STORMWATER REPORT

THORNDIKE PLACE
DOROTHY ROAD
ARLINGTON, MA

NOVEMBER 2020

Owner/Applicant:

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SECTION 1.0

PROJECT INFORMATION

1.01 PROJECT DESCRIPTION

Arlington Realty, LLC (The Applicant) is seeking to construct a new multi-family housing development in Arlington, Massachusetts, hereinafter referred to as "the Project." The total property area is approximately 17.66 acres and is located off of Dorothy Road near the intersection with Littlejohn Street. The project is bounded on the north by Dorothy Road, on the east by residential properties and Thorndike Field, and bounded on the south and west by Concord Turnpike (Route 2).

The Project consists of clearing and grubbing of the northwest section of the property and construction of one 3-4 story multi-family apartment building with a lower level parking garage, as well as surface parking, walkways, courtyards, a playground, utility services, and a stormwater management system. The building has a footprint of approximately 51,555 square feet.

The Project is designed to comply with the Massachusetts General Laws (M.G.L.) Chapter 40B, which allows developers to override certain aspects of municipal zoning bylaws by providing a certain percentage of affordable housing, as well as the Department of Environmental Protection's Stormwater Management Standards. There are wetland resource areas in the south, west and east portions of the property. The Project is concentrated in the northwest area of the property and minimizes impacts to the 100-foot wetland buffer zones, which are regulated by the Arlington Wetlands Bylaw as Adjacent Upland Resource Areas (AURA's). Part of the site is located within the 1% Chance Annual Flood as defined by FEMA which is regulated under the Wetlands Protection Act and the Arlington Wetlands Bylaw as Bordering Land Subject to Flooding (BLSF). Compensatory flood storage is proved at a 2:1 ratio as described in section 2.12 below.

1.02 PRE-DEVELOPMENT CONDITIONS

The existing site topography generally slopes southeast across the property towards the wetlands located on the property with slopes ranging from 0-15%. The current site is comprised of forest and the primary soil classification identified by the NRCS Web Soil Survey is udorthents (655), which accounts for the majority of the property and all of the project area. As such, the soils have been modeled as Hydrologic Soil Group C.

The existing site being largely undeveloped has no existing drainage facilities and the majority of the stormwater runoff is directed to the wetlands on the property. A small portion of the site discharges to the north to Dorothy Road.

1.03 POST-DEVELOPMENT CONDITIONS

The proposed stormwater management system has been designed in a manner that will exceed the provisions of the Department of Environmental Protection (DEP) Stormwater Management Standards for a new construction project. The design is also in general conformance the with Town of Arlington Zoning Bylaws.

Stormwater runoff from the building will be detained on the roof of the building, with larger, less frequent storms overflowing through roof drains to an underground infiltration system in the adjacent surface parking lot. Stormwater runoff from the small parking/drop-off area at the main entrance to the building will be collected via a trench drain, and runoff from the other surface parking area will be collected in a deep sump catch basin, both of which are conveyed through a water quality unit before being directed to the underground infiltration system. This underground infiltration system will overflow via a flared end section to the northwest. Based upon previous soil investigations on site by others, the estimated seasonal high groundwater elevation is approximately 3.0. As such the infiltration system has been set with a bottom elevation of 5.0 to provide the minimum 2-feet of clearance above groundwater.

Stormwater runoff from the driveway into the garage below the building will be collected via a trench drain and conveyed through a water quality unit before being directed to a second underground infiltration system located directly south of this area. No credit has been taken for recharge from this infiltration system as, due to grades of the driveway, insufficient clearance from estimated seasonal high groundwater exists. This infiltration system will overflow via a flared end section to the area directly south of the proposed building.

To provide emergency access to the sides and rear of the building, a reinforced grass access lane will be installed. A portion of this access lane will include a 6-foot wide, porous asphalt walkway to allow residents to have ADA/AAB accessible access the rear of the site including the play area. Both the reinforced grass and porous asphalt will allow stormwater runoff to freely infiltrate back to the ground and will result in negligible runoff.

Specifics of the project's compliance with the Stormwater Standards are discussed in detail in the following sections.

SECTION 2.0

DRAINAGE SUMMARY

2.01 Stormwater Standard 1 – New Stormwater Conveyances

Per Massachusetts Stormwater Management Standard #1, no new outfalls may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. No new untreated stormwater discharges are proposed. Rip-rap outlet protection sizing calculations are included in Section 6.0 of this Report.

2.02 Stormwater Standard 2 – Stormwater Runoff Rates

Watershed modeling was performed using HydroCAD Stormwater Modeling Software version 10.00, a computer aided design program that combines SCS runoff methodology with standard hydraulic calculations. A model of the site's hydrology was developed for both pre and post-development conditions to assess the effects of the proposed development on the project site and surrounding areas.

The stormwater management system for the project has been designed such that the post-development conditions result in no increase to peak runoff rates to the adjacent wetlands or the adjacent public street for the 2, 10, 25, 50, and 100-year, 24-hour storm events, as detailed in the table below.

Peak Flow Discharge Rates

Node 1S/1L – Flow to Wetlands

Storm Event	Pre-Development Peak Discharge Rate (cfs)	Post-Development Peak Discharge Rate (cfs)	Change in Peak Discharge Rate (cfs)
2-Year	2.1	1.6	-0.5
10-Year	5.4	4.2	-1.2
25-Year	8.3	6.2	-2.1
50-Year	11.3	8.2	-3.1
100-Year	14.9	12.6	-2.3

Node 2S/2L – Flow to Street

Storm Event	Pre-Development Peak Discharge Rate (cfs)	Post-Development Peak Discharge Rate (cfs)	Change in Peak Discharge Rate (cfs)
2-Year	0.2	0.2	0.0
10-Year	0.4	0.4	0.0
25-Year	0.6	0.6	0.0
50-Year	0.8	0.8	0.0
100-Year	1.1	1.0	-0.1

2.03 Stormwater Standard 3 – Groundwater Recharge

Groundwater recharge is provided on site via an underground structural infiltration system beneath the surface parking area to the west of the building. Overall, the project will result in no loss of annual recharge to groundwater as required by Standard 3. Refer to Section 6.0 of this Report for groundwater recharge information.

2.04 Stormwater Standard 4 – TSS Removal

As a new development, the Project stormwater management system will achieve a TSS removal greater than 80%. The proposed stormwater management system has been designed to provide treatment of runoff in order to reduce suspended solids prior to discharge off-site through the implementation of the following best management practices:

- Deep Sump Hooded Catch Basins
- Proprietary Hydrodynamic Separator
- Underground Stormwater Infiltration System

The water quality volume is defined as the runoff volume requiring TSS Removal for the site, and is equal to 0.5-inches of runoff over the total impervious area of the post-development site. The required water quality volume for the project is provided in Section 6.0 of this Report

The underground infiltration system has been sized to treat the required water quality volume and calculations are included in Section 6.0 of this Report.

A long-term pollution prevention plan complying with the requirements of Standard 4 is included in Section 4.0 of this Report.

2.05 Stormwater Standard 5 – Land Uses with Higher Potential Pollutant Loads

This standard is not applicable as the project site is not a land use with higher potential pollutant loads (LUHPPL).

2.06 Stormwater Standard 6 – Stormwater Discharges to a Critical Area

This standard is not applicable as runoff from the project site does not discharge to a critical area.

2.07 Stormwater Standard 7 – Redevelopment Projects

This project is a new development and therefore has been designed to fully comply with the Stormwater Management Standards.

2.08 Stormwater Standard 8 – Sedimentation and Erosion Control Plan

Erosion and sedimentation controls are shown on the Project Plans. Additionally, a Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan is included in Section 3.0 of this Report.

2.09 Stormwater Standard 9 – Long Term Operation and Maintenance Plan

A Long-Term Operation and Maintenance Plan is included in Section 4.0 of this Report.

2.10 Stormwater Standard 10 – Illicit Discharges

There are no known illicit discharges on the project site and none are proposed.

2.11 Conclusion

The project has been designed in accordance with DEP Stormwater Management Standards and the Town of Arlington Wetlands Protection Bylaw and Regulations. Through the construction of the aforementioned stormwater systems, the project will provide peak rate attenuation, TSS removal and groundwater recharge.

2.12 Compensatory Flood Storage

A portion of the project site is located within the 1% Chance Annual Flood as defined by FEMA, which is regulated under the Wetlands Protection Act and Arlington Wetlands Bylaw as Bordering Land Subject to Flooding (BLSF). In order to protect the values provided by BLSF and prevent downstream flooding impacts, the project is required to provide compensatory flood storage on a 1-foot incremental basis to match whatever is lost due to the project's development. Further, Arlington requires compensatory flood storage to be provided at a 2 to 1 ratio for any flood storage lost. In order to provide this compensatory flood storage, the project will minimize the area of BLSF impacted and regrade a portion of the project property southeast of the proposed building as shown on the Plans. A breakdown of the flood storage impacts and compensatory storage provided is shown below:

Elevations	Existing Incremental Available Flood Stoage (CU.FT.)	Incremental Available Flood Stoage with No Compensatory Storage (CU.FT.)	Incremental Flood Storage Change w/No Compensatory Storage (CU.FT.)	Proposed Incremental Compensatory Storage (CU.FT.)	Ratio of Compensatory Storage to Storage Lost
5.0 - 6.0	**67.0**	**0.0**	**-67.0**	**144.5**	**2.2**
6.0 - 6.8	**7,454.0**	**4,806.8**	**-2,647.2**	**5,990.0**	**2.3**

As shown above, the project will exceed the 2 to 1 ratio of compensatory flood storage for all flood storage lost due to the project development. In addition, as shown on the Plans, the proposed compensatory storage is hydrologically connected to the flood plain impacted by the project. Therefore, the project as proposed meets the applicable requirements for BLSF in both the Wetlands Protection Act and the Arlington Wetlands Bylaw and Regulations.

SECTION 3.0

CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

3.0 CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL PLAN

This Section specifies requirements and suggestions for implementation of a Stormwater Pollution Prevention Plan (SWPPP) for **Thorndike Place, in Arlington, Massachusetts**. The SWPPP shall be provided and maintained on-site by the Contractor(s) during all construction activities. The SWPPP shall be updated as required to reflect changes to construction activity.

The stormwater pollution prevention measures contained in the SWPPP shall be at least the minimum required by Local Regulations. The Contractor shall provide additional measures to prevent pollution from stormwater discharges in compliance with the National Pollution Discharge Elimination System (NPDES) Phase II permit requirements and all other local, state and federal requirements.

The SWPPP shall include provisions for, but not be limited to, the following:

1. Construction Trailers
2. Lay-down Areas
3. Equipment Storage Areas
4. Stockpile Areas
5. Disturbed Areas

The Contractor shall NOT begin construction without submitting evidence that a NPDES Notice of Intent (NOI) governing the discharge of stormwater from the construction site for the entire construction period has been filed **at least fourteen (14) days prior to construction**. It is the Contractor's responsibility to complete and file the NOI, unless otherwise determined by the project team.

