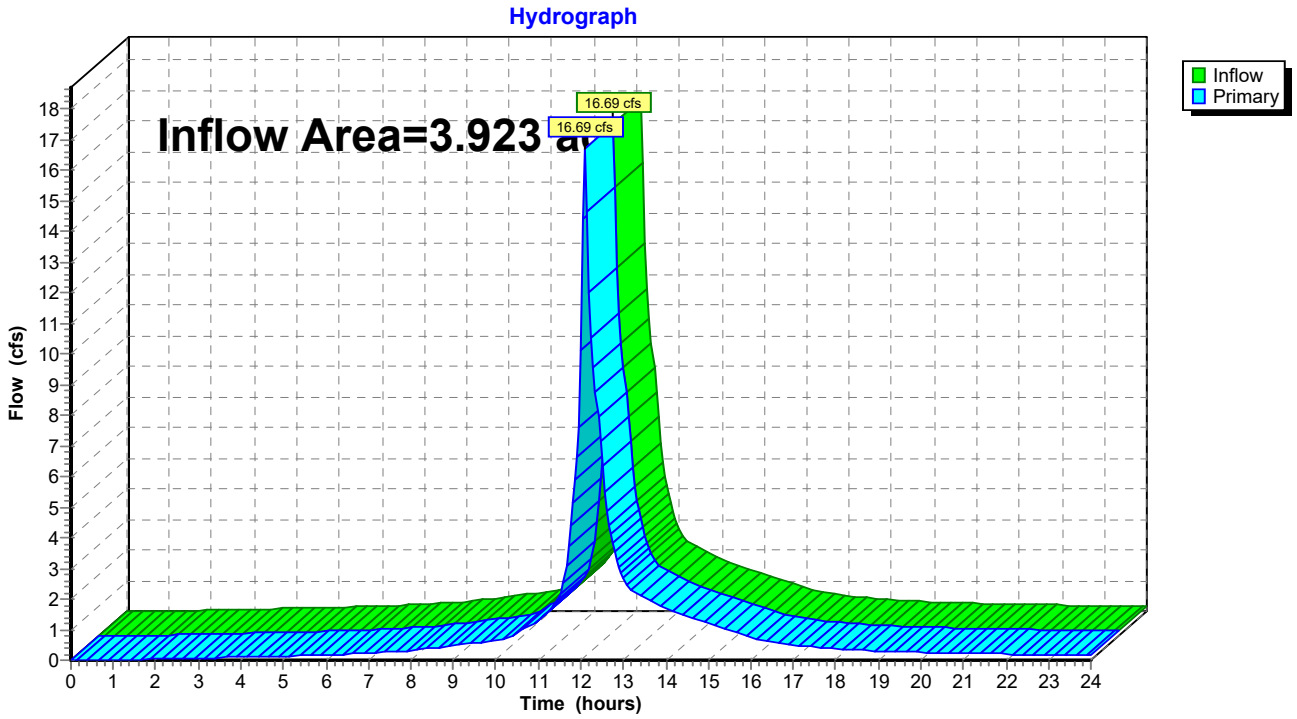
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
235.50	**3,694**	0
235.60	3,694	148
235.70	3,694	296
235.80	3,694	443
235.90	3,694	591
236.00	3,694	739
236.10	3,694	887
236.20	3,694	1,034
236.30	3,694	1,266
236.40	3,694	1,579
236.50	3,694	1,892
236.60	3,694	2,203
236.70	3,694	2,514
236.80	3,694	2,822
236.90	3,694	3,130
237.00	3,694	3,436
237.10	3,694	3,740
237.20	3,694	4,043
237.30	3,694	4,344
237.40	3,694	4,643
237.50	3,694	4,941
237.60	3,694	5,236
237.70	3,694	5,528
237.80	3,694	5,818
237.90	3,694	6,106
238.00	3,694	6,391
238.10	3,694	6,673
238.20	3,694	6,952
238.30	3,694	7,228
238.40	3,694	7,501
238.50	3,694	7,769
238.60	3,694	8,034
238.70	3,694	8,294
238.80	3,694	8,550
238.90	3,694	8,800
239.00	3,694	9,046
239.10	3,694	9,285
239.20	3,694	9,518
239.30	3,694	9,744
239.40	3,694	9,962
239.50	3,694	10,169
239.60	3,694	10,363
239.70	3,694	10,540
239.80	3,694	10,705
239.90	3,694	10,864
240.00	3,694	11,015
240.10	3,694	11,163
240.20	3,694	11,310
240.30	3,694	11,458
240.40	3,694	11,606
240.50	3,694	11,754
240.60	3,694	11,901
240.70	3,694	12,049
240.80	3,694	12,197
240.90	3,694	12,345
241.00	3,694	**12,493**

Summary for Link 1L: Ledin Avenue

Inflow Area = 3.923 ac, 90.41% Impervious, Inflow Depth > 5.17" for 25-Year event
Inflow = 16.69 cfs @ 12.10 hrs, Volume= 1.689 af
Primary = 16.69 cfs @ 12.10 hrs, Volume= 1.689 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: Ledin Avenue



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

Subcatchment1A-PR: 20 Ledin - Front of Runoff Area=27,547 sf 80.69% Impervious Runoff Depth>7.38"
Flow Length=275' Tc=6.0 min CN=94 Runoff=4.83 cfs 0.389 af

Subcatchment1B-PR: 20 Ledin - West Runoff Area=7,160 sf 15.82% Impervious Runoff Depth>5.01"
Flow Length=151' Slope=0.0200 '/' Tc=6.0 min CN=74 Runoff=0.94 cfs 0.069 af

Subcatchment1C-PR: 20 Ledin - Roof Runoff Area=42,421 sf 100.00% Impervious Runoff Depth>7.86"
Flow Length=279' Tc=6.0 min CN=98 Runoff=7.56 cfs 0.638 af

Subcatchment1D-PR: 20 Ledin - Rear Runoff Area=21,766 sf 94.58% Impervious Runoff Depth>7.62"
Flow Length=112' Tc=6.0 min CN=96 Runoff=3.85 cfs 0.317 af

Subcatchment1OFF-EX: 40 Ledin Runoff Area=45,932 sf 100.00% Impervious Runoff Depth>7.85"
Flow Length=656' Tc=6.8 min CN=98 Runoff=8.04 cfs 0.690 af

Subcatchment2OFF-EX: 40 Ledin Runoff Area=26,056 sf 85.16% Impervious Runoff Depth>7.50"
Flow Length=470' Tc=6.0 min CN=95 Runoff=4.59 cfs 0.374 af

Pond 5P: MC-3500 Peak Elev=240.94' Storage=12,397 cf Inflow=11.42 cfs 0.955 af
Discarded=0.09 cfs 0.160 af Primary=7.69 cfs 0.726 af Outflow=7.77 cfs 0.886 af

Link 1L: Ledin Avenue Inflow=22.57 cfs 2.248 af
Primary=22.57 cfs 2.248 af

Total Runoff Area = 3.923 ac Runoff Volume = 2.476 af Average Runoff Depth = 7.57"
9.59% Pervious = 0.376 ac 90.41% Impervious = 3.547 ac

Summary for Subcatchment 1A-PR: 20 Ledin - Front of Property

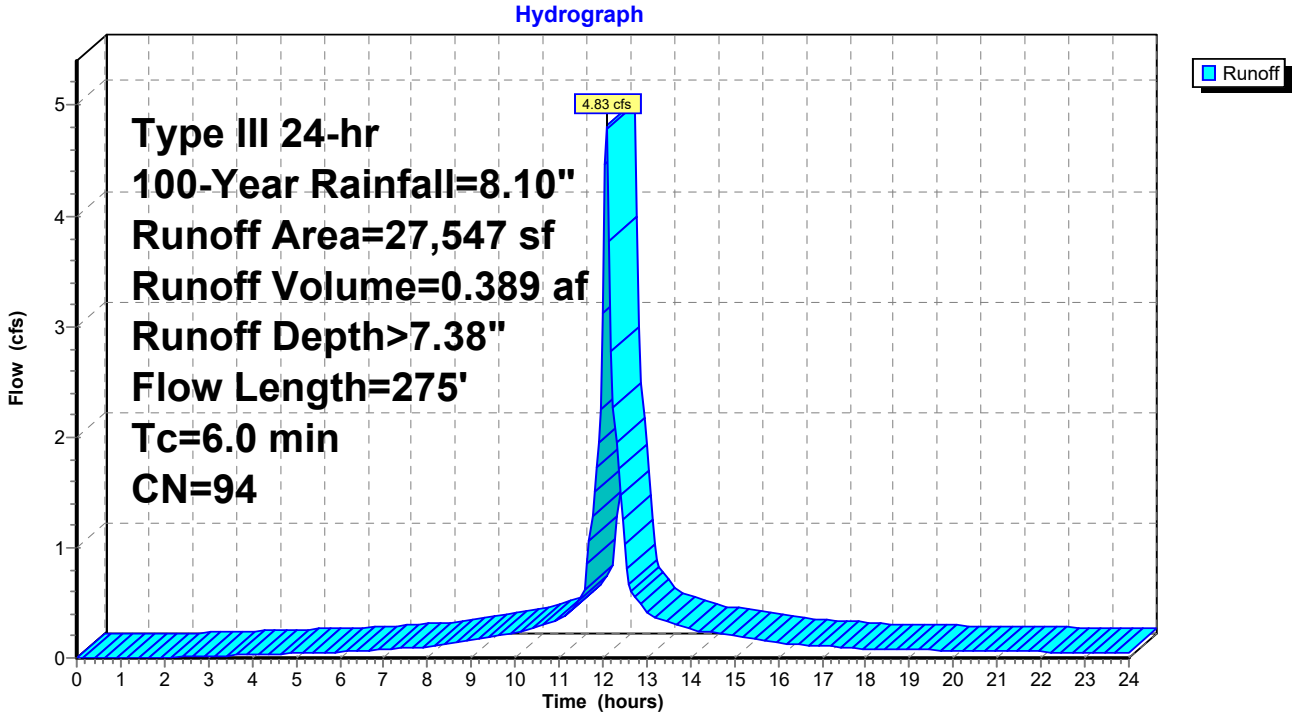
Runoff = 4.83 cfs @ 12.09 hrs, Volume= 0.389 af, Depth> 7.38"

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-Year Rainfall=8.10"

Area (sf)	CN	Description
1,289	96	Gravel surface, HSG B
4,029	69	50-75% Grass cover, Fair, HSG B
22,229	98	Paved parking, HSG B
27,547	94	Weighted Average
5,318		19.31% Pervious Area
22,229		80.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.3	29	0.0340	0.11		**Sheet Flow, Grassed Area** Grass: Dense n= 0.240 P2= 3.20"
0.2	39	0.0500	3.60		**Shallow Concentrated Flow, Gravel** Unpaved Kv= 16.1 fps
0.8	207	0.0500	4.54		**Shallow Concentrated Flow, Front Parking Area and Road** Paved Kv= 20.3 fps
5.3	275	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1A-PR: 20 Ledin - Front of Property



Summary for Subcatchment 1B-PR: 20 Ledin - West Swale

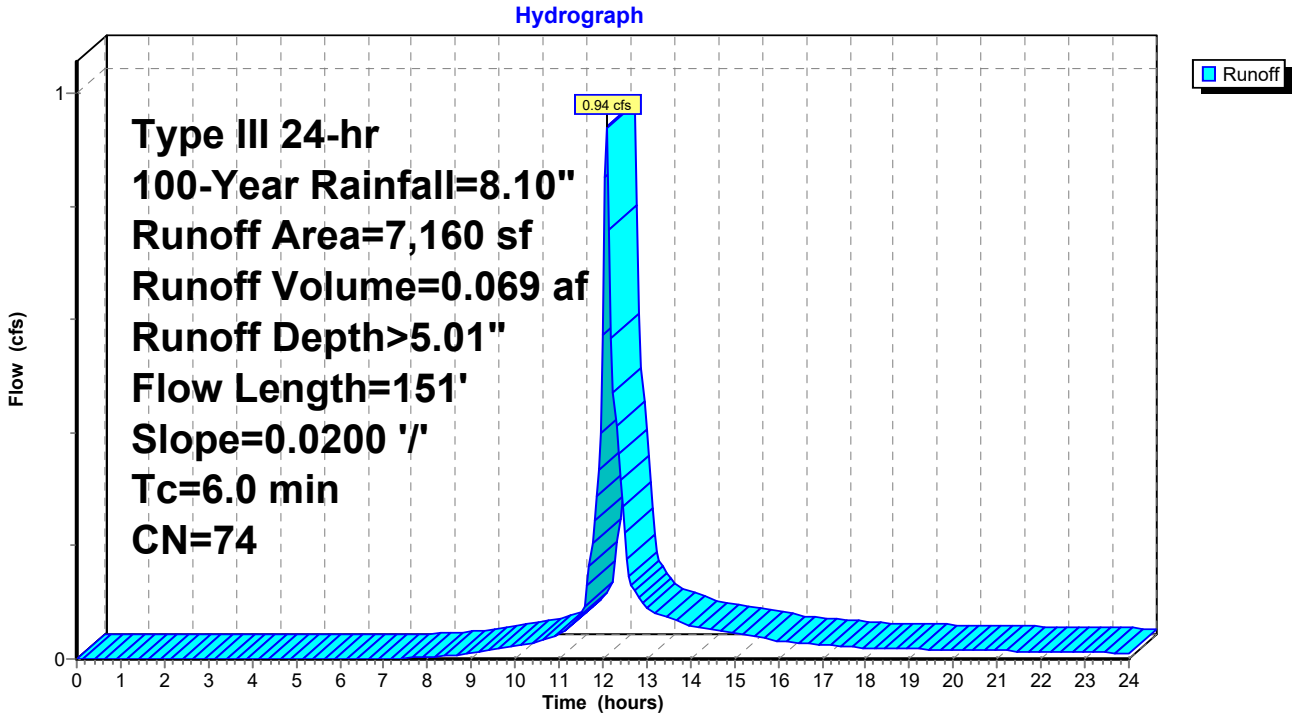
Runoff = 0.94 cfs @ 12.09 hrs, Volume= 0.069 af, Depth> 5.01"

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-Year Rainfall=8.10"

Area (sf)	CN	Description
6,027	69	50-75% Grass cover, Fair, HSG B
1,133	98	Paved parking, HSG B
7,160	74	Weighted Average
6,027		84.18% Pervious Area
1,133		15.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
2.5	151	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1B-PR: 20 Ledin - West Swale



Summary for Subcatchment 1C-PR: 20 Ledin - Roof Addition

[47] Hint: Peak is 103% of capacity of segment #3

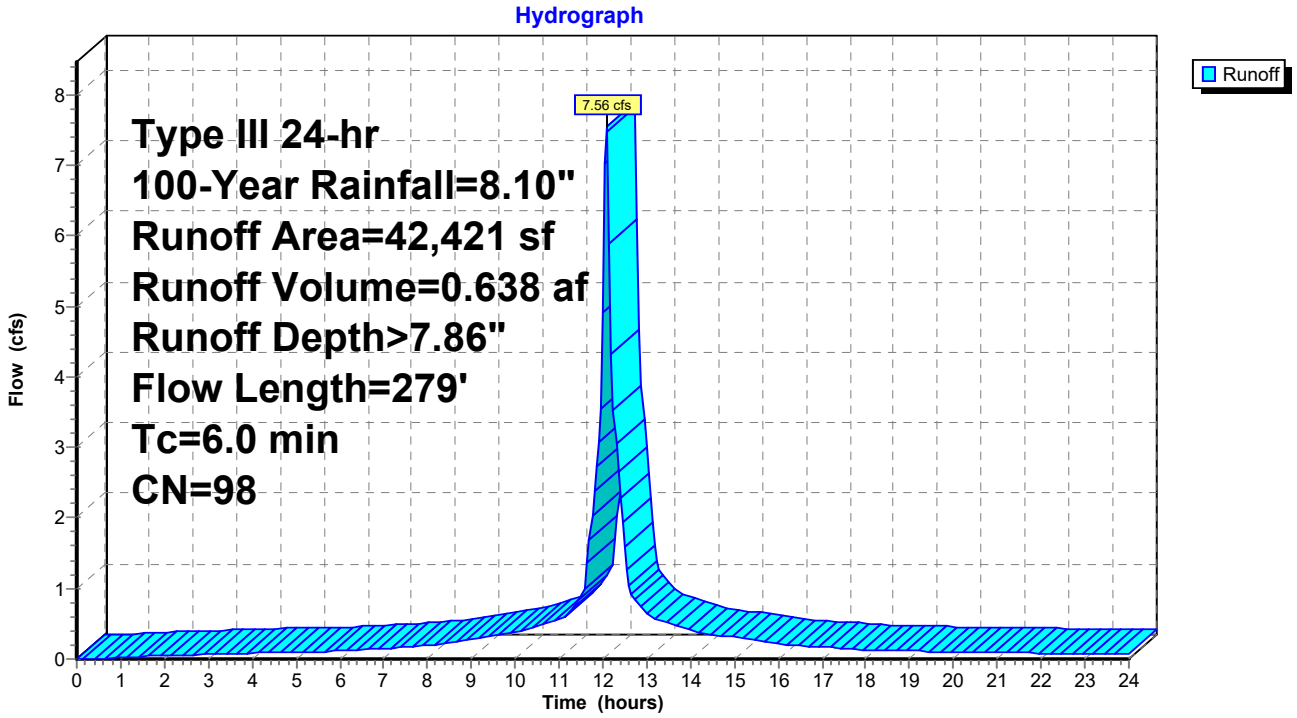
Runoff = 7.56 cfs @ 12.09 hrs, Volume= 0.638 af, Depth> 7.86"

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-Year Rainfall=8.10"

Area (sf)	CN	Description
24,112	98	Roofs, HSG B
18,309	98	Roofs, HSG B
42,421	98	Weighted Average
42,421		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.7	196	0.0100	1.19		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.0	40	0.9900	44.78	15.63	**Pipe Channel, Gutter** 8.0" Round Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.010 PVC, smooth interior
0.1	43	0.0250	9.32	7.32	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.8	279	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1C-PR: 20 Ledin - Roof Addition



Summary for Subcatchment 1D-PR: 20 Ledin - Rear Developed

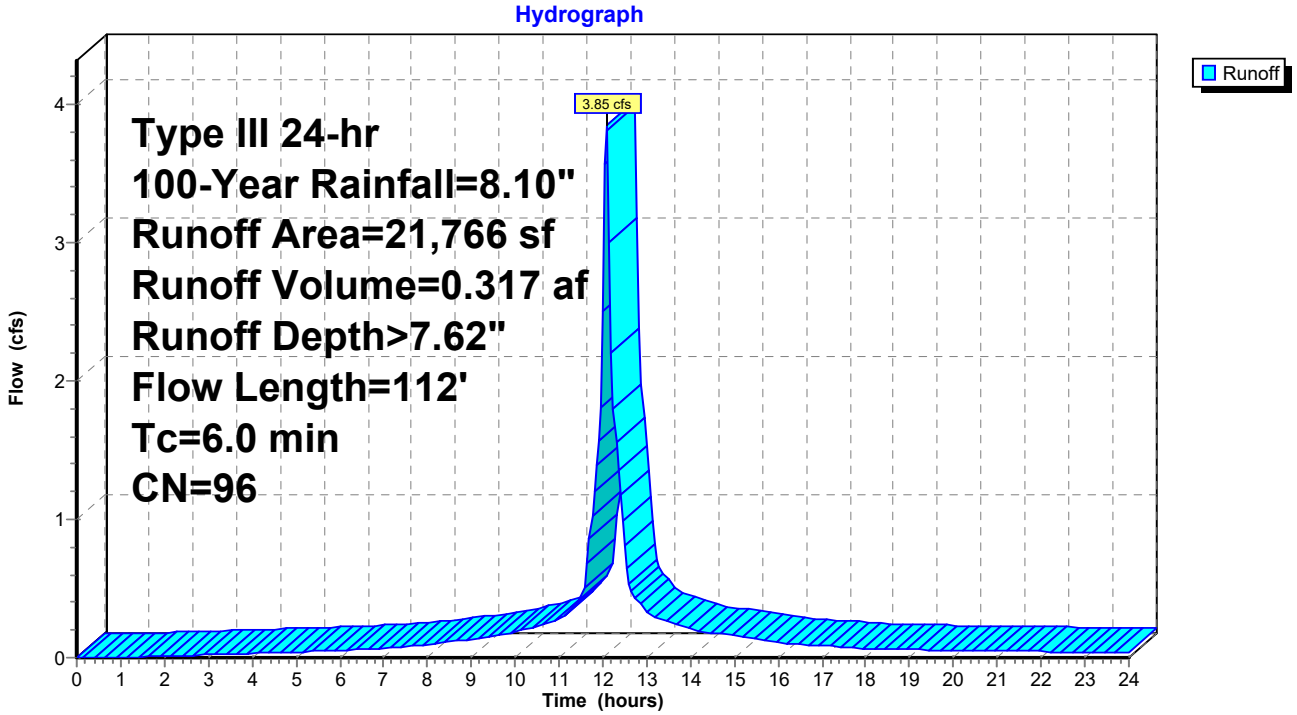
Runoff = 3.85 cfs @ 12.09 hrs, Volume= 0.317 af, Depth> 7.62"