The cost of any fines, construction delays and remedial actions resulting from the Contractor's failure to comply with all provisions of local regulations and Federal NPDES permit requirements shall be paid for by the Contractor at no additional cost to the Owner.

As a requirement of the EPA's NPDES permitting program, each Contractor and Subcontractor responsible for implementing and maintaining stormwater Best Management Practices shall execute a Contractor's Certification form.

Erosion and Sedimentation Control

The Contractor shall be solely responsible for erosion and sedimentation control at the site. The Contractor shall utilize a system of operations and all necessary erosion and sedimentation control measures, even if not specified herein or elsewhere, to minimize erosion damage at the site to prevent the migration of sediment into environmentally sensitive areas. Environmentally sensitive areas include all wetland resource areas within, and downstream of, the site, and those areas of the site that are not being altered.

Erosion and sedimentation control shall be in accordance with this Section, the design drawings, and the following:

- "National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities (EPA Construction General Permit February 16, 2017).
- Massachusetts Stormwater Management Policy Handbook issued by the Massachusetts Department of Environmental Protection, January 2008.
- Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas, A Guide for Planners, Designers and Municipal Officials, March 1997.

The BMP's presented herein should be used as a guide for erosion and sedimentation control and are not intended to be considered specifications for construction. The most important BMP is maintaining a rapid

construction process, resulting in prompt stabilization of surfaces, thereby reducing erosion potential. Given the primacy of rapid construction, these guidelines have been designed to allow construction to progress with essentially no hindrance by the erosion control methods prescribed. These guidelines have also been designed with sufficient flexibility to allow the Contractor to modify the suggested methods as required to suit seasonal, atmospheric, and site-specific physical constraints.

Another important BMP is the prevention of concentrated water flow. Sheet flow does not have the erosive potential of a concentrated rivulet. These guidelines recommend construction methods that allow localized erosion control and a system of construction, which inhibits the development of shallow concentrated flow. These BMP's shall be maintained throughout the construction process.

CONTACT INFORMATION AND RESPONSIBLE PARTIES

The following is a list of all project-associated parties:

Owner
Arlington Land Realty, LLC
84 Sherman Street, 2nd Floor
Cambridge, MA 02140

Contractor
To be determined

Environmental Consultant
BSC Group, Inc.
803 Summer Street
Boston, MA 02127

Contact: John Hession, P.E.
Phone: (617) 896–4300
Email: jhession@bscgroup.com

Qualified SWPPP Inspectors
To Be Determined

3.1 Procedural Conditions of the Construction General Permit (CGP)

The following list outlines the Stormwater Responsibilities for all construction operators working on the Project. The operators below agree through a cooperative agreement to abide by the following conditions throughout the duration of the construction project, effective the date of signature of the required SWPPP. These conditions apply to all operators on the project site.

The project is subject to EPA's NPDES General Permit through the CGP. The goal of this permit is to prevent the discharge of pollutants associated with construction activity from entering the existing and proposed storm drain system or surface waters.

All contractors/operators involved in clearing, grading and excavation construction activities must sign the appropriate certification statement required, which will remain with the SWPPP. The owner must also sign a certification, which is to remain with the SWPPP in accordance with the signatory requirements of the SWPPP.

Once the SWPPP is finalized, a signed copy, plus supporting documents, must be held at the project site during construction. A copy must remain available to EPA, State and Local agencies, and other interested parties during normal business hours.

The following items associated with this SWPPP must be posted in a prominent place at the construction site until final stabilization has been achieved:

- The completed/submitted NOI form
- Location where the public can view the SWPPP during normal business hours
- A copy of the signed/submitted NOI, permit number issued by the EPA and a copy of the current CGP.

Project specific SWPPP documents are not submitted to the US EPA unless the agency specifically requests a copy for review. SWPPP documents requested by a permitting authority, the permitee(s) will submit it in a timely manner.

EPA inspectors will be allowed free and unrestricted access to the project site and all related documentation and records kept under the conditions of the permit.

The permitee is expected to keep all BMP's and Stormwater controls operating correctly and maintained regularly.

Any additions to the project which will significantly change the anticipated discharges of pollutants, must be reported to the EPA. The EPA should also be notified in advance of any anticipated events of noncompliance. The permitee must also orally inform the EPA of any discharge, which may endanger health or the environment within 24 hours, with a written report following within 5 days.

In maintaining the SWPPP, all records and supporting documents will be compiled together in an orderly fashion. Inspection reports and amendments to the SWPPP must remain with the document. Federal regulations require permitee(s) to keep their Project Specific SWPPP and all reports and documents for at least three (3) years after the project is complete.

3.2 Existing Site and Soil Conditions

The total project area is approximately 17.66 acres and is located off of Dorothy Road. The project is bounded on the north by Dorothy Road, bounded on the east by residential properties, and bounded on the south and west by Concord Turnpike (Route 2).

The current site is comprised of forest and the primary soil classification identified by the NRCS Web Soil Survey is udorthents (655), which accounts for the majority of the property and all of the project area. As such, the soils have been modeled as Hydrologic Soil Group C.

3.3 Project Description and Intended Construction Sequence

The site is currently comprised of woods. The proposed activities will include the following major components:

- The construction of one (1) multi-family housing building with associated parking, driveways, and walkways,
- The construction of stormwater management systems, and
- Site grading, and utility installation.

The proposed project will disturb a total of approximately 138,233± S.F. (3.17± acres).

Soil disturbing activities will include site demolition, installing stabilized construction exits, installation of erosion and sedimentation controls, grading, storm drain inlets, stormwater management systems, utilities,

building foundation, construction of site driveways and preparation for final landscaping. Please refer to Table 1 for the projects anticipated construction timetable. A description of BMP's associated with project timetable and construction-phasing elements is provided in this Erosion and Sediment Control Plan.

Table 1 – Anticipated Construction Timetable

Construction Phasing Activity	Anticipated Timetable
Grubbing and Stripping of Limits of Construction Phase	To be determined
Rough Site Grading and Site Utilities	To be determined
Utility Plan Construction	To be determined
Landscaping	To be determined

3.4 Potential Sources of Pollution

Any project site activities that have the potential to add pollutants to runoff are subject to the requirements of the SWPPP. Listed below are a description of potential sources of pollution from both sedimentation to Stormwater runoff, and pollutants from sources other than sedimentation.

Table 2 – Potential Sources of Sediment to Stormwater Runoff

Potential Source	Activities/Comments
Construction Site Entrance and Site Vehicles	Vehicles leaving the site can track soils onto public roadways. Site Vehicles can readily transport exposed soils throughout the site and off-site areas.
Grading Operations	Exposed soils have the potential for erosion and discharge of sediment to off-site areas.
Material Excavation, Relocation, and Stockpiling	Stockpiling of materials during excavation and relocation of soils can contribute to erosion and sedimentation. In addition, fugitive dust from stockpiled material, vehicle transport and site grading can be deposited in wetlands and waterway.
Landscaping Operations	Landscaping operations specifically associated with exposed soils can contribute to erosion and sedimentation. Hydroseeding, if not properly applied, can runoff to adjacent wetlands and waterways.

Table 3 – Potential Pollutants and Sources, other than Sediment to Stormwater Runoff

Potential Source	Activities/Comments
Staging Areas and Construction Vehicles	Vehicle refueling, minor equipment maintenance, sanitary facilities and hazardous waste storage
Materials Storage Area	General building materials, solvents, adhesives, paving materials, paints, aggregates, trash, etc.
Construction Activities	Construction, paving, curb/gutter installation, concrete pouring/mortar/stucco

3.5 Erosion and Sedimentation Control Best Management Practices

All construction activities will implement Best Management Practices (BMP's) in order to minimize overall site disturbance and impacts to the sites natural features. Please refer to the following sections for a detailed description of site specific BMP's. In addition, an Erosion and Sedimentation Control Plan is provided in the Site Plans.

3.6 Timetable and Construction Phasing

This section provides the Owner and Contractor with a suggested order of construction that shall minimize erosion and the transport of sediments. The individual objectives of the construction techniques described herein shall be considered an integral component of the project design intent of each project phase. The construction sequence is not intended to prescribe definitive construction methods and should not be interpreted as a construction specification document. However, the Contractor shall follow the general construction phase principles provided below:

- Protect and maintain existing vegetation wherever possible.
- Minimize the area of disturbance.
- To the extent possible, route unpolluted flows around disturbed areas.
- Install mitigation devices as early as possible.
- Minimize the time disturbed areas are left unstabilized.
- Maintain siltation control devices in proper condition.
- The contractor should use the suggested sequence and techniques as a general guide and modify the suggested methods and procedures as required to best suit seasonal, atmospheric, and site specific physical constraints for the purpose of minimizing the environmental impact of construction.

Demolition, Grubbing and Stripping of Limits of Construction Phase

- Install Temporary Erosion Control (TEC) devices as required to prevent sediment transport into resource areas.
- Place a ring of silt socks and/or haybales around stockpiles.
- Stabilize all exposed surfaces that will not be under immediate construction.
- Store and/or dispose all pavement and building demolition debris as indicated in accordance with all applicable local, state, and federal regulations.

Driveway Area Sub-Base Construction

- Install temporary culverts and diversion ditches and additional TEC devices as required by individual construction area constraints to direct potential runoff toward detention areas designated for the current construction phase.
- Compact gravel as work progresses to control erosion potential.
- Apply water to control air suspension of dust.
- Avoid creating an erosive condition due to over-watering.
- Install piped utility systems as required as work progresses, keeping all inlets sealed until all downstream drainage system components are functional.

Binder Construction

- Fine grade gravel base and install processed gravel to the design grades.
- Compact pavement base as work progresses.
- Install pavement binder coat starting from the downhill end of the site and work toward the top.

Finish Paving

- Repair and stabilize damaged side slopes.
- Clean inverts of drainage structures.
- Install final top coat of pavement.

Final Clean-up

- Clean inverts of culverts and catch basins.
- Remove sediment and debris from rip-rap outlet areas.
- Remove TEC devices only after permanent vegetation and erosion control has been fully established.

3.7 Site Stabilization

Grubbing Stripping and Grading

- Erosion control devices shall be in place as shown on the design plans before grading commences.
- Stripping shall be done in a manner, which will not concentrate runoff. If precipitation is expected, earthen berms shall be constructed around the area being stripped, with a silt sock, silt fence or haybale dike situated in an arc at the low point of the berm.
- If intense precipitation is anticipated, silt socks, haybales, dikes and /or silt fences shall be used as required to prevent erosion and sediment transport. The materials required shall be stored on site at all time.
- If water is required for soil compaction, it shall be added in a uniform manner that does not allow excess water to flow off the area being compacted.
- Dust shall be held at a minimum by sprinkling exposed soil with an appropriate amount of water.