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-Year Rainfall=8.10"

Area (sf)	CN	Description
1,179	69	50-75% Grass cover, Fair, HSG B
20,587	98	Paved parking, HSG B
21,766	96	Weighted Average
1,179		5.42% Pervious Area
20,587		94.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	25	0.1600	0.30		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.20"
0.5	25	0.0100	0.79		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20"
0.5	62	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
2.4	112	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 1D-PR: 20 Ledin - Rear Developed



Summary for Subcatchment 1OFF-EX: 40 Ledin

[47] Hint: Peak is 641% of capacity of segment #2

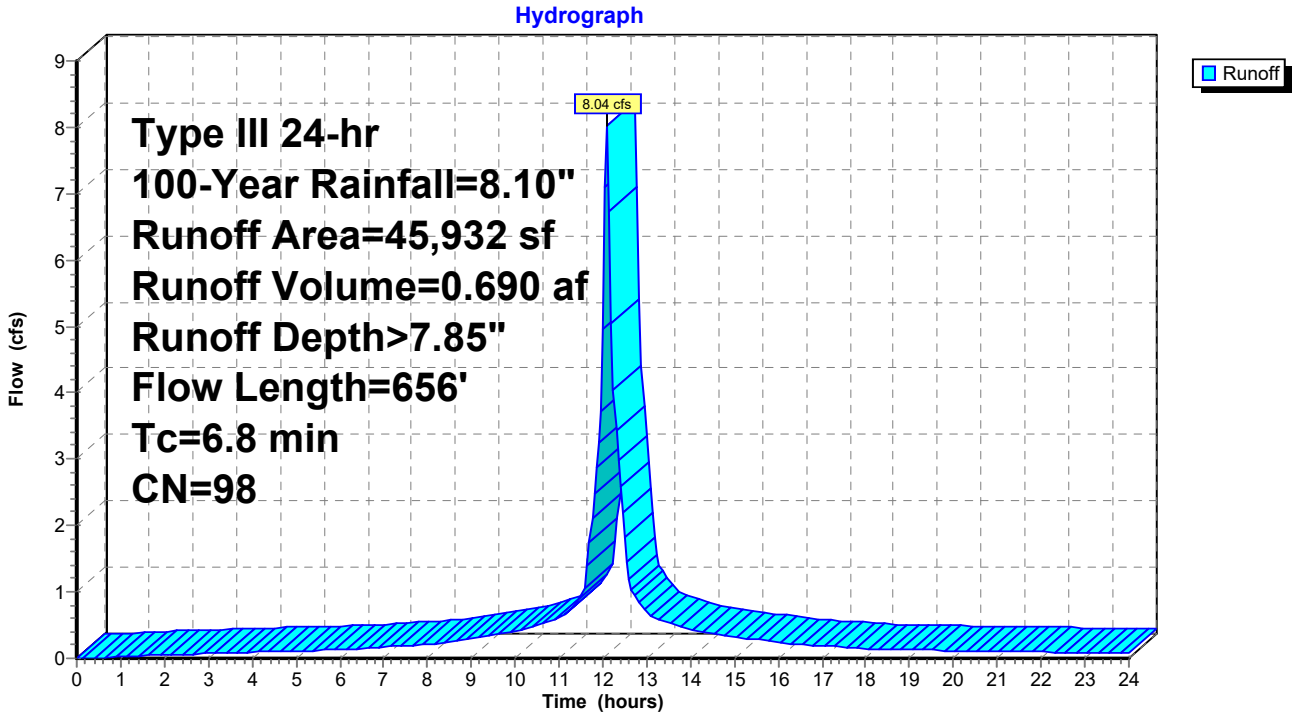
Runoff = 8.04 cfs @ 12.10 hrs, Volume= 0.690 af, Depth> 7.85"

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 100-Year Rainfall=8.10"

Area (sf)	CN	Description
18,549	98	Roofs, HSG B
27,383	98	Paved parking, HSG B
45,932	98	Weighted Average
45,932		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.6	184	0.0100	1.18		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
0.7	93	0.0110	2.13		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
2.5	151	0.0200	0.99		**Shallow Concentrated Flow, Grass** Short Grass Pasture Kv= 7.0 fps
1.0	198	0.0270	3.34		**Shallow Concentrated Flow, 20 Ledin Parking Lot** Paved Kv= 20.3 fps
6.8	656	Total			

Subcatchment 1OFF-EX: 40 Ledin



Summary for Subcatchment 2OFF-EX: 40 Ledin

[47] Hint: Peak is 366% of capacity of segment #2

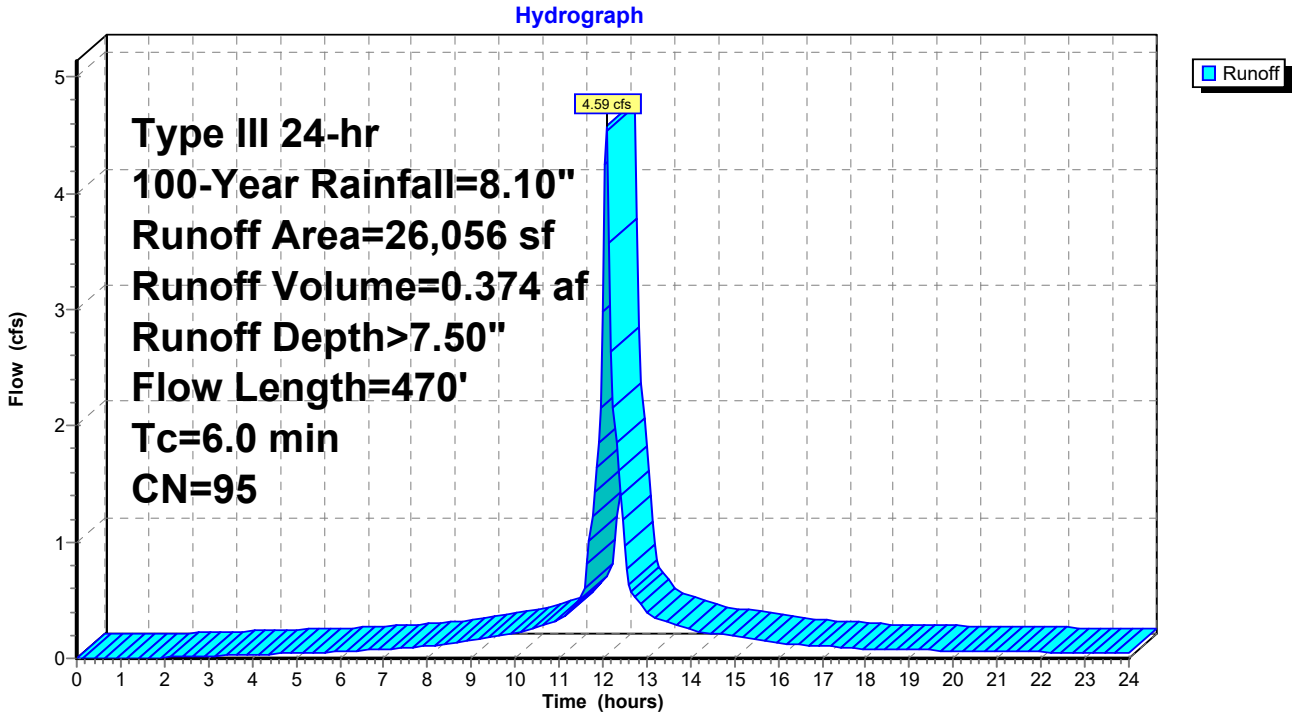
Runoff = 4.59 cfs @ 12.09 hrs, Volume= 0.374 af, Depth> 7.50"

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-Year Rainfall=8.10"

Area (sf)	CN	Description
13,682	98	Roofs, HSG B
3,867	79	<50% Grass cover, Poor, HSG B
8,507	98	Paved parking, HSG B
26,056	95	Weighted Average
3,867		14.84% Pervious Area
22,189		85.16% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	145	0.0100	1.12		**Sheet Flow, 40 Ledin Ave Rood** Smooth surfaces n= 0.011 P2= 3.20"
0.0	30	0.9900	11.28	1.25	**Pipe Channel, Gutter** 4.0" x 4.0" Box Area= 0.1 sf Perim= 1.3' r= 0.08' n= 0.025 Corrugated metal
1.4	295	0.0300	3.52		**Shallow Concentrated Flow, Pavement** Paved Kv= 20.3 fps
3.6	470	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2OFF-EX: 40 Ledin



Summary for Pond 5P: MC-3500

Inflow Area = 1.474 ac, 98.16% Impervious, Inflow Depth > 7.77" for 100-Year event
Inflow = 11.42 cfs @ 12.09 hrs, Volume= 0.955 af
Outflow = 7.77 cfs @ 12.18 hrs, Volume= 0.886 af, Atten= 32%, Lag= 5.8 min
Discarded = 0.09 cfs @ 3.20 hrs, Volume= 0.160 af
Primary = 7.69 cfs @ 12.18 hrs, Volume= 0.726 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 240.94' @ 12.18 hrs Surf.Area= 3,694 sf Storage= 12,397 cf

Plug-Flow detention time= 98.9 min calculated for 0.886 af (93% of inflow)
Center-of-Mass det. time= 59.7 min (804.0 - 744.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	235.50'	5,217 cf	**58.58'W x 63.06'L x 5.50'H Field A** 20,318 cf Overall - 7,275 cf Embedded = 13,043 cf x 40.0% Voids
#2A	236.25'	7,275 cf	**ADS_StormTech MC-3500 d +Cap**x 64 Inside #1 Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap 64 Chambers in 8 Rows Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf
		12,493 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	235.00'	**18.0" Round Culvert** L= 5.0' Ke= 1.000 Inlet / Outlet Invert= 235.00' / 234.80' S= 0.0400 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 1.77 sf
#2	Device 1	240.50'	**4.0' 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
#3	Device 1	238.50'	**8.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	236.75'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	235.50'	**1.020 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.09 cfs @ 3.20 hrs HW=235.56' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.09 cfs)

Primary OutFlow Max=7.48 cfs @ 12.18 hrs HW=240.92' (Free Discharge)
└**1=Culvert** (Passes 7.48 cfs of 14.51 cfs potential flow)
  ├**2=Broad-Crested Rectangular Weir** (Weir Controls 3.18 cfs @ 1.90 fps)
  ├**3=Orifice/Grate** (Orifice Controls 2.43 cfs @ 6.95 fps)
  └**4=Orifice/Grate** (Orifice Controls 1.87 cfs @ 9.53 fps)

Pond 5P: MC-3500 - Chamber Wizard Field A

Chamber Model = ADS_StormTechMC-3500 d +Cap (ADS StormTech®MC-3500 d rev 03/14 with Cap volume)
Effective Size= 70.4"W x 45.0"H => 15.33 sf x 7.17'L = 110.0 cf
Overall Size= 77.0"W x 45.0"H x 7.50'L with 0.33' Overlap
Cap Storage= +14.9 cf x 2 x 8 rows = 238.4 cf

77.0" Wide + 9.0" Spacing = 86.0" C-C Row Spacing

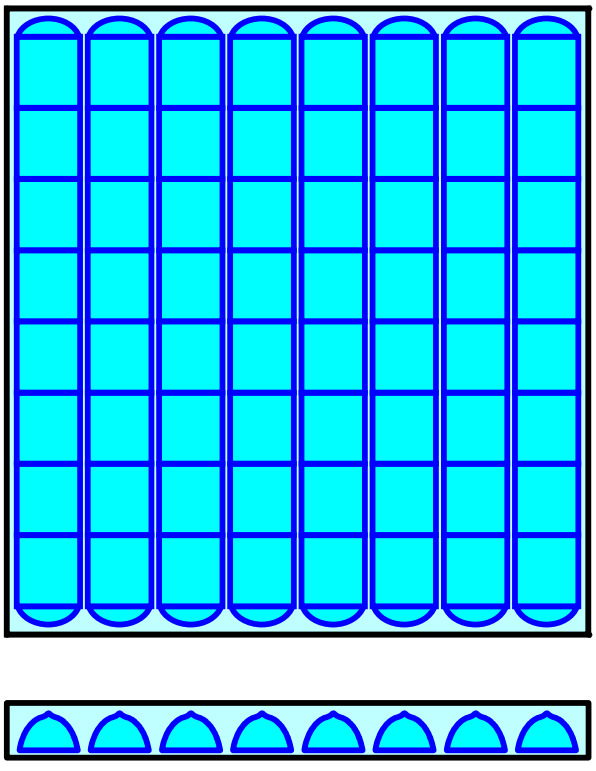
8 Chambers/Row x 7.17' Long +1.85' Cap Length x 2 = 61.06' Row Length +12.0" End Stone x 2 = 63.06' Base Length
8 Rows x 77.0" Wide + 9.0" Spacing x 7 + 12.0" Side Stone x 2 = 58.58' Base Width
9.0" Stone Base + 45.0" Chamber Height + 12.0" Stone Cover = 5.50' Field Height

64 Chambers x 110.0 cf + 14.9 cf Cap Volume x 2 x 8 Rows = 7,275.3 cf Chamber Storage

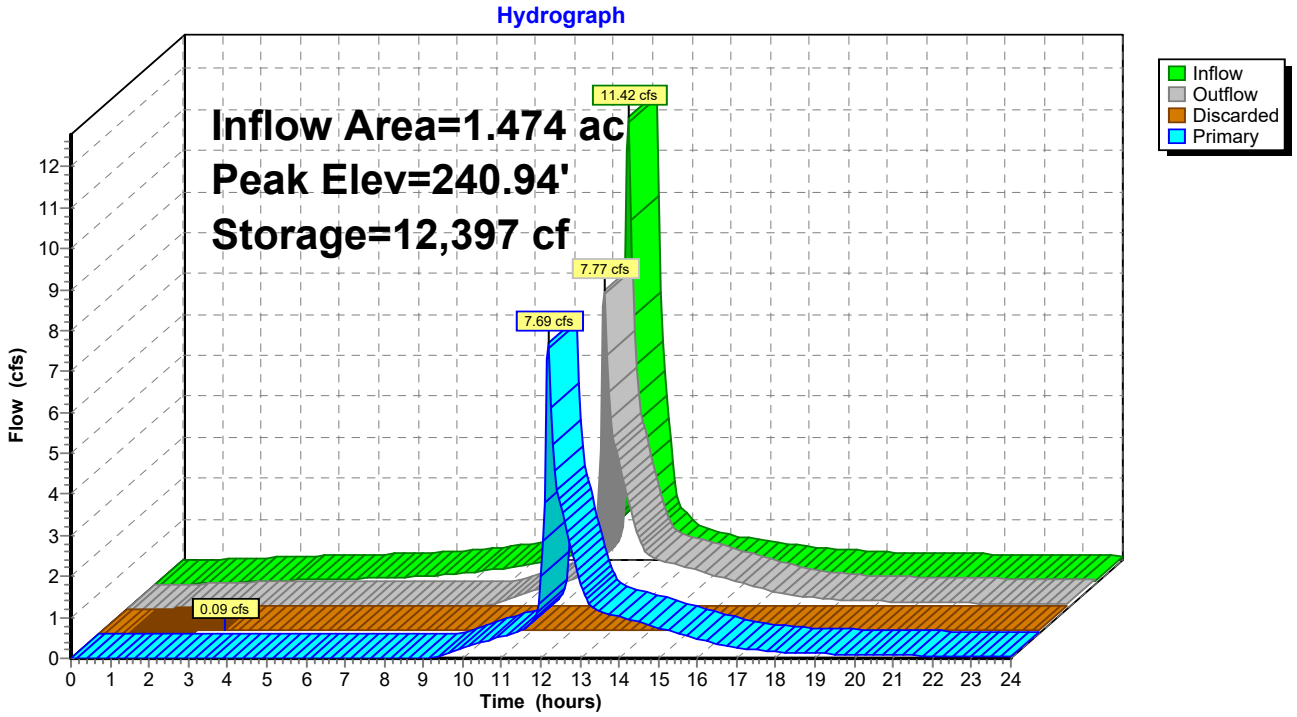
20,318.5 cf Field - 7,275.3 cf Chambers = 13,043.1 cf Stone x 40.0% Voids = 5,217.3 cf Stone Storage

Chamber Storage + Stone Storage = 12,492.6 cf = 0.287 af
Overall Storage Efficiency = 61.5%
Overall System Size = 63.06' x 58.58' x 5.50'

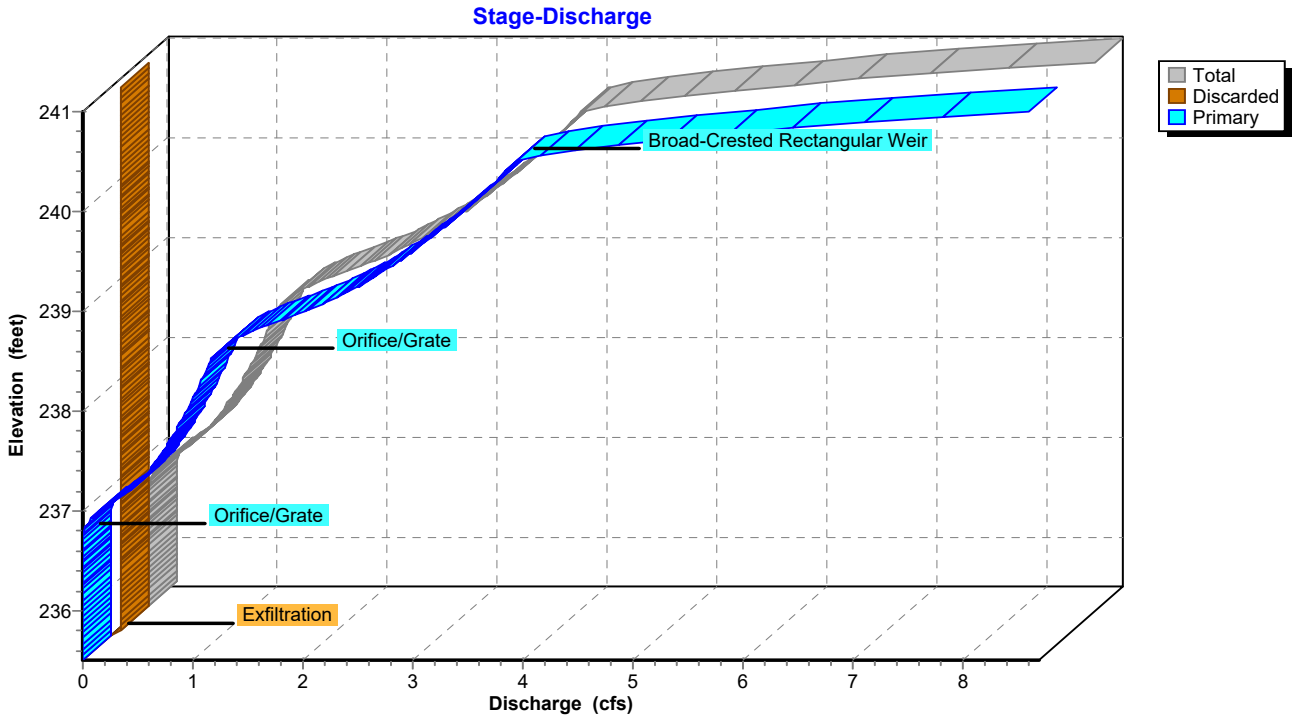
64 Chambers
752.5 cy Field
483.1 cy Stone