Maintenance of Disturbed Surfaces

- Runoff shall be diverted from disturbed side slopes in both cut and fill.
- Mulching may be used for temporary stabilization.
- Silt sock, haybale or silt fences shall be set where required to trap products of erosion and shall be maintained on a continuing basis during the construction process.

Loaming and Seeding

- Loam shall not be placed unless it is to be seeded directly thereafter.
- All disturbed areas shall have a minimum of 4" of loam placed before seeded and mulched.
- Consideration shall be given to hydro-mulching, especially on slopes in excess of 3 to 1.
- Loamed and seeded slopes shall be protected from washout by mulching or other acceptable slope protection until vegetation begins to grow.

Stormwater Collection System Installation

- The Stormwater drainage system shall be installed from the downstream end up and in a manner which will not allow runoff from disturbed areas to enter pipes.
- Excavation for the drainage system shall not be left open when rainfall is expected overnight. If left open under other circumstances, pipe ends shall be closed by a staked board or by an equivalent method.
- All catch basin openings shall be covered by a silt bag between the grate and the frame or protected from sediment by silt fence surrounding the catch basin grate.

Completion of Paved Areas

- During the placement of sub-base and pavement, the entrance to the Stormwater drainage systems shall be sealed when rain is expected. When these entrances are closed, consideration must be given to the direction of run-off and measures shall be undertaken to minimize erosion and to provide for the collection of sediment.
- In some situations it may be necessary to keep catch basins open.

- Appropriate arrangements shall be made downstream to remove all sediment deposition.

Stabilization of Surfaces

- Stabilization of surfaces includes the placement of pavement, rip-rap, wood bark mulch and the establishment of vegetated surfaces.
- Upon completion of construction, all surfaces shall be stabilized even though it is apparent that future construction efforts will cause their disturbance.
- Vegetated cover shall be established during the proper growing season and shall be enhanced by soil adjustment for proper pH, nutrients and moisture content.
- Surfaces that are disturbed by erosion processes or vandalism shall be stabilized as soon as possible.
- Areas where construction activities have permanently or temporarily ceased shall be stabilized within 14 days from the last construction activity, except when construction activity will resume within 21 days (e.g., the total time period that construction activity is temporarily ceased is less than 21 days).
- Hydro-mulching of grass surfaces is recommended, especially if seeding of the surfaces is required outside the normal growing season.
- Hay mulch is an effective method of temporarily stabilizing surfaces, but only if it is properly secured by branches, weighted snow fences or weighted chicken wire.

3.8 Temporary Structural Erosion Control Measures

Temporary erosion control measures serve to minimize construction-associated impacts to wetland resource and undisturbed areas. Please refer to the following sections for a description of temporary erosion control measures implemented as part of the project and this sample SWPPP.

3.8.1 Silt Socks, Haybales, and Silt Fencing

The siltation barriers will demarcate the limit of work, form a work envelope and provide additional assurance that construction equipment will not enter the adjacent wetlands or undisturbed portions of the site. All barriers will remain in place until disturbed areas are stabilized.

3.8.2 Temporary Stormwater Diversion Swale

A temporary diversion swale is an effective practice for temporarily diverting stormwater flows and to reduce stormwater runoff velocities during storm events. The swale channel can be installed before infrastructure construction begins at the site, or as needed throughout the construction process. The diversion swale should be routinely compacted or seeded to minimize the amount of exposed soil.

3.8.3 Dewatering Basins

Dewatering may be required during stormwater system, foundation construction and utility installation. Should the need for dewatering arise, groundwater will be pumped directly into a temporary settling basin, which will act as a sediment trap during construction. All temporary settling basins will be located within close proximity of daily work activities. Prior to discharge, all groundwater will be treated by means of the settling basin or acceptable substitute. Discharges from sediment basins will be free of visible floating, suspended and settleable solids that would impair the functions of a wetland or degrade the chemical composition of the wetland resource area receiving ground or surface water flows and will be to the combined system.

3.8.4 Material Stockpiling Locations

Piping and trench excavate associated with the subsurface utility work will be contained with a single row of silt socks and/or haybales.

3.9 Permanent Structural Erosion Control Measures

Permanent erosion control measures serve to minimize post-construction impacts to wetland resource areas and undisturbed areas. Please refer to the Site Plans and Long-Term Operations and Maintenance Plan for a description of permanent erosion control measures implemented as part of the project and this SWPPP.

3.10 Good Housekeeping Best Management Practices

3.10.1 Material Handling and Waste Management

Solid waste generation during the construction period will be primarily construction debris. The debris will include scrap lumber (used forming and shoring pallets and other shipping containers), waste packaging materials (plastic sheeting and cardboard), scrap cable and wire, roll-off containers (or dumpsters) and will be removed by a contract hauler to a properly licensed landfill. The roll-off containers will be covered with a properly secured tarp before the hauler exits the site. In addition to construction debris, the construction work force will generate some amount of household-type wastes (food packing, soft drink containers, and other paper). Trash containers for these wastes will be located around the site and will be emptied regularly so as to prevent wind-blown litter. This waste will also be removed by a contract hauler.

All hazardous waste material such as oil filters, petroleum products, paint and equipment maintenance fluids will be stored in structurally sound and sealed shipping containers in the hazardous-materials storage area and segregated from other non-waste materials. Secondary containment will be provided for all materials in the hazardous materials storage area and will consist of commercially available spill pallets. Additionally, all hazardous materials will be disposed of in accordance with federal, state and municipal regulations.

Two temporary sanitary facilities (portable toilets) will be provided at the site in the combined staging area. The toilets will be away from a concentrated flow path and traffic flow and will have collection pans underneath as secondary treatment. All sanitary waste will be collected from an approved party at a minimum of three times per week.

3.10.2 Building Material Staging Areas

Construction equipment and maintenance materials will be stored at the combined staging area and materials storage areas. Silt fence will be installed around the perimeter to designate the staging and materials storage area. A watertight shipping container will be used to store hand tools, small parts and other construction materials.

Non-hazardous building materials such as packaging material (wood, plastic and glass) and construction scrap material (brick, wood, steel, metal scraps, and pine cuttings) will be stored in a separate covered storage facility adjacent to other stored materials. All hazardous-waste materials such as oil filters, petroleum products, paint and equipment maintenance fluids will be stored in structurally sound and sealed containers under cover within the hazardous materials storage area.

Large items such as framing materials and stockpiled lumber will be stored in the open storage area. Such materials will be elevated on wood blocks to minimize contact with runoff.

The combined storage areas are expected to remain clean, well-organized and equipped with ample cleaning supplies as appropriate for the materials being stored. Perimeter controls such as containment structures, covers and liners will be repaired or replaced as necessary to maintain proper function.

3.10.3 Designated Washout Areas

Designated temporary, below-ground concrete washout areas will be constructed, as required, to minimize the pollution potential associated with concrete, paint, stucco, mixers etc. Signs will, if required, be posted marking the location of the washout area to ensure that concrete equipment operators use the proper facility.

Concrete pours will not be conducted during or before an anticipated precipitation event. All excess concrete and concrete washout slurries from the concrete mixer trucks and chutes will be discharged to the washout area or hauled off-site for disposal.

3.10.4 Equipment/Vehicle Maintenance and Fueling Areas

Several types of vehicles and equipment will be used on-site throughout the project including graders, scrapers, excavators, loaders, paving equipment, rollers, trucks and trailers, backhoes and forklifts. All major equipment/vehicle fueling and maintenance will be performed off-site. A small, 20-gallon pickup bed fuel tank will be kept on-site in the combined staging area. When vehicle fueling must occur on-site, the fueling activity will occur in the staging area. Only minor equipment maintenance will occur on-site. All equipment fluids generated from maintenance activities will be disposed of into designated drums stored on spill pallets. Absorbent, spill-cleanup materials and spill kits will be available at the combined staging and materials storage area. Drip pans will be placed under all equipment receiving maintenance and vehicles and equipment parked overnight.

3.10.5 Equipment/Vehicle Wash down Area

All equipment and vehicle washing will be performed off-site.

3.10.6 Spill Prevention Plan

A spill containment kit will be kept on-site in the Contractor's trailer and/or the designated staging area throughout the duration of construction. Should there be an accidental release of petroleum product into a resource area, the appropriate agencies will be immediately notified.

3.10.7 Inspections

Maintenance of existing and proposed BMP's to address stormwater management facilities during construction is an on-going process. The purpose of the inspections is to observe all sources of stormwater or non-stormwater discharge as identified in the SWPPP as well as the status of the receiving waters and fulfill the requirements of the Order of Conditions. The following sections describe the appropriate inspection measures to adequately implement the project's SWPPP. A blank inspection form is provided at the end of this section. Completed inspection forms are to be maintained on site.

Inspection Personnel

The owner's appointed representative will be responsible for performing regular inspections of erosion controls and ordering repairs as necessary.

Inspection Frequency

Inspections will be performed by qualified personnel once every 7 days and within 24-hours after a storm event of greater than one-quarter inch, in accordance with the CGP. The inspections must be documented on the inspection form provided at the end of this section, and completed forms will be provided to the on-site supervisor and maintained at the Owner's office throughout the entire duration of construction.

Inspection Reporting

Each inspection report will summarize the scope of the inspection, name(s) and qualifications of personnel making the inspection, and major observations relating to the implementation of the SWPPP, including compliance and non-compliance items. Completed inspection reports will remain with the completed SWPPP on site.

3.10.8 Amendment Requirements

The final SWPPP is intended to be a working document that is utilized regularly on the construction site, and provides guidance to the Contractor. It must reflect changes made to the originally proposed plan and will be updated to include project specific activities and ensure that they are in compliance with the NPDES General Permit and state and local laws and regulations. It should be amended whenever there is a change in design, construction, operation or maintenance that affects discharge of pollutants. The following items should be addressed should an amendment to the SWPPP occur:

- Dates of certain construction activities such as major grading activities, clearing and initiation of and completion of stabilization measures should be recorded.
- Future amendments to the SWPPP will be recorded as required. As this SWPPP is amended, all amendments will be kept on site and made part of the SWPPP.
- Upon completion of site stabilization (completed as designed and/or 70% background vegetative cover), it can be documented and marked on the plans. Inspections are no longer required at this time.
- Inspections often identify areas not included in the original SWPPP, which will require the SWPPP to be amended. These updates should be made within seven days of being recognized by the inspector.

3.11 SWPPP Inspection and Maintenance Report

The following form is an example to be used for SWPPP Inspection Reporting.

Stormwater Construction Site Inspection and Maintenance Report

TO BE COMPLETED AT LEAST EVERY 7 DAYS AND WITHIN 24 HOURS OF A STORM EVENT OF AT LEAST 0.25 INCHES. AFTER SITE STABILIZATION, TO BE COMPLETED AT LEAST ONCE PER MONTH FOR THREE YEARS OR UNTIL A NOTICE OF TERMINATION IS FILED (IF APPLICABLE).

General Information			
Project Name	Thorndike Place		
NPDES Tracking No. (if applicable)		**Location**	Dorothy Road Arlington, MA
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present phase of construction			
Type of Inspection: ❑ Regular ❑ Pre-storm event ❑ During storm event ❑ Post-storm event			
Weather Information			
Has there been a storm event since the last inspection? ❑Yes ❑No **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):			
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:			
Have any discharges occurred since the last inspection? ❑Yes ❑No **If yes, describe:**			
Are there any discharges at the time of inspection? ❑Yes ❑No **If yes, describe:**			

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	**BMP Installed?**	**BMP Maintenance Required?**	**Corrective Action Needed and Notes Action required by whom and when**
1	Catch Basin Protection	❑Yes ❑No	❑Yes ❑No	
2	Haybale & Silt Fencing	❑Yes ❑No	❑Yes ❑No	
3	Straw Wattles	❑Yes ❑No	❑Yes ❑No	
4	Construction Entrance	❑Yes ❑No	❑Yes ❑No	
5	Sediment Basins	❑Yes ❑No	❑Yes ❑No	
6	Dewatering Pit	❑Yes ❑No	❑Yes ❑No	
7		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes Action required by whom and when
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	❑Yes ❑No	❑Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	❑Yes ❑No	❑Yes ❑No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	❑Yes ❑No	❑Yes ❑No	
4	Are discharge points and receiving waters free of any sediment deposits?	❑Yes ❑No	❑Yes ❑No	
5	Are storm drain inlets properly protected?	❑Yes ❑No	❑Yes ❑No	
6	Is the construction exit preventing sediment from being tracked into the street?	❑Yes ❑No	❑Yes ❑No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	❑Yes ❑No	❑Yes ❑No	
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	❑Yes ❑No	❑Yes ❑No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	❑Yes ❑No	❑Yes ❑No	Vehicle Maintenance not allowed on site
10	Are materials that are potential stormwater	❑Yes ❑No	❑Yes ❑No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes Action required by whom and when
	contaminants stored inside or under cover?			
11	Are non-stormwater discharges (e.g., wash water, dewatering) properly controlled?	❑Yes ❑No	❑Yes ❑No	
12	(Other)	❑Yes ❑No	❑Yes ❑No	

Non-Compliance

Describe any incidents of non-compliance not described above:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____
(Qualified Person Performing the Inspection)

Signature:_____ **Date:** _____

Print name and title: _____
(Contractor/Operator)

Signature:_____ **Date:**_____

SECTION 4.0

LONG-TERM POLLUTION PREVENTION & OPERATION AND MAINTENANCE PLAN

4.0 LONG-TERM POLLUTION PREVENTION & OPERATION AND MAINTENANCE PLAN

As required by Standard #4 of the Stormwater Management Policy, this Long-Term Pollution Prevention Plan has been developed for source control and pollution prevention at the site after construction.

MAINTENANCE RESPONSIBILITY

Ensuring that the provisions of the Long-Term Pollution Prevention Plan are followed will be the responsibility of The Applicant, Arlington Land Realty, LLC.

GOOD HOUSEKEEPING PRACTICES

The site to be kept clean of trash and debris at all times. Trash, junk, etc. is not to be left outside.

VEHICLE WASHING CONTROLS

The following BMP's, or equivalent measures, methods or practices are required if you are engaged in vehicle washing and/or steam cleaning:

It is allowable to rinse down the body or a vehicle, including the bed of a truck, with just water without doing any wash water control BMP's.

If you wash (with mild detergents) on an area that infiltrates water, such as gravel, grass, or loose soil, it is acceptable to let the wash water infiltrate as long as you only wash the body of vehicles.

However, if you wash on a paved area and use detergents or other cleansers, or if you wash/rinse the engine compartment or the underside of vehicles, you must take the vehicles to a commercial vehicle wash.

REQUIREMENTS FOR ROUTINE INSPECTIONS AND MAINTENANCE OF STORMWATER BMPS

All stormwater BMPs are to be inspected and maintain as follows;

Haybales, Silt Fence, and other temporary measures

The temporary erosion control measures will be installed up gradient of any wetland resource area where any disturbance or alteration might otherwise allow for erosion or sedimentation. They will be regularly inspected to ensure that they are functioning adequately. Additional supplies of these temporary measures will be stockpiled on site for any immediate needs or routine replacement.

Deep Sump Hooded Catch Basins

Regular maintenance is essential. Catch basins remain effective at removing pollutants only if they are cleaned out frequently. Inspect or clean basins at least four times per year and at the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or whenever the depth of the deposits in the catch basin sump is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.

Water Quality Treatment Units

The water quality treatment structures require periodic inspection and cleaning to maintain operation and function. Owners should have these units inspected on a semi-annual basis and after periods of intense precipitation. Inspections can be done by using a clear Plexiglas tube ("sludge judge") to extract a water column sample. When sediment accumulation reaches 15% of storage capacity, cleaning of the unit is required.

These water quality structures must and will be checked and cleaned immediately after petroleum spills; contact appropriate regulatory agencies.

Maintenance of these units should be done by a vacuum truck that will remove the water, sediment, debris, floating hydrocarbons and other materials in unit. Proper cleaning and disposal of the removed materials and liquid must be followed.

Underground Infiltration System

Maintenance is required for the proper operation of the underground infiltration system. Infiltration systems are prone to failure due to clogging if the upstream water quality units are not maintained. The use of pretreatment BMPs will minimize failure and maintenance requirements.

After construction, the infiltration system shall be inspected after every major storm for the first few months to ensure proper stabilization and function. Water levels in the access ports shall be recorded over several days to check the drainage of the systems. It is recommended that a log book be maintained showing the depth of water in the detention/infiltration systems at each observation in order to determine the rate at which the system dewaters after runoff producing storm events. Once the performance characteristics of the detention/infiltration have been verified, the monitoring schedule can be reduced to an annual basis, unless the performance data suggests that a more frequent schedule is required.

Preventive maintenance on the infiltration system shall be performed at least twice a year, and sediment shall be removed from any and all pretreatment and collection structures. Sediment shall be removed when deposits approach within six inches of the invert heights of connecting pipes between unit rows, or in sumped inlet structures. Ponded water inside the systems (as visible from the access ports) that remains after several days most likely indicates that the bottom of the system is clogged and will require cleaning or replacement.

The system is designed with a defined top portal area at the "down-flow" end of the chamber that can be cut out to accept up to a 10-inch diameter riser pipe. The 10-inch riser can be used as an observation well and as access for a vacuum truck tube for use in removing sediment. The "down flow" ends of the units have end walls that are closed on the bottom. The closed bottom functions like a coffer dam, with most of the sediment depositing prior to flowing into the next chamber, facilitating its removal through the riser pipe, which is positioned directly above this area.

Pipe Outlet Protection

The outlet protection should be checked at least annually and after every major storm. If the rip-rap has been displaced, undermined or damaged, it should be repaired immediately. The channel immediately below the outlet should be checked to see that erosion is not occurring. The downstream channel should be kept clear of obstructions such as fallen trees, debris, and sediment that could change flow patterns and/or tailwater depths on the pipes. Repairs must be carried out immediately to avoid additional damage to the outlet protection apron.

PROVISIONS FOR MAINTENANCE OF LAWNS, GARDENS AND OTHER LANDSCAPE AREAS

Suggested Maintenance Operations

A. Trees and Shrubs

Disease and Pest Management - Prevention of disease or infestation is the first step of Pest Management. A plant that is in overall good health is far less susceptible to disease. Good general landscape maintenance can reduce problems from disease.

Inspections of plant materials for signs of disease or infestation are to be performed monthly by the Landscape Maintenance Contractor's Certified Arborist. This is a critical step for early diagnosis. Trees and Shrubs that have been diagnosed to have a plant disease or an infestation of insect pests are to be treated promptly with an appropriate material by a licensed applicator.

Fertilization - Trees and shrubs live outside their natural environment and should be given proper care to maintain health and vigor. Fertilizing trees and shrubs provides the plants with nutrients needed to resist insect attack, to resist drought and to grow thicker foliage. Fertilizing of new and old trees may be done in one of three ways, in either the early spring or the late fall.

- Systemic Injection of new and existing trees on trees 2 inches or greater in diameter. You must be licensed to apply this method.

- Soil Injection – a liquid fertilizer with a product such as Arbor Green or Rapid Grow injected into the soil under the drip zone of a tree or shrub. Material must be used according to manufacturers' specifications to be effective. Outside contracting is recommended.
- Punch Bar Method – a dry fertilizer such as 10-10-10, may be used by punched holes in the drip zone of the tree 12-18" deep, two feet apart around the circumference, to the edge of the drip line. Three pounds of fertilizer should be used per diameter inch for trees with trunks six inches or more in diameter.
- Fertilizer of shrubs – use a fertilizer such as 10-10-10, broadcast over the planting area according to the manufacturers' rate and water in.
- All fertilization must be noted on daily maintenance log.

Watering - Trees and Shrubs will need supplemental watering to remain in vigorous health. All new plants need to be watered once a week in cool weather, twice a week during warm weather, and up to three times in a week during periods of extreme heat and drought. Trees and shrubs should be watered in such a manner as to totally saturate the soil in the root zone area. Over-watering or constant saturation of the soil must be avoided as this could lead to root rot and other disease problems. The use of a soil moisture meter can help you monitor the soil's water intake.

Plant Replacement - Unhealthy plants that may cause widespread infestation of other nearby plants shall be immediately removed from the site. Any vegetation removed from the site must be recorded and submitted with the daily maintenance log. The area shall be treated to prevent further infestation. The plant shall then be replaced with a healthy specimen of the same species and size. This work shall have a pre-established budget allowance for the year.

A spring inspection of all plant materials shall be performed to identify those plant materials that are not in vigorously healthy condition. Unhealthy plant materials shall be evaluated. If the problem is determined to be minor the plant material shall be given appropriate restorative care in accordance with this maintenance guideline until it is restored to a vigorously healthy condition. Unhealthy plant materials that do not respond to restorative care or are determined to be beyond saving shall be replaced with a healthy specimen of the same species and size. In the case of the necessity of replacing extremely large plant materials the Landscape Architect shall determine the size of the replacement plant.

Pruning - Proper pruning is the selective removal of branches without changing the plant's natural appearance, or habit of growth. All tree pruning is to be performed by a licensed Arborist. All branches that are dead, broken, scared or crossing should be removed. All cuts should be made at the collar and not cut flush with the base.