Pond 5P: MC-3500



Pond 5P: MC-3500



Stage-Area-Storage for Pond 5P: MC-3500

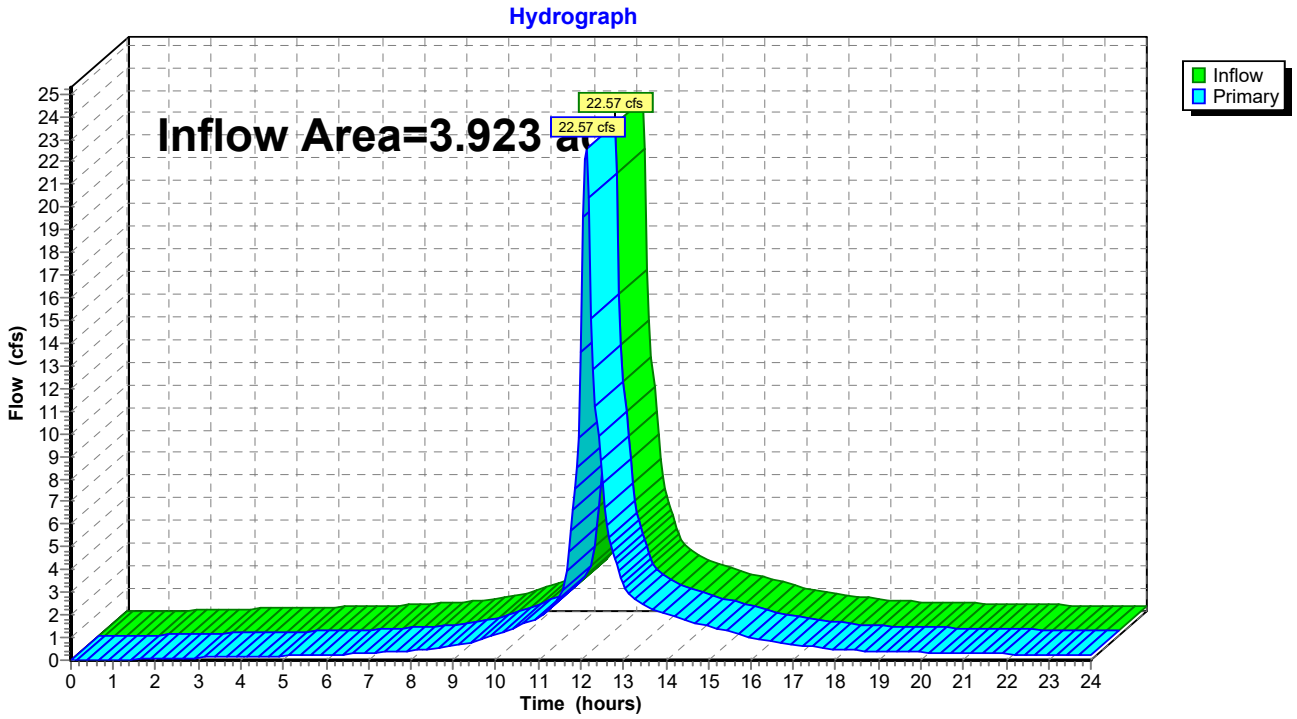
Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
235.50	**3,694**	0
235.60	3,694	148
235.70	3,694	296
235.80	3,694	443
235.90	3,694	591
236.00	3,694	739
236.10	3,694	887
236.20	3,694	1,034
236.30	3,694	1,266
236.40	3,694	1,579
236.50	3,694	1,892
236.60	3,694	2,203
236.70	3,694	2,514
236.80	3,694	2,822
236.90	3,694	3,130
237.00	3,694	3,436
237.10	3,694	3,740
237.20	3,694	4,043
237.30	3,694	4,344
237.40	3,694	4,643
237.50	3,694	4,941
237.60	3,694	5,236
237.70	3,694	5,528
237.80	3,694	5,818
237.90	3,694	6,106
238.00	3,694	6,391
238.10	3,694	6,673
238.20	3,694	6,952
238.30	3,694	7,228
238.40	3,694	7,501
238.50	3,694	7,769
238.60	3,694	8,034
238.70	3,694	8,294
238.80	3,694	8,550
238.90	3,694	8,800
239.00	3,694	9,046
239.10	3,694	9,285
239.20	3,694	9,518
239.30	3,694	9,744
239.40	3,694	9,962
239.50	3,694	10,169
239.60	3,694	10,363
239.70	3,694	10,540
239.80	3,694	10,705
239.90	3,694	10,864
240.00	3,694	11,015
240.10	3,694	11,163
240.20	3,694	11,310
240.30	3,694	11,458
240.40	3,694	11,606
240.50	3,694	11,754
240.60	3,694	11,901
240.70	3,694	12,049
240.80	3,694	12,197
240.90	3,694	12,345
241.00	3,694	**12,493**

Summary for Link 1L: Ledin Avenue

Inflow Area = 3.923 ac, 90.41% Impervious, Inflow Depth > 6.88" for 100-Year event
Inflow = 22.57 cfs @ 12.13 hrs, Volume= 2.248 af
Primary = 22.57 cfs @ 12.13 hrs, Volume= 2.248 af, Atten= 0%, Lag= 0.0 min

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

Link 1L: Ledin Avenue



TSS Removal Calculations

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: Subsurface Infiltration Chambers - Subcatchment 1D-PR (Rear Pavement Area)

TSS Removal Calculation Worksheet

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

Total TSS Removal = **80%**

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

Project: **20 Ledin Avenue, Avon, MA**

Prepared By: **DWP**

Date: **8/3/2021**

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

*** Stormtech Isolator Row conservatively assumed to provide a minimum of 25% TSS removal*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: Deep Sump Catch basin and Water Quality Unit (Barracuda S4) - Subcatchment 1OFF-EX& 1B-PR (Adjacent property and small paved area)

TSS Removal Calculation Worksheet

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

Total TSS Removal = **80%**

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

Project: **20 Ledin Avenue, Avon, MA**

Prepared By: **DWP**

Date: **8/3/2021**

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

*** Stormtech Isolator Row conservatively assumed to provide a minimum of 25% TSS removal*

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

Location: Trench Drain and Water Quality Unit (Barracuda S4) - Subcatchment 2OFF-EX (Adjacent property and small paved area)

TSS Removal Calculation Worksheet

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

Total TSS Removal = **80%**

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

Project: **20 Ledin Avenue, Avon, MA**

Prepared By: **DWP**

Date: **8/3/2021**

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

*** Stormtech Isolator Row conservatively assumed to provide a minimum of 25% TSS removal*

Water Quality Volume and Recharge Calculations

Water Quality Volume Flow Rate Calculations

Project Name:	Ledin Avenue Building Expansion	Date:	8/3/2021
Project Location:	20 Ledin Avenue, Avon, MA	Calculated By:	DWP
Project Number:	311-399	Checked By:	KPS

Structure Name: WQU A2 Description: Barracuda

Subcatchment: 1B-PR, 1OFF-EX & 2OFF-EX

Total Drainage Area:	79,148	sq ft
	1.82	ac
Total Impervious Area*:	37,023	sq ft
	0.85	ac
Runoff Depth to be Treated:	1.0	inches

* Clean Roof Areas Excluded from Impervious Area

Required Water Quality Volume:	**0.071**	**ac ft**
	3086	**cf**

FLOW RATE CONVERSION

$$Q = (qu)(A)(WQV)$$

Where:

Q = flow rate associated with the **1**-inch of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre =	0.0015625	mi^2
5 minute =	0.083	hours
qu (**1/2**-inch) =	**773**	csm/in

Calculation:

qu=	**773**	
A=	0.85	ac
WQV=	1.0	in

Required Water Quality Flow Rate:	**1.03**	**cfs**

Barracuda S4 will provide 80% TSS Removal Efficiency for flows up to 1.52 cfs

(Based on Manufacturer's sizing. See attached calculation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Water Quality Volume Flow Rate Calculations

Project Name:	Ledin Avenue Building Expansion	Date:	8/3/2021
Project Location:	20 Ledin Avenue, Avon, MA	Calculated By:	DWP
Project Number:	311-399	Checked By:	KPS

Structure Name:	WQU-5	Description:	Barracuda S3	
Subcatchment:	1D-PR	Total Drainage Area:	21,766	sq ft
			0.50	ac
		Total Impervious Area:	20,587	sq ft
			0.47	ac
		Runoff Depth to be Treated:	1.0	inches

Required Water Quality Volume:	**0.039**	**ac ft**
	1716	**cf**

FLOW RATE CONVERSION

Q = (qu)(A)(WQV)

Where:

Q = flow rate associated with the **1/2**-inch of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre = 0.0015625 mi^2
5 minute = 0.083 hours
qu (**1/2**-inch) = **773** csm/in

Calculation:

qu= **773**
A= 0.47 ac
WQV= 1.0 in

Required Water Quality Flow Rate:	**0.57**	**cfs**

Barracuda S3 will provide 80% TSS Removal Efficiency for flows up to 0.86 cfs

Subsurface Infiltration Chambers provide 2,668 cf of storage below low flow outlet exceeding WQV Requirement

(Based on Manufacturer's sizing. See attached calculation.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

Groundwater Recharge Calculations

Project Name: Ledin Avenue Building Expansion
Project Location: 20 Ledin Avenue, Avon, MA
Project Number: 311-399

Date: 8/3/2021
Calculated By: DWP
Checked By: KPS

Existing Conditions Impervious Area

Hydraulic Soil Group	Area (sq ft)	Area (acres)	Recharge Depth (in)	Volume (cu ft)
A	0	0.00	0.60	0.0
B	54,102	1.24	0.35	1578.0
C	0	0.00	0.25	0.0
D	0	0.00	0.10	0.0
TOTAL	**54,102**	**1.24**		**1,578**