Pruning on the site shall be done for the following purposes;

- To maintain or reduce the size of a tree or shrub
- To remove dead, diseased or damaged branches
- To rejuvenate old shrubs and encourage new growth
- To stimulate future flower and fruit development
- To maximize the visibility of twig color
- To prevent damage and reduce hazards to people and properties

All shrubs are recommended to be pruned on an annual basis to prevent the shrub from becoming overgrown and eliminate the need for drastic pruning. There are several types of pruning for deciduous shrubs. Hand snips should be used to maintain a more natural look or hand shears can be used for a more formal appearance.

Winter Protection - All trees and shrubs are to be watered, fertilized, and mulched before the first frost. All stakes should be checked and ties adjusted. Damaged branches should be pruned.

Broadleaf and Coniferous Evergreen plant materials are to be sprayed with an anti-desiccant product to prevent winter burn. The application shall be repeated during a suitable mid-winter thaw.

Shrubs located in areas likely to be piled with snow during snow removal (but not designated as Snow Storage Areas) shall be marked by six-foot high poles with bright green banner flags. Stockpiles of snow are not to be located in these areas due to potential damage to the plant materials from both the weight of the snow and the snow melting chemicals.

At the fall landscape maintenance conference parameters will be discussed between the Landscape Maintenance Contractor and the snow removal contractor to assure minimal damage and loss of landscape amenities during the winter season.

Seasonal Clean Up - A thorough spring cleanup is to be performed. This includes the removal and replacement of dead or unhealthy plant materials and the cleanup of plant debris and any general debris that has accumulated over the winter season. Mulch is to be lightly raked to clean debris from the surface without removing any mulch. Twigs and debris are to be removed from the planting beds throughout the growing season.

Mulching - Planting beds shall be mulched with a treated shredded hardwood mulch free from dirt, debris, and insects. A sample of this mulch shall be given to the Owner for approval prior to installation.

Maintain a 2-3" maximum depth and keep free of weeds either by hand weeding or by the use of a pre-emergent weed control such as Treflan or Serfian. Seasonal re-mulching shall occur as necessary in the spring and the fall to maintain this minimum depth. When new mulch is added to the planting bed it shall be spread to create a total depth of no more than three inches. Edges should be maintained in a cleanly edged fashion.

Mulch shall not be placed directly against the trunk of any tree or shrub.

B. Groundcover and Perennials

Disease and Pest Management – Pesticides and herbicides should be applied only as problems occur, with the proper chemical applied only by a trained professional or in the case of pesticide, a Certified Pesticide Applicator. Plants should be monitored weekly and treated accordingly.

Fertilizer – The health of the plants can be maintained or improved, and their growth encouraged by an application of complete fertilizer. Apply a fertilizer such as 4-12-4 as growth becomes apparent and before mulching. Apply to all groundcover and perennial planting areas by hand and avoid letting the fertilizer come in contact with the foliage, or use a liquid fertilizer and apply by soaking the soil. Apply according to the manufacturers' specifications.

Fertilization shall stop at the end of July.

Water – Groundcovers and Perennials will need supplemental watering in order to become established, healthy plants. All new plants need to be watered once a week in cool weather, twice a week during warm weather, and up to three times in a week during periods of extreme heat and drought. Until established, groundcovers and perennials should be watered in such a manner as to totally saturate the soil in the root zone area, to a depth of 6 inches. Once established, perennials shall continue to be watered as necessary to maintain them in a vigorous healthy condition. Over-watering or constant saturation of the soil must be avoided as this could lead to root rot and other disease problems. The use of a soil moisture meter can help you monitor the soil's water intake.

On-site water shall be furnished by the Owner. Hose and other watering equipment shall be furnished by the Landscape Maintenance Contractor.

Replacement – Any unhealthy plant/s that may cause widespread infestation of other nearby plants shall be immediately removed from the site. Any vegetation removed from the site must be recorded and submitted with the landscape maintenance log. The area shall be treated to prevent further infestation. The plant/s shall then be replaced with healthy specimen/s of the same species and size. Old Forge shall have a pre-established budget allowance for this type of replacement, each year.

Plant material that is damaged as a result of other landscape maintenance activities, such as mowing, shall be replaced with healthy specimens of the same species and size, at no additional cost to the owner.

Deadheading – Perennials shall be checked on a weekly basis and dead-headed once flowers have faded or as necessary based on plant type and duration of flower. Spent flowers can be pinched off with the thumb and forefinger. Continue to remove all faded flowers until Fall. All associated debris shall be removed from site daily.

Staking – Upright-growing perennials need support especially when in flower. Use of bamboo stakes, galvanized wire hoops or mesh may be necessary for their support. Supports should be put in place before they have become too difficult to handle. The supports should not be taller than the mature height of the perennial plant.

Division of Perennials – Two or three-year-old perennials are easily divided in the spring if more plants are needed. To divide, cut out the entire section of plant to be divided, including roots. The larger divisions (those with three or more shoots), can be set out immediately in their permanent location, where they can be expected to bloom the same season. Smaller divisions are best planted in an out-of-the-way planting bed until the following autumn or spring, when they can be moved to their permanent location.

Weeding – All planting beds should be kept weed-free. Weed either by hand or with a pre-emergent herbicide such as Treflen used according to manufacturers' specifications. Manual weeding is to be used in combination with the use of spot applications of herbicides. Both live and dead weeds are to be pulled and removed from the site.

All herbicide applications shall be documented in the Landscape Maintenance Log. The actual product label or the manufacturer's product specification sheet for the specific product shall also be included in the Log.

Only personnel with appropriate applicator licenses shall supervise and/or perform the application of pesticide products requiring a license.

Winterizing – Perennial gardens should be cleaned-up when growth ceases in the fall. Remove foliage of plants that normally die down to the ground. Divide and replant over-grown clumps.

C. Lawn Areas - Turf Systems

Mowing – Proper mowing is an integral part of any good turf maintenance program. Without it, the finest in fertilization, watering and other vital maintenance practices would be completely ineffective. Proper mowing will help control dicot weeds; help the turf survive during periods of extreme heat, and gain strength and vigor to resist disease and other infestations.

Mowing height – The proper mowing height will vary somewhat according to the type of grass. The most common type of seed & sod lawns contain a mixture of bluegrass, fine fescue and perennial rye, which should be mowed at 2-3 inches.

Mowing frequency – The basic rule of thumb for mowing frequency is to never remove more than 1/3 of the grass blade in one mowing. Example: if you want to mow your turf at 2 inches, you should cut it when it reaches 3 inches. Removing more than ½ of the grass plant at a time can put the plant into shock, thus making it more susceptible to stress disease and weed infestation.

Mowing frequency will vary with the growing season and should be set by the plant height and not a set date. It will often be necessary to mow twice a week during periods of surge growth to help maintain plant health and color. Mowing should be cut back during periods of stress.

Grass clippings should be removed whenever they are thick enough to layer the turf. The return of clippings to the soil actually adds nutrients and helps retain moisture. Heavily clumped grass clippings are a sign of infrequent mowing, calling for an adjustment in the mowing schedule.

When mowing any area, try to alternate mowing patterns. This tends to keep grass blades more erect and assures an even cut. A dull mower will cause color loss due to tearing of the turf plant, and since mowing will ultimately determine the appearance of any turf area there is an absolute necessity for a clean sharp cut.

Weed & Pest Control and Fertilizing- In order to maintain turf grass health, vigor color, and nutrients, fertilizer must be added to the soil. Recommendations for fertilization of lawn areas are as follows; fertilize at the rate of one (1) pound of nitrogen per thousand square feet, per year is optimum. Fertilizer should be a balanced slow release, sulfur coated type fertilizer.

Weed Control - All turf areas will require some weed control, for both weed grasses and dicot weeds. Weeds should be treated at the appropriate time and with a material labeled for the target weed. Please refer to the fertilizer weed and pest schedule for timing.

Pest Control - All turf areas will require some pest control. Pests should be treated at the appropriate time with a material labeled for the target pest. Please refer to the fertilizer, weed and pest schedule for timing.

Lime - A common cause for an unhealthy lawn is acidic soil. When the pH is below the neutral range (between 6-7) vital plant nutrients become fixed in the soil and cannot be absorbed by the grass plant. Lime corrects an acid soil condition, supplies calcium for plant growth and improves air and water circulation. Limestone applied at the rate of 50 lbs. per thousand square feet will adjust the soil pH one point over a period of 6-9 months.

D. Fertilizer, Weed & Pest Control Schedule – Turf Systems

Spring - (April)	Fertilize one (1) pound of nitrogen per 1,000 square feet Pre-emergent weed grass control Broadleaf weed control
Late Spring - (June)	Fertilize one (1) pound of nitrogen per 1,000 square feet Pre-emergent weed grass control Broadleaf weed control Insect Control (if needed)
*Summer - (August)	Fertilize one (1) pound of nitrogen per 1,000 square feet Broadleaf weed control (if needed) Insect Control (if needed)
Fall - (September)	Fertilize one (1) pound of nitrogen per 1,000 square feet

*Omit if area is not to be irrigated

Lawn Maintenance Task Schedule

MARCH (Weather permitting)
- Clean up winter debris, sand, leaves, trash etc.
- Re-edge mulch beds, maintain at 2-3" maximum.
- Fertilize plants
- Aerate and thatch turf (conditions permitting)

APRIL
- Reseed or sod all areas needing attention.
- Fertilize and weed control
- Lime
- Start mowing when grass reaches 2-1/2", mow to 2"

MAY
- Mow turf to 2-2-1/2"
- Weed as necessary.
- Check for disease and pest problems in both turf and plants.

JUNE

- Mow turf to 2-1/2" – 3"
- Fertilize and weed control.
- Weed
- Check for disease and pest problems in both turf and plants, treat as necessary.

PROVISIONS FOR SOLID WASTE MANAGEMENT (SITE TRASH)

Trash will be placed in on-site dumpsters and the Owner will make provisions for its regular and timely removal.

SNOW DISPOSAL AND PLOWING PLANS

The purpose of the snow and snowmelt management plan is to provide guidelines regarding snow disposal site selection, site preparation and maintenance that are acceptable to the Department of Environmental Protection. For the areas that require snow removal, snow storage onsite will largely be accomplished by using pervious areas along the shoulder of the roadway and development as windrowed by plows.

- Avoid dumping of snow into any water body, including rivers, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid disposing of snow on top of storm drain catch basins or in stormwater basins. Snow combined with sand and debris may block a storm drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.
- In significant storm events, the melting or off-site trucking of snow may be implemented. These activities shall be conducted in accordance with all local, state and federal regulations.

WINTER ROAD SALT AND/OR SAND USE AND STORAGE RESTRICTIONS

The applicant will be responsible for sanding and salting the site. No storage on site.

STREET SWEEPING SCHEDULES

There are three types of sweepers: Mechanical, Regenerative Air, and Vacuum Filter.

1) Mechanical: Mechanical sweepers use brooms or rotary brushes to scour the pavement.
2) Regenerative Air: These sweepers blow air onto the road or parking lot surface, causing fines to rise where they are vacuumed.
3) Vacuum filter: These sweepers remove fines along roads. Two general types of vacuum filter sweepers are available - wet and dry. The dry type uses a broom in combination with the vacuum. The wet type uses water for dust suppression

Regardless of the type chosen, the efficiency of street sweeping is increased when sweepers are operated in tandem.

This project has not included street sweeping as part of the TSS removal calculations. However, it is recommended that street sweeping of the parking areas occur four times a year, including once after the spring snow melt.

Reuse and Disposal of Street Sweepings

Once removed from paved surfaces, the sweepings must be handled and disposed of properly. Mass DEP's Bureau of Waste Prevention has issued a written policy regarding the reuse and disposal of street sweepings. These sweepings are regulated as a solid waste, and can be used in three ways:

- In one of the ways already approved by Mass DEP (e.g., daily cover in a landfill, additive to compost, fill in a public way)

- If approved under a Beneficial Use Determination
- Disposed in a landfill

TRAINING OF STAFF OR PERSONNEL INVOLVED WITH IMPLEMENTING LONG-TERM POLLUTION PREVENTION PLAN

The Long-Term Pollution Prevention Plan is to be implemented by property owner of the site. Trained and, if required, licensed Professionals are to be hired by the owner as applicable to implement the Long-Term Pollution Prevention Plan.

LIST OF EMERGENCY CONTACTS FOR IMPLEMENTING LONG-TERM POLLUTION PREVENTION PLAN

The applicant will be required to implement the Long-Term Pollution Prevention Plan and will create and maintain a list of emergency contacts.

POST CONSTRUCTION PHASE INSPECTION SCHEDULE AND EVALUATION CHECKLIST

Inspection Date	Inspector	BMP Inspected	Inspection Frequency Requirements	Comments	Recommendation	Follow-up Inspection Required (yes/no)
		Catch Basin	Four times a year			
		Water Quality Units	Four times a year			
		Infiltration System	Twice a year			
		Pipe Outlet Protection	Once a year			

1. Refer to the Massachusetts Stormwater Handbook Volume Two: Stormwater Technical Handbook (February 2008) for recommendations regarding frequency for inspections and maintenance of specific BMP's

2. Inspections to be conducted by a qualified professional such as an environmental scientist or civil engineer.

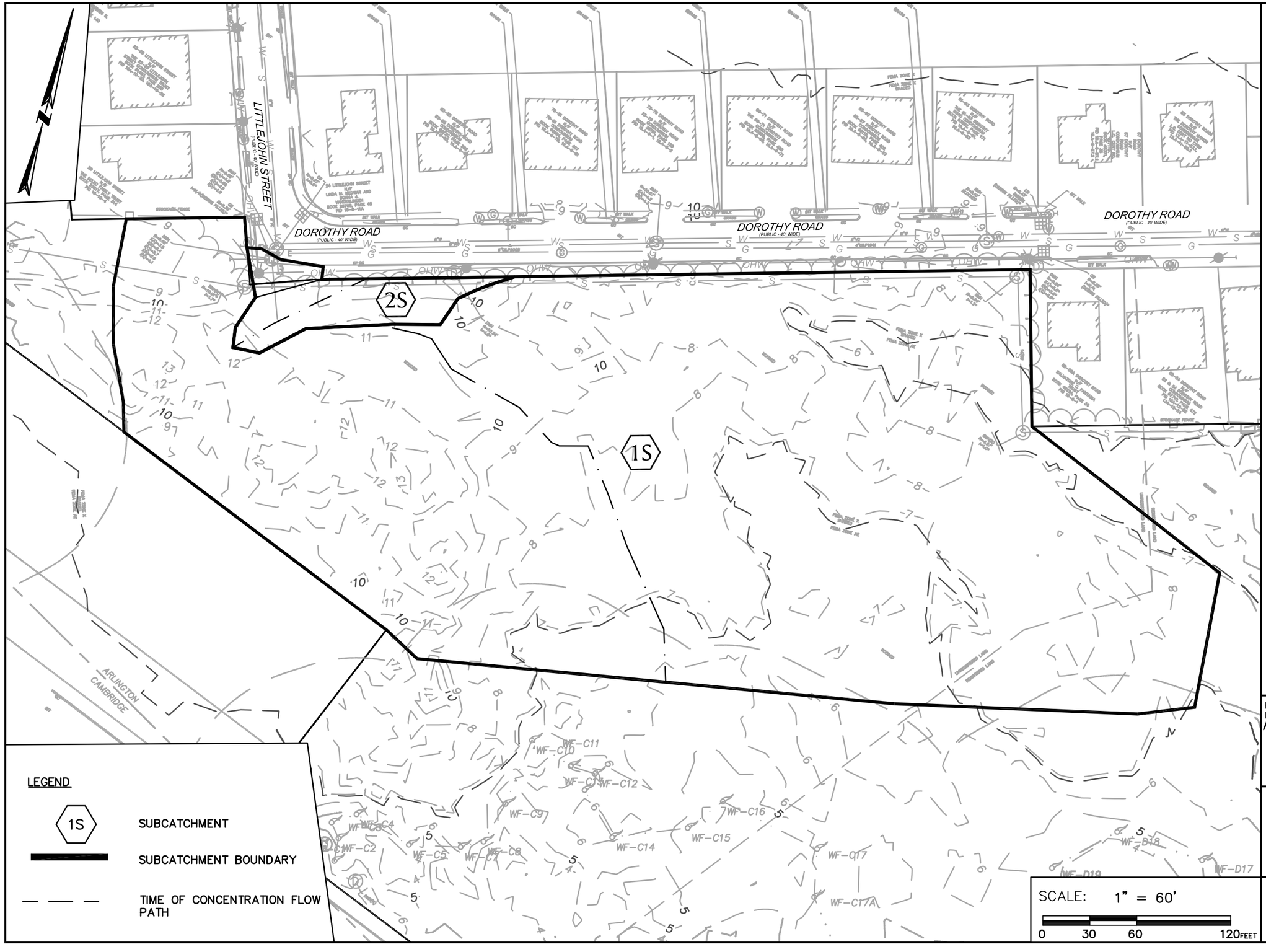
3. Limited or no use of sodium chloride salts, fertilizers or pesticides recommended.

4. Other Notes: (Include deviations from Conservation Commission Approvals, Planning Board Approvals and Approved Plans)

SECTION 5.0

HYDROLOGY CALCULATIONS

5.01 EXISTING WATERSHED PLAN



THORNDIKE PLACE

DOROTHY ROAD

ARLINGTON
MASSACHUSETTS
(MIDDLESEX COUNTY)

EXISTING WATERSHED PLAN

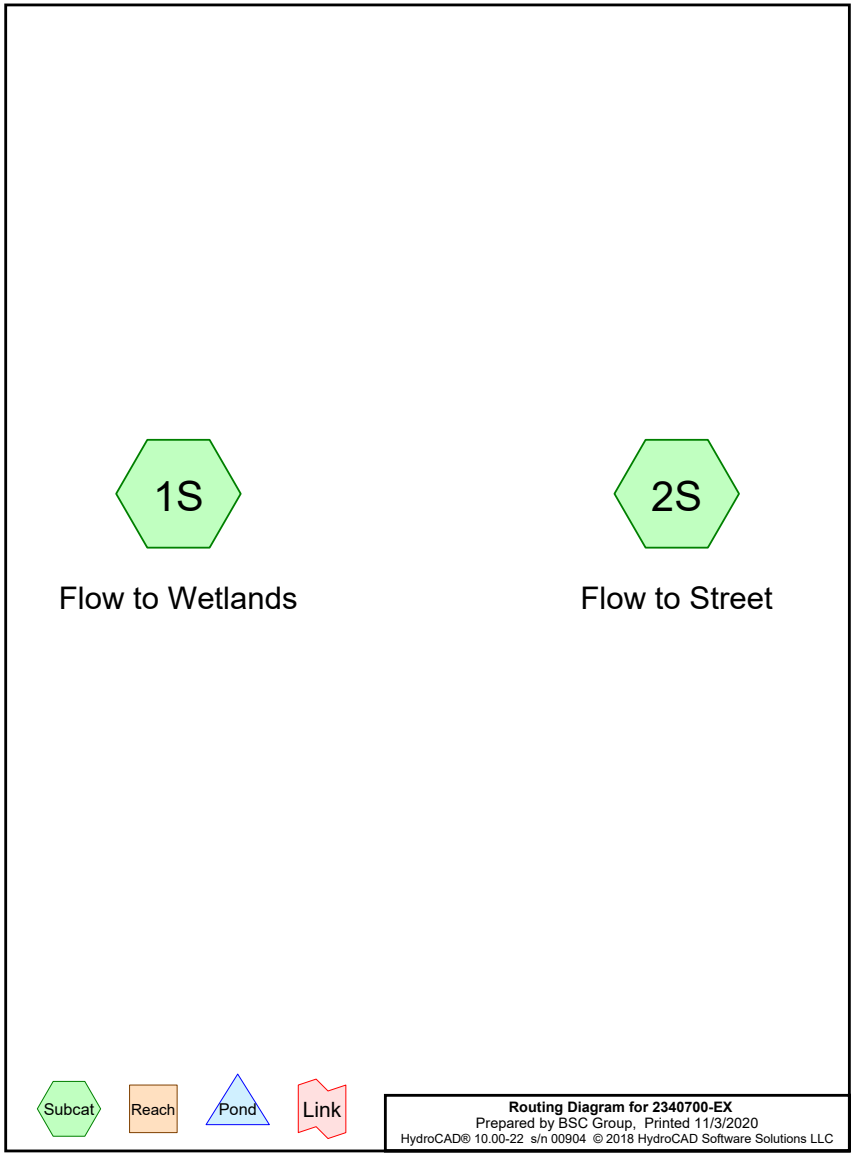
NOVEMBER 3, 2020

PREPARED FOR:
ARLINGTON LAND REALTY
84 SHERMAN STREET
CAMBRIDGE, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 23407.00 Date: 11/3/2020
Scale: 1" = 60' Revised:
Dwg No: EXW
File: C\DRAINAGE DESIGN\2340700-EXW

5.02 EXISTING HYDROLOGY CALCULATIONS (HYDROCAD™ PRINTOUTS)



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.021	98	Paved parking, HSG C (2S)
3.534	70	Woods, Good, HSG C (1S, 2S)
3.555	**70**	**TOTAL AREA**

Soil Listing (all nodes)

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

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.021	0.000	0.000	0.021	Paved parking	2S
0.000	0.000	3.534	0.000	0.000	3.534	Woods, Good	1S, 2S
0.000	**0.000**	**3.555**	**0.000**	**0.000**	**3.555**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=147,900 sf 0.00% Impervious Runoff Depth>0.84"
Flow Length=310' Tc=17.5 min CN=70 Runoff=2.1 cfs 0.238 af