Proposed Conditions Impervious Area

Hydraulic Soil Group	Area (sq ft)	Area (acres)	Recharge Depth (in)	Volume (cu ft)
A	0	0.00	0.60	0.0
B	86,580	1.99	0.35	2525.3
C		0.00	0.25	0.0
D	0	0.00	0.10	0.0
TOTAL	**86,580**	**1.99**		**2,525**

Net Required Recharge Volume: 947 cu ft

Provided Recharge Volume

Subcatchment 1D 2,668 cf — *MC3500 Stormtech Chambers* (see attached HydroCAD analysis)

Total Provided Recharge Volume: 2,668 cu ft > the total required for the Site of 2,525

Provided Recharge Volume

Bottom of Basin: 236.25 ft
Low Flow Outlet Elevation: 236.75 ft
*** Infiltration Provided: 2668 cu ft

*** (See attached HydroCAD output)

Total Provided Recharge Volume: 2,668 cu ft

72-hour Drawdown Calculation

Provided Recharge Volume: 2,668 cu ft
Saturated Hydraulic Conductivity: 1.02 in / hr

(Rawls Rate for HSG B was used)

Stage-Area-Storage for Pond 5P: MC-3500 (continued)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
236.54	3,694	2,017
236.55	3,694	2,048
236.56	3,694	2,079
236.57	3,694	2,110
236.58	3,694	2,141
236.59	3,694	2,172
236.60	3,694	2,203
236.61	3,694	2,235
236.62	3,694	2,266
236.63	3,694	2,297
236.64	3,694	2,328
236.65	3,694	2,359
236.66	3,694	2,390
236.67	3,694	2,421
236.68	3,694	2,452
236.69	3,694	2,483
236.70	3,694	2,514
236.71	3,694	2,545
236.72	3,694	2,575
236.73	3,694	2,606
236.74	3,694	2,637
236.75	3,694	2,668
236.76	3,694	2,699
236.77	3,694	2,730
236.78	3,694	2,761
236.79	3,694	2,792
236.80	3,694	2,822
236.81	3,694	2,853
236.82	3,694	2,884
236.83	3,694	2,915
236.84	3,694	2,946
236.85	3,694	2,976
236.86	3,694	3,007
236.87	3,694	3,038
236.88	3,694	3,069
236.89	3,694	3,099
236.90	3,694	3,130
236.91	3,694	3,161
236.92	3,694	3,191
236.93	3,694	3,222
236.94	3,694	3,253
236.95	3,694	3,283
236.96	3,694	3,314
236.97	3,694	3,344
236.98	3,694	3,375
236.99	3,694	3,405
237.00	3,694	3,436
237.01	3,694	3,467
237.02	3,694	3,497
237.03	3,694	3,528
237.04	3,694	3,558
237.05	3,694	3,588
237.06	3,694	3,619
237.07	3,694	3,649
237.08	3,694	3,680
237.09	3,694	3,710
237.10	3,694	3,740
237.11	3,694	3,771
237.12	3,694	3,801
237.13	3,694	3,831
237.14	3,694	3,862
237.15	3,694	3,892
237.16	3,694	3,922
237.17	3,694	3,953
237.18	3,694	3,983
237.19	3,694	4,013
237.20	3,694	4,043
237.21	3,694	4,073
237.22	3,694	4,104
237.23	3,694	4,134
237.24	3,694	4,164
237.25	3,694	4,194
237.26	3,694	4,224
237.27	3,694	4,254
237.28	3,694	4,284
237.29	3,694	4,314
237.30	3,694	4,344
237.31	3,694	4,374
237.32	3,694	4,404
237.33	3,694	4,434
237.34	3,694	4,464
237.35	3,694	4,494
237.36	3,694	4,524
237.37	3,694	4,554
237.38	3,694	4,584
237.39	3,694	4,613
237.40	3,694	4,643
237.41	3,694	4,673
237.42	3,694	4,703
237.43	3,694	4,733
237.44	3,694	4,762
237.45	3,694	4,792
237.46	3,694	4,822
237.47	3,694	4,852
237.48	3,694	4,881
237.49	3,694	4,911
237.50	3,694	4,941
237.51	3,694	4,970
237.52	3,694	5,000
237.53	3,694	5,029
237.54	3,694	5,059
237.55	3,694	5,088
237.56	3,694	5,118
237.57	3,694	5,147

2,668 CF storage provided below low flow outlet

Manufacturer's O&M Procedures

BOGGS ENVIRONMENTAL CONSULTANTS

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BaySaver Technologies, LLC
1030 Deer Hollow Drive
Mount Airy, MD 21771
(301) 679-0640; dfigola@ads-pipe.com

January 28, 2021

ATTENTION: Daniel Figola, Director, Product Design
REFERENCE: Third Party Review of Testing Procedures for Barracuda™ MAX Separator at the BaySaver Laboratory, 1207 Park Ridge Drive, Mount Airy, MD 21771

SUMMARY

Boggs Environmental Consultants, Inc. (BEC) was hired by Advanced Drainage Systems (ADS) in November of 2020, to serve as independent third-party oversight of the BaySaver Barracuda™ MAX Separator (S4 Model) test unit for removal of sediment with equivalent particle size distribution to the industry standard OK-110. The BaySaver Barracuda is a storm water treatment device with a Maximum Treatment Flow Rate (MTFR) of approximately 1.52 cubic feet per second (cfs) that removes suspended solids from storm water runoff, with an average removal efficiency of 80% at the MTFR and a feed concentration of 280 mg/L. The device is an insert that can be installed in either Polypropylene plastic pipe or concrete vault, and consists of a cone (vortex separator) and baffles ("teeth").

SCALED RESULTS

Testing flow rates ranged from 0.33 to 1.58 cfs, with a feed OK-110 concentration of 280 mg/L. Based upon New Jersey scaling methodology, the table below represents treatment and device information for the S3, S4, S5, S6, S8 units.

Table 1: MTFR's and Sizing for BaySaver Barracuda Models

Model[1]	Man-hole Diam-eter[1] (ft)	OK110 80% TSS Maximum Treatment Flow Rate (cfs)	Treat-ment Area (ft^2)	Hydraulic Loading rate (gpm/ft^2)	Chamber Depth (ft)	Wet Volume (ft^3)	50% Maximum Sediment Storage[2] (ft^3)
Barracuda MAX S3	3	0.86	7.07	54.2	5.00	29.5	5.89
Barracuda MAX S4	4	1.52	12.57	54.2	7.08	78.6	10.47
Barracuda MAX S5	5	2.38	19.63	54.2	7.08	122.7	16.36
Barracuda MAX S6	6	3.42	28.27	54.2	7.08	176.7	23.56
Barracuda MAX S8	8	6.08	50.27	54.2	11.44	533.4	41.89

Notes:
1. In some areas, Barracuda MAX units are available in additional diameters. Units not listed here are sized not to exceed 54.2 gpm/ft^2 of effective treatment during the peak water quality flow.
2. 50% Sediment Storage Capacity is equal to manhole diameter x 10 inches of sediment depth. Each Barracuda unit has a 20-inche deep sediment sump.

Should you have any questions, contact our office at your earliest convenience.

Sincerely,
BOGGS ENVIRONMENTAL CONSULTANTS, INC
William R. Warfel
Principal Environmental Scientist

KIM GUADAGNO

CHRIS CHRISTIE
Governor

Lt. Governor

State of New Jersey

DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Nonpoint Pollution Control
Division of Water Quality
401-02B
Post Office Box 420
Trenton, New Jersey 08625-0420
609-633-7021 Fax: 609-777-0432
http://www.state.nj.us/dep/dwq/bnpc_home.htm

BOB MARTIN
Commissioner

September 18, 2017

Daniel J. Figola, P.E.
General Manager
BaySaver Technologies, LLC
1030 Deer Hollow Drive
Mt. Airy, MD 21771

Re: MTD Lab Certification
BaySaver Barracuda™ Hydrodynamic Separator by BaySaver Technologies, LLC
Online Installation

TSS Removal Rate 50%

Dear Mr. Figola:

The Stormwater Management rules under N.J.A.C. 7:8-5.5(b) and 5.7 (c) allow the use of manufactured treatment devices (MTDs) for compliance with the design and performance standards at N.J.A.C. 7:8-5 if the pollutant removal rates have been verified by the New Jersey Corporation for Advanced Technology (NJCAT) and have been certified by the New Jersey Department of Environmental Protection (NJDEP). BaySaver Technologies, LLC has requested an MTD Laboratory Certification for the BaySaver Barracuda™ Hydrodynamic Separator (BaySaver Barracuda).

The project falls under the "Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advance Technology" dated January 25, 2013. The applicable protocol is the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" dated January 25, 2013.

NJCAT verification documents submitted to the NJDEP indicate that the requirements of the aforementioned protocol have been met or exceeded. The NJCAT letter also included a recommended certification TSS removal rate and the required maintenance plan. The NJCAT Verification Report with the Verification Appendix (dated September 2017) for this device is published online at http://www.njcat.org/verification-process/technology-verification-database.html.

The NJDEP certifies the use of the BaySaver Barracuda by BaySaver Technologies, LLC at a TSS removal rate of 50% when designed, operated, and maintained in accordance with the information provided in the Verification Appendix and the following conditions:

1. The maximum treatment flow rate (MTFR) for the manufactured treatment device (MTD) is calculated using the New Jersey Water Quality Design Storm (1.25 inches in 2 hrs) in N.J.A.C. 7:8-5.5.

2. The BaySaver Barracuda shall be installed using the same configuration reviewed by NJCAT and shall be sized in accordance with the criteria specified in item 6 below.

3. This BaySaver Barracuda cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

4. Additional design criteria for MTDs can be found in Chapter 9.6 of the New Jersey Stormwater Best Management Practices (NJ Stormwater BMP) Manual, which can be found online at www.njstormwater.org.

5. The maintenance plan for a site using this device shall incorporate, at a minimum, the maintenance requirements for the BaySaver Barracuda. A copy of the maintenance plan is attached to this certification. However, it is recommended to review the maintenance website at http://www.ads-pipe.com/pdf/en/Barracuda_Maintenance_07_17.pdf for any changes to the maintenance requirements.