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>1.06"
Flow Length=95' Tc=6.0 min CN=74 Runoff=0.2 cfs 0.014 af

Total Runoff Area = 3.555 ac Runoff Volume = 0.252 af Average Runoff Depth = 0.85"
99.40% Pervious = 3.534 ac 0.60% Impervious = 0.021 ac

Summary for Subcatchment 1S: Flow to Wetlands

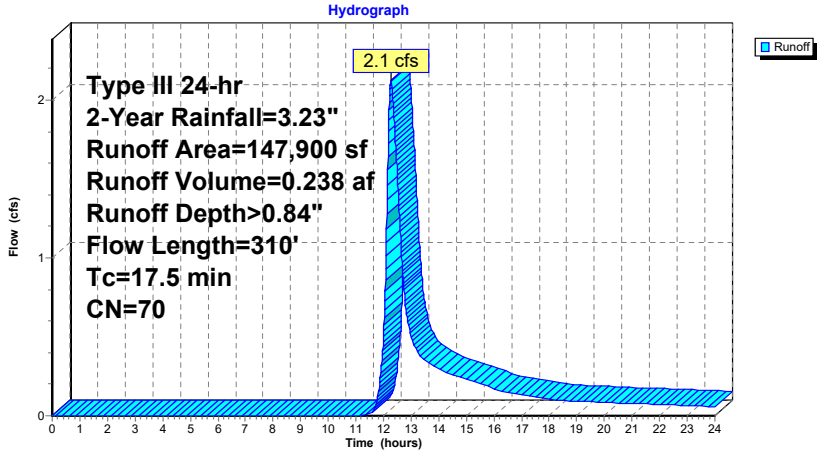
Runoff = 2.1 cfs @ 12.27 hrs, Volume= 0.238 af, Depth> 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
147,900	70	Woods, Good, HSG C
147,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

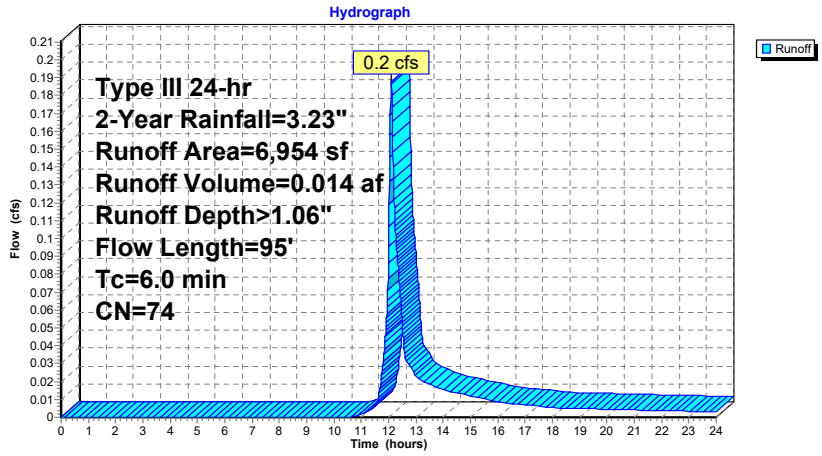
Runoff = 0.2 cfs @ 12.10 hrs, Volume= 0.014 af, Depth> 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=147,900 sf 0.00% Impervious Runoff Depth>1.95"
Flow Length=310' Tc=17.5 min CN=70 Runoff=5.4 cfs 0.553 af

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>2.28"
Flow Length=95' Tc=6.0 min CN=74 Runoff=0.4 cfs 0.030 af

Total Runoff Area = 3.555 ac Runoff Volume = 0.583 af Average Runoff Depth = 1.97"
99.40% Pervious = 3.534 ac 0.60% Impervious = 0.021 ac

Summary for Subcatchment 1S: Flow to Wetlands

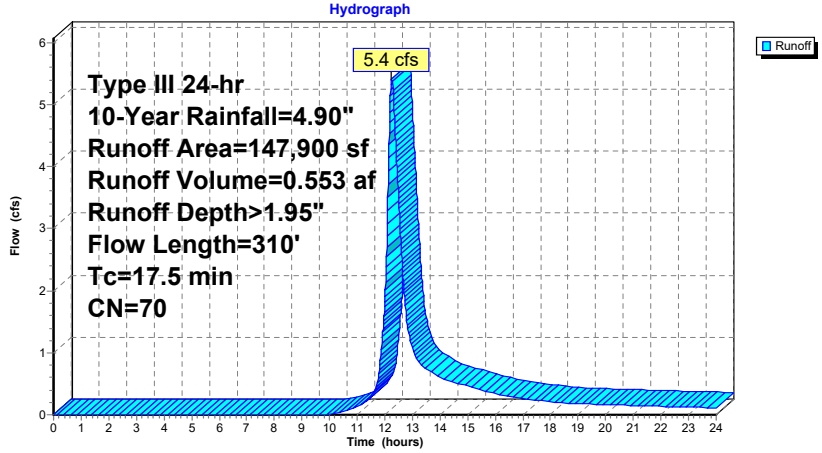
Runoff = 5.4 cfs @ 12.25 hrs, Volume= 0.553 af, Depth> 1.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
147,900	70	Woods, Good, HSG C
147,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

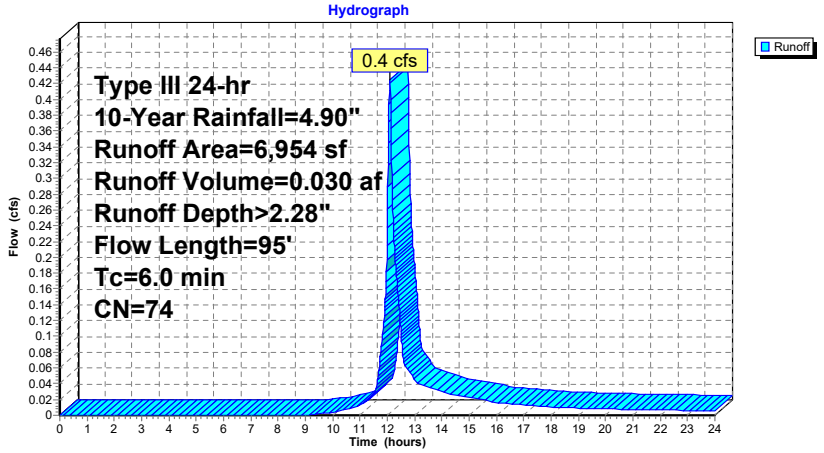
Runoff = 0.4 cfs @ 12.09 hrs, Volume= 0.030 af, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=147,900 sf 0.00% Impervious Runoff Depth>2.95"
Flow Length=310' Tc=17.5 min CN=70 Runoff=8.3 cfs 0.836 af

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>3.35"
Flow Length=95' Tc=6.0 min CN=74 Runoff=0.6 cfs 0.045 af

Total Runoff Area = 3.555 ac Runoff Volume = 0.880 af Average Runoff Depth = 2.97"
99.40% Pervious = 3.534 ac 0.60% Impervious = 0.021 ac

Summary for Subcatchment 1S: Flow to Wetlands

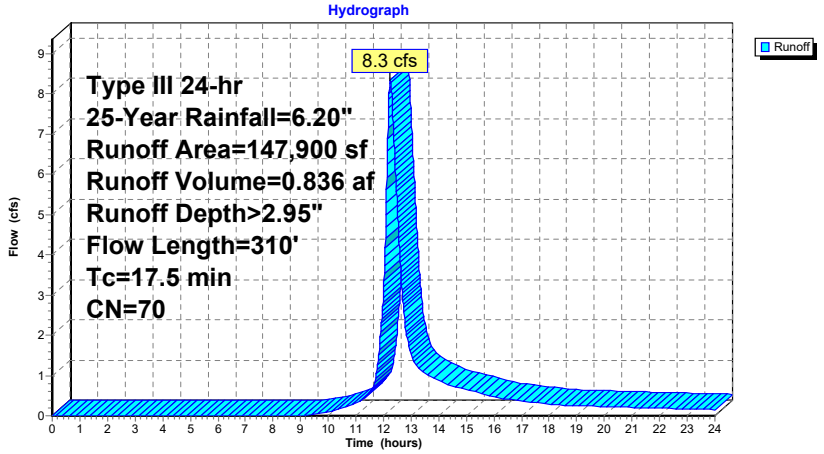
Runoff = 8.3 cfs @ 12.24 hrs, Volume= 0.836 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
147,900	70	Woods, Good, HSG C
147,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

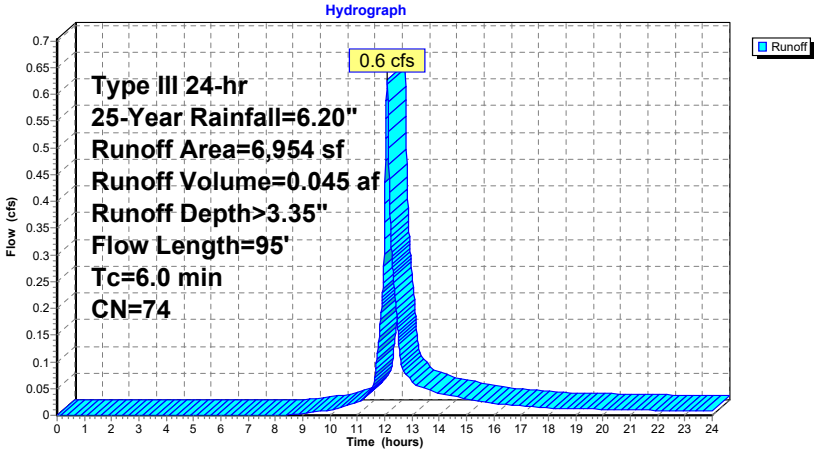
Runoff = 0.6 cfs @ 12.09 hrs, Volume= 0.045 af, Depth> 3.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=147,900 sf 0.00% Impervious Runoff Depth>3.96"
Flow Length=310' Tc=17.5 min CN=70 Runoff=11.3 cfs 1.122 af

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>4.41"
Flow Length=95' Tc=6.0 min CN=74 Runoff=0.8 cfs 0.059 af

Total Runoff Area = 3.555 ac Runoff Volume = 1.180 af Average Runoff Depth = 3.98"
99.40% Pervious = 3.534 ac 0.60% Impervious = 0.021 ac