6. Sizing Requirement:

   The example below demonstrates the sizing procedure for the BaySaver Barracuda:

   Example: A 0.25-acre impervious site is to be treated to 50% TSS removal using a BaySaver Barracuda. The impervious site runoff (Q) based on the New Jersey Water Quality Design Storm was determined to be 0.79 cfs.

   Maximum Treatment Flow Rate (MTFR) Evaluation:

   The site runoff (Q) was based on the following:
   time of concentration = 10 minutes
   i = 3.2 in/hr (page 5-8, Fig. 5-3 of the NJ Stormwater BMP Manual)
   c = 0.99 (curve number for impervious)
   Q = ciA = 0.99 x 3.2 x 0.25 = 0.79 cfs

   Given the site runoff is 0.79 cfs and based on Table 1 below, the Barracuda Model S4 with a MTFR of 1.25 cfs could be used for this site to remove 50% of the TSS from the impervious area without exceeding the MTFR.

   The sizing table corresponding to the available system models is noted below. Additional specifications regarding each model can be found in the Verification Appendix under Table A-1.

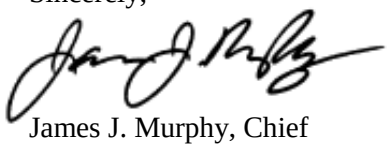
Table 1 BaySaver Barracuda Sizing Information

Barracuda Model	NJDEP 50% TSS Maximum Treatment Flow Rate (cfs)	Treatment Area (ft^2)	Hydraulic Loading Rate (gpm/ft^2)	50% Maximum Sediment Storage (ft^3)
S3	0.70	7.07	44.6	5.89
S4	1.25	12.57	44.6	10.47
S5	1.95	19.63	44.6	16.36
S6	2.80	28.27	44.6	23.56
S8	5.00	50.27	44.6	41.89
S10	7.80	78.54	44.6	65.45

A detailed maintenance plan is mandatory for any project with a Stormwater BMP subject to the Stormwater Management Rules, N.J.A.C. 7:8. The plan must include all of the items identified in the Stormwater Management Rules, N.J.A.C. 7:8-5.8. Such items include, but are not limited to, the list of inspection and maintenance equipment and tools, specific corrective and preventative maintenance tasks, indication of problems in the system, and training of maintenance personnel. Additional information can be found in Chapter 8: Maintenance and Retrofit of Stormwater Management Measures.

If you have any questions regarding the above information, please contact Mr. Shashi Nayak of my office at (609) 633-7021.

Sincerely,



James J. Murphy, Chief
Bureau of Nonpoint Pollution Control

Attachment: Maintenance Plan

cc: Chron File
Richard Magee, NJCAT
Vince Mazzei, NJDEP - DLUR
Ravi Patraju, NJDEP - BES
Gabriel Mahon, NJDEP - BNPC
Shashi Nayak, NJDEP - BNPC

Maintenance Guide

BaySaver Barracuda

July 2017

One of the advantages of the BaySaver Barracuda is the ease of maintenance. Like any system that collects pollutants, the BaySaver Barracuda must be maintained for continued effectiveness. Maintenance is a simple procedure performed using a vacuum truck or similar equipment. The systems were designed to minimize the volume of water removed during routine maintenance, reducing disposal costs.

Contractors can access the pollutants stored in the manhole through the manhole cover. This allows them to gain vacuum hose access to the bottom of the manhole to remove sediment and trash. There is no confined space entry necessary for inspection or maintenance.

The entire maintenance procedure typically takes from 2 to 4 hours, depending on the size of the system, the captured material, and the capacity of the vacuum truck.

Local regulations may apply to the maintenance procedure. Safe and legal disposal of pollutants is the responsibility of the maintenance contractor. Maintenance should be performed only by a qualified contractor.

Inspection and Cleaning Cycle

Periodic inspection is needed to determine the need for and frequency of maintenance. You should begin inspecting as soon as construction is complete and thereafter on an annual basis. Typically, the system needs to be cleaned every 1-3 years.

Excessive oils, fuels or sediments may reduce the maintenance cycle. Periodic inspection is important.

Determining When to Clean

To determine the sediment depth, the maintenance contractor should lower a stadia rod into the manhole until it contacts the top of the captured sediment and mark that spot on the rod. Then push the probe through to the bottom of the sump and mark that spot to determine sediment depth.

Maintenance should occur when the sediment has reached the levels indicated in the Storage Capacity Chart.

BaySaver Barracuda Storage Capacities

Model	Manhole Diameter	Treatment Chamber Capacity	Standard Sediment Capacity (20" depth)	NJDEP Sediment Capacity (50% of standard depth)
S3	36"	212 gallons	0.44 cubic yards	0.22 cubic yards
S4	48"	564 gallons	0.78 cubic yards	0.39 cubic yards
S5	60"	881 gallons	1.21 cubic yards	0.61 cubic yards
S6	72"	1269 gallons	1.75 cubic yards	0.88 cubic yards
S8	96"	3835 gallons	3.10 cubic yards	1.55 cubic yards
S10	120"	7496 gallons	4.85 cubic yards	2.43 cubic yards

Maintenance Instructions

1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the bowl assembly visible from the surface. You'll access this area through the 10" diameter access cylinder.

2. Use a vacuum truck or other similar equipment to remove all water, debris, oils and sediment. See figure 1.
3. Use a high pressure hose to clean the manhole of all the remaining sediment and debris. Then, use the vacuum truck to remove the water.
4. Fill the cleaned manhole with water until the level reaches the invert of the outlet pipe.
5. Replace the manhole cover.
6. Dispose of the polluted water, oils, sediment and trash at an approved facility.
   - Local regulations prohibit the discharge of solid material into the sanitary system. Check with the local sewer authority for authority to discharge the liquid.
   - Some localities treat the pollutants as leachate. Check with local regulators about disposal requirements.
   - Additional local regulations may apply to the maintenance procedure.

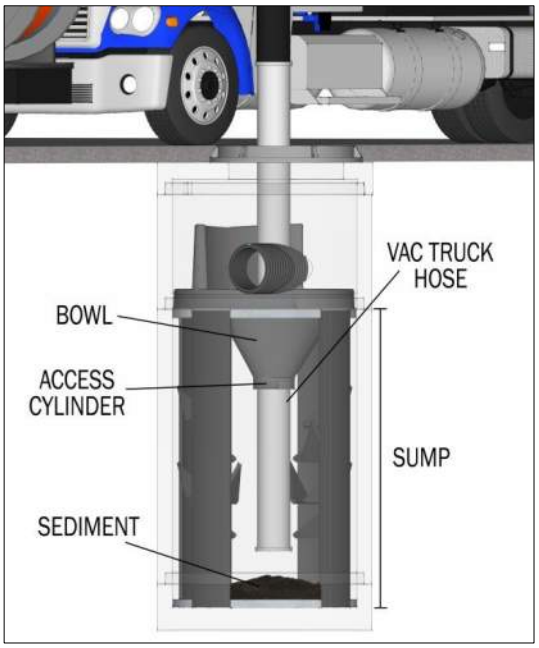


Figure 1

UNIVERSITY OF MASSACHUSETTS
AT AMHERST
Water Resources Research Center
Blaisdell House, UMass
310 Hicks Way
Amherst, MA 01003

MASTEP Technology Review

Massachusetts Stormwater Evaluation Project
(413) 545-5532
(413) 545-2304 FAX
www.mastep.net

Technology Name: Isolator Row

Studies Reviewed: Christensen, Andrew and Vince Neary. Hydraulic Performance and Sediment Trap Efficiency for the StormTech SC-740 Isolator Row. Tennessee Technological University, February 2005.

Neary, Vincent, PhD. Performance Evaluation of Sediment Removal Efficiency Stormtech Isolator Row. Tennessee Tech University. October 20, 2006.

New Jersey Corporation for Advanced Technology. NJCAT Verification of the StormTech Isolator Row. August 2007.

University of New Hampshire Stormwater Center. Final Report on Field Verification Testing of the Stormtech Isolator Row Treatment Unit. Submitted to StormTech LLC June 2008.

University of New Hampshire Stormwater Center. Performance Evaluation Report on of the Stormtech Isolator Row Treatment Unit. September 2010

Date: January 14, 2012

Reviewers: Sarah Titus, updated by Jerry Schoen

Rating: 2

Brief rationale for rating:
The Isolator Row was tested in the field by the UNH Stormwater Center and in the lab by Tennessee Tech University. Field testing monitored 23 events over two years, sampling 13.2" rainfall or about 27% of the annual average. This study was done under a QAPP that was designed to substantially meet TARP and TAPE requirements.

Lab testing examined sediment removal for three different influent mixes; the SIL-CO-SIL 106, SIL-CO-SIL 250 and the OK-110 silica. Across all influent mixes, 21 test runs were done and 14 flow rates were tested at average influent concentrations from 164-424mg/l. NJCAT was able to use the runs to extrapolate the data to calculate weighted removal efficiencies for 25, 50, 75, 100 and 125% of treatment operating rate. Claims for each influent mix were verified by NJCAT. While all of these studies met many requirements necessary for TARP there was no scour testing, statistical analysis or QC data presented for any study. The laboratory studies did not use a certified lab and the one micron filter sock at the outlet was only partially effective at trapping the finer particles from the flow stream. This led to increasing influent and effluent SSC values as the detention time went up during the course of each test run. Removal rates for earlier samples were higher than later samples in the same run.

Requirements not met:
- No discussion of QC test results.
- Sampled <50% of average annual rainfall and less than minimum 13" required total in the field
- No discussion of scour testing

Other comments:
Field study:
- d50 influent particle size 44 microns.
- Effective TSS, SSC, Zinc, total phosphorus, total petroleum hydrocarbon reported throughout study period.
- Zinc and TP removal efficiency improved over the course of the study, presumably due to build of an organic filter cake on system's fabric. However, this buildup may also lead to increased incidence of bypass in larger storms. This may be a consideration for maintenance planning.
- Negative removal rates for dissolved inorganic nitrogen, suggesting this system is not effective at treating dissolved nitrogen.

Lab study:
- Particle size distributions: OK 110 d50=110, SIL CO SIL 106 d50=22, SIL CO SIL 250= 45 microns. In the field the d50 was measured as 0.038mm.
- Flow rates tested in the lab at treatment flow rates from 0.1-1.2cfs. SIL CO SIL 106 was tested at 3.2gpm/ft2 and SIL CO SIL 250 was tested at 3.2 (0.4cfs) and 1.7gpm/ft2 (0.21cfs). The OK 110 was tested at hydraulic loading rates of 4.8 and 8.1 gpm/ft2.

- Average influent SSC for the SIL CO SIL 106 test runs 270mg/L. The average influent SSC was 211 and 424mg/L for the SIL CO SIL 250 influent at 3.2 and 1.7gpm respectively. The OK 110 tests calculated influent SSC ranged from 140-230mg/L with an average of 183.18. Field testing measured influent TSS at a mean 58mg/l.

StormTech®
Detention • Retention • Water Quality
An ADS company

Isolator® Row O&M Manual


SC-740


MC-3500


MC-4500

THE MOST **ADVANCED** NAME IN WATER MANAGEMENT SOLUTIONS™

ADS®

THE ISOLATOR® ROW

INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.

THE ISOLATOR ROW

The Isolator Row is a row of StormTech chambers, either SC-160LP, SC-310, SC-310-3, SC-740, DC-780, MC-3500 or MC-4500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls (SC-310, SC- 310-3 and SC-740 models) allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber. The non-woven fabric is not required over the SC-160LP, DC-780, MC-3500 or MC-4500 models as these chambers do not have perforated side walls.

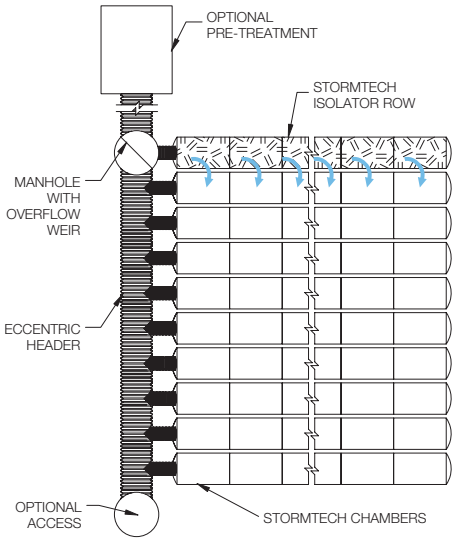
The Isolator Row is typically designed to capture the “first flush” and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

StormTech Isolator Row with Overflow Spillway (not to scale)



ISOLATOR ROW INSPECTION/MAINTENANCE

INSPECTION

The frequency of inspection and maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial, residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

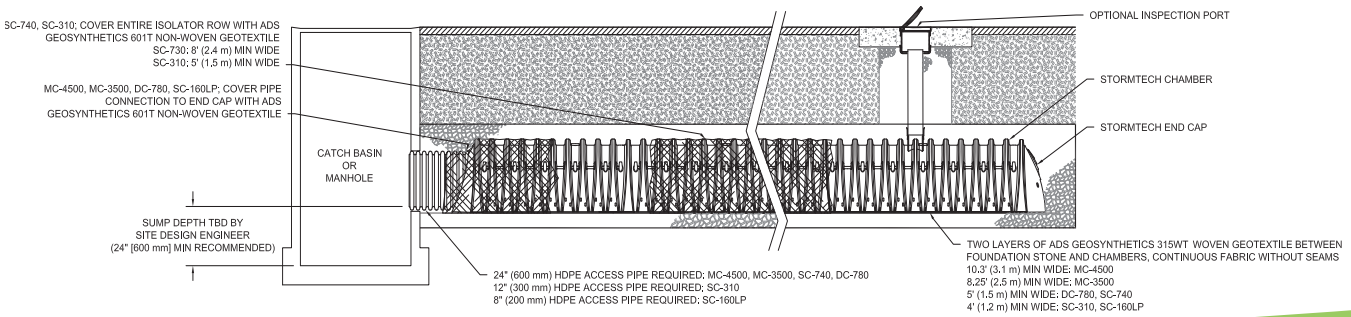
MAINTENANCE

The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)

Note: Non-woven fabric is only required over the inlet pipe connection into the end cap for SC-160LP, DC-780, MC-3500 and MC-4500 chamber models and is not required over the entire Isolator Row.



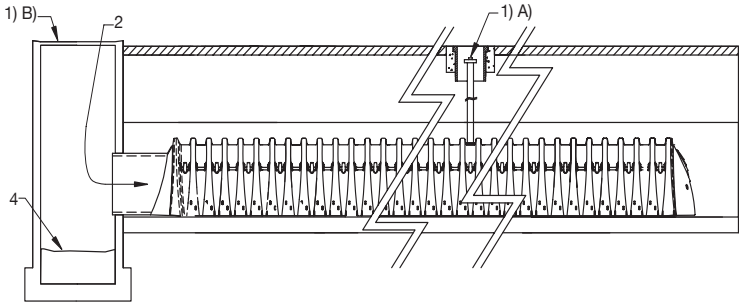
ISOLATOR ROW STEP BY STEP MAINTENANCE PROCEDURES

STEP 1
Inspect Isolator Row for sediment.
- A) Inspection ports (if present)
  - i. Remove lid from floor box frame
  - ii. Remove cap from inspection riser
  - iii. Using a flashlight and stadia rod,measure depth of sediment and record results on maintenance log.
  - iv. If sediment is at or above 3 inch depth, proceed to Step 2. If not, proceed to Step 3.
- B) All Isolator Rows
  - i. Remove cover from manhole at upstream end of Isolator Row
  - ii. Using a flashlight, inspect down Isolator Row through outlet pipe
    1. Mirrors on poles or cameras may be used to avoid a confined space entry
    2. Follow OSHA regulations for confined space entry if entering manhole
  - iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches), proceed to Step 2. If not, proceed to Step 3.

STEP 2
Clean out Isolator Row using the JetVac process.
- A) A fixed floor cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
- B) Apply multiple passes of JetVac until backflush water is clean
- C) Vacuum manhole sump as required

STEP 3
Replace all caps, lids and covers, record observations and actions.

STEP 4
Inspect & clean catch basins and manholes upstream of the StormTech system.



SAMPLE MAINTENANCE LOG

Date	Stadia Rod Readings		Sediment Depth (1)–(2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/11	6.3 ft	none		New installation. Fixed point is CI frame at grade	DJM
9/24/11		6.2	0.1 ft	Some grit felt	SM
6/20/13		5.8	0.5 ft	Mucky feel, debris visible in manhole and in Isolator Row, maintenance due	NV
7/7/13	6.3 ft		0	System jetted and vacuumed	DJM

StormTech® Detention • Retention • Water Quality
A division of ADS

Advanced Drainage Systems, Inc.
4640 Trueman Blvd., Hilliard, OH 43026
1-800-821-6710 www.ads-pipe.com

Illicit Discharge Compliance Statement

ILLICIT DISCHARGE COMPLIANCE STATEMENT

I VERIFY THAT NO ILLICIT DISCHARGES EXIST FROM THE 20 LEDIN AVENUE REDEVELOPMENT. THROUGH THE IMPLEMENTATION OF THE *CONSTRUCTION PERIOD POLLUTION PREVENTION AND SEDIMENTATION AND EROSION CONTROL PLAN* AS WELL AS THE *OPERATION AND MAINTENANCE PLAN*, MEASURES ARE SET FORTH TO PREVENT ILLICIT DISCHARGES FROM ENTERING THE STORMWATER MANAGEMENT DRAINAGE SYSTEM.

SIGNATURE	**PRINT NAME**	**DATE**

TITLE	**COMPANY**

SIGNATURE	**PRINT NAME**	**DATE**

TITLE	**COMPANY**

NOTE: THIS CERTIFICATION MUST BE SIGNED BEFORE STORMWATER IS CONVEYED TO THE PROPOSED STORMWATER DRAINAGE SYSTEM IN ACCORDANCE WITH STANDARD 10 OF THE MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS.

Mounding Analysis

311-399 → 20 Ledin Ave, Avon

Mounding Analysis

$$R = \frac{\text{Volume}}{\text{Foot print}}$$

Recharge Volume = 2,525 CF
Provided Volume = 2,668 CF

2,668 CF Recharge Rate over 72 hours (3 days) = 889.3 CF/day

$$R = \frac{889.3\ CF/day}{(58.58\ ft)(63.06\ ft)} = 0.2407\ ft/day$$

Chamber System
L = 63.06 ft
W = 58.58 ft

$S_y = 0.20$ (Sandy Loam)

$K = 2.04\ ft/day$ (infiltration rate = 1.02 in/hr)

$x = 29.29\ ft$ (½ width of basin)

$y = 31.53\ ft$ (½ length of basin)

$t = 3$ days (72 hour drawdown period)

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
0.2407	***R***	**Recharge (infiltration) rate (feet/day)**
0.200	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
2.04	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
29.290	**x**	**1/2 length of basin (x direction, in feet)**
31.530	**y**	**1/2 width of basin (y direction, in feet)**
3.000	**t**	**duration of infiltration period (days)**
30.000	**hi(0)**	**initial thickness of saturated zone (feet)**

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

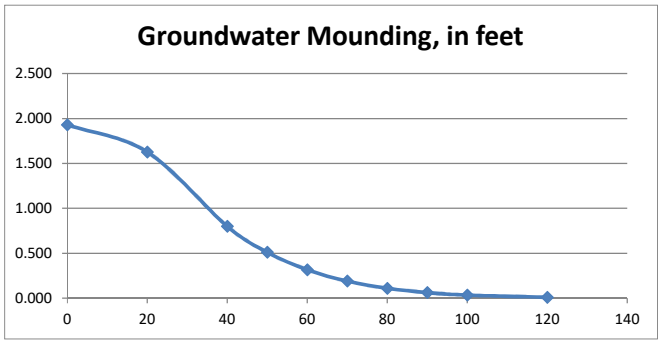
hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

31.930	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
1.930	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
1.930	**0**
1.626	**20**
0.799	**40**
0.510	**50**
0.316	**60**
0.190	**70**
0.111	**80**
0.063	**90**
0.034	**100**
0.010	**120**

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.