Summary for Subcatchment 1S: Flow to Wetlands

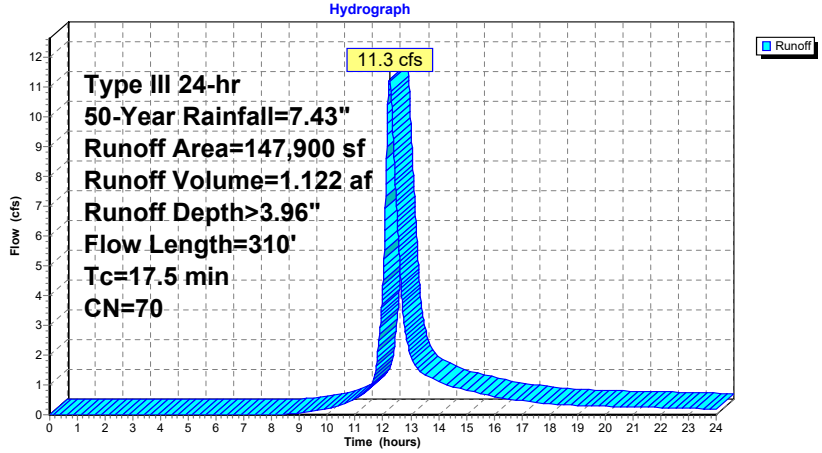
Runoff = 11.3 cfs @ 12.24 hrs, Volume= 1.122 af, Depth> 3.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
147,900	70	Woods, Good, HSG C
147,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

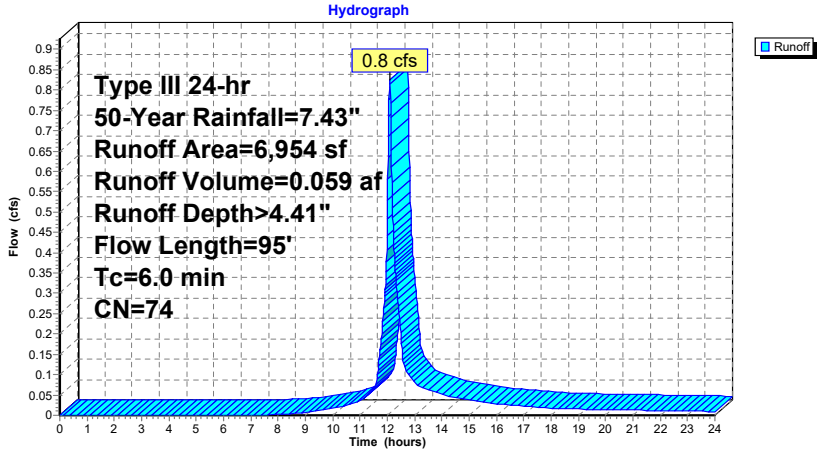
Runoff = 0.8 cfs @ 12.09 hrs, Volume= 0.059 af, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Flow to Wetlands Runoff Area=147,900 sf 0.00% Impervious Runoff Depth>5.22"
Flow Length=310' Tc=17.5 min CN=70 Runoff=14.9 cfs 1.477 af

Subcatchment 2S: Flow to Street Runoff Area=6,954 sf 13.30% Impervious Runoff Depth>5.72"
Flow Length=95' Tc=6.0 min CN=74 Runoff=1.1 cfs 0.076 af

Total Runoff Area = 3.555 ac Runoff Volume = 1.553 af Average Runoff Depth = 5.24"
99.40% Pervious = 3.534 ac 0.60% Impervious = 0.021 ac

Summary for Subcatchment 1S: Flow to Wetlands

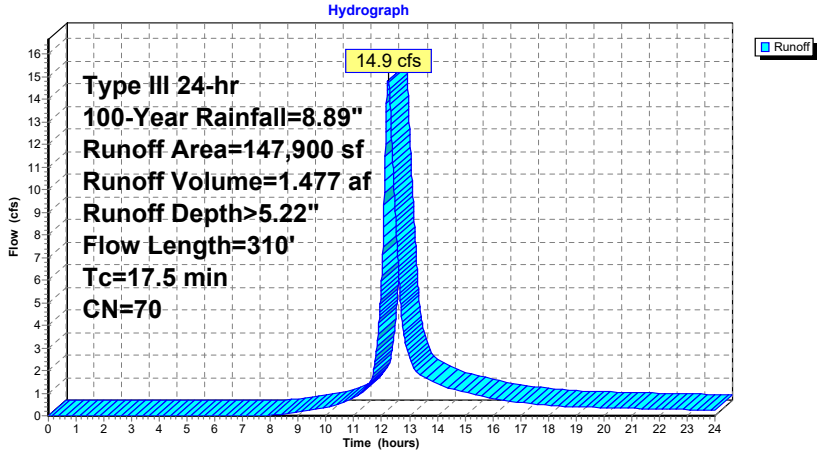
Runoff = 14.9 cfs @ 12.23 hrs, Volume= 1.477 af, Depth> 5.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
147,900	70	Woods, Good, HSG C
147,900		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	50	0.0240	0.07		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
6.1	260	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
17.5	310	Total			

Subcatchment 1S: Flow to Wetlands



Summary for Subcatchment 2S: Flow to Street

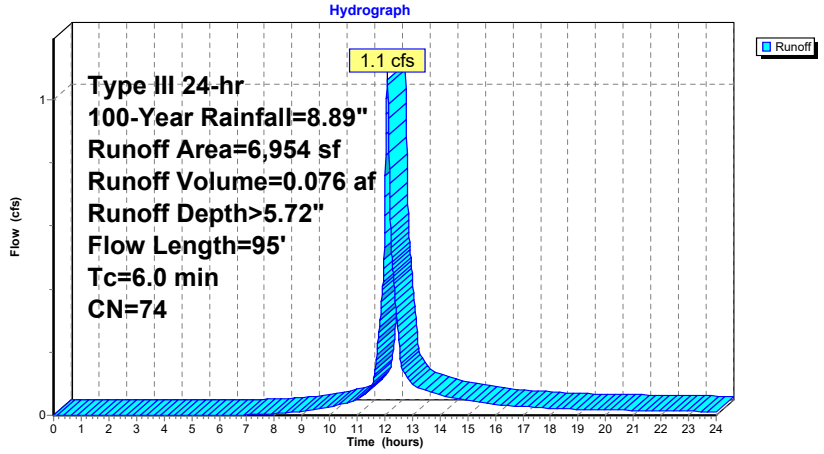
Runoff = 1.1 cfs @ 12.09 hrs, Volume= 0.076 af, Depth> 5.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

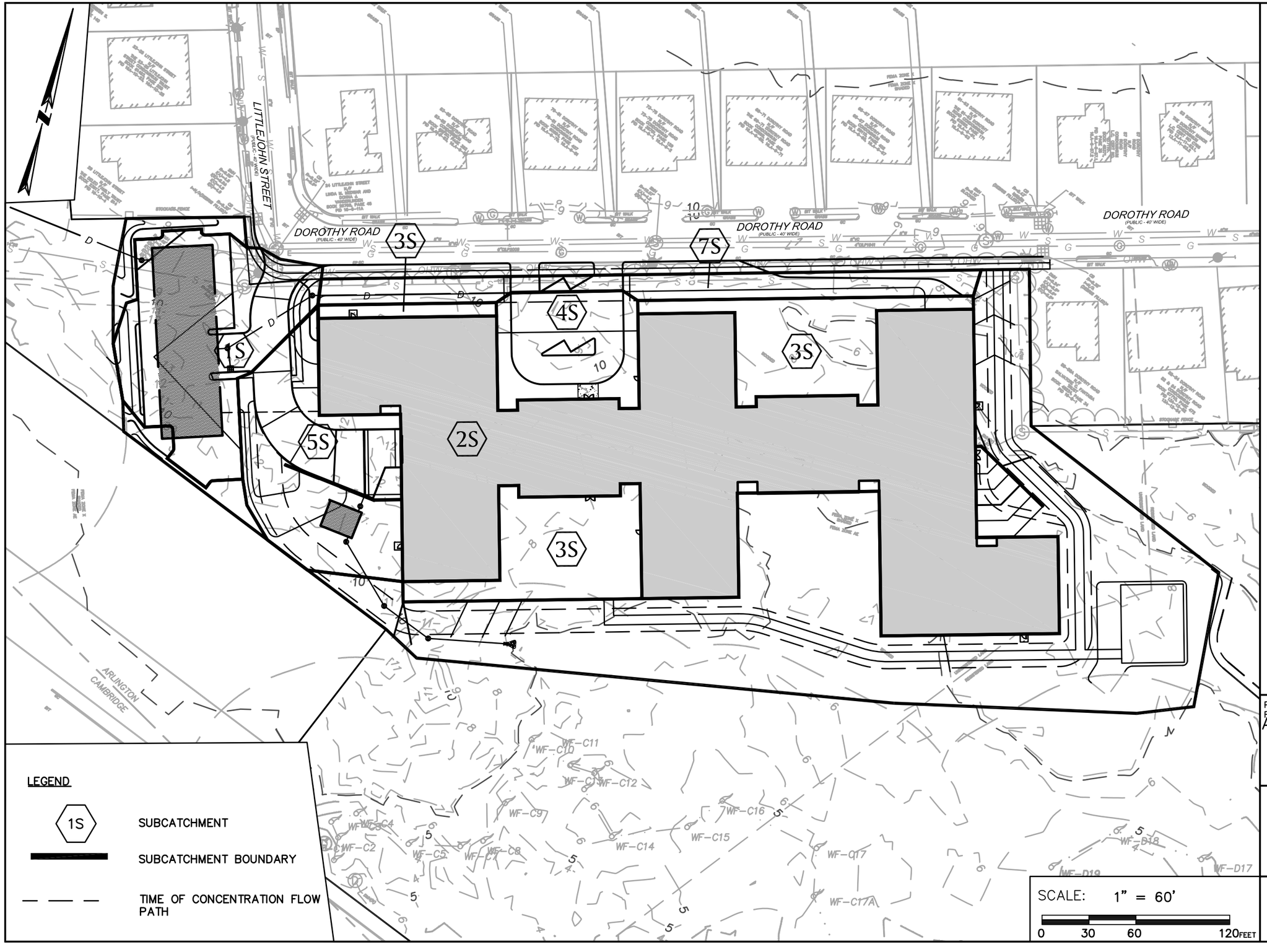
Area (sf)	CN	Description
6,029	70	Woods, Good, HSG C
925	98	Paved parking, HSG C
6,954	74	Weighted Average
6,029		86.70% Pervious Area
925		13.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	20	0.0750	0.10		**Sheet Flow, A to B** Woods: Light underbrush n= 0.400 P2= 3.23"
1.8	75	0.0200	0.71		**Shallow Concentrated Flow, B to C** Woodland Kv= 5.0 fps
5.3	95	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 2S: Flow to Street



5.03 PROPOSED WATERSHED PLAN



THORNDIKE PLACE

DOROTHY ROAD

ARLINGTON
MASSACHUSETTS
(MIDDLESEX COUNTY)

PROPOSED WATERSHED PLAN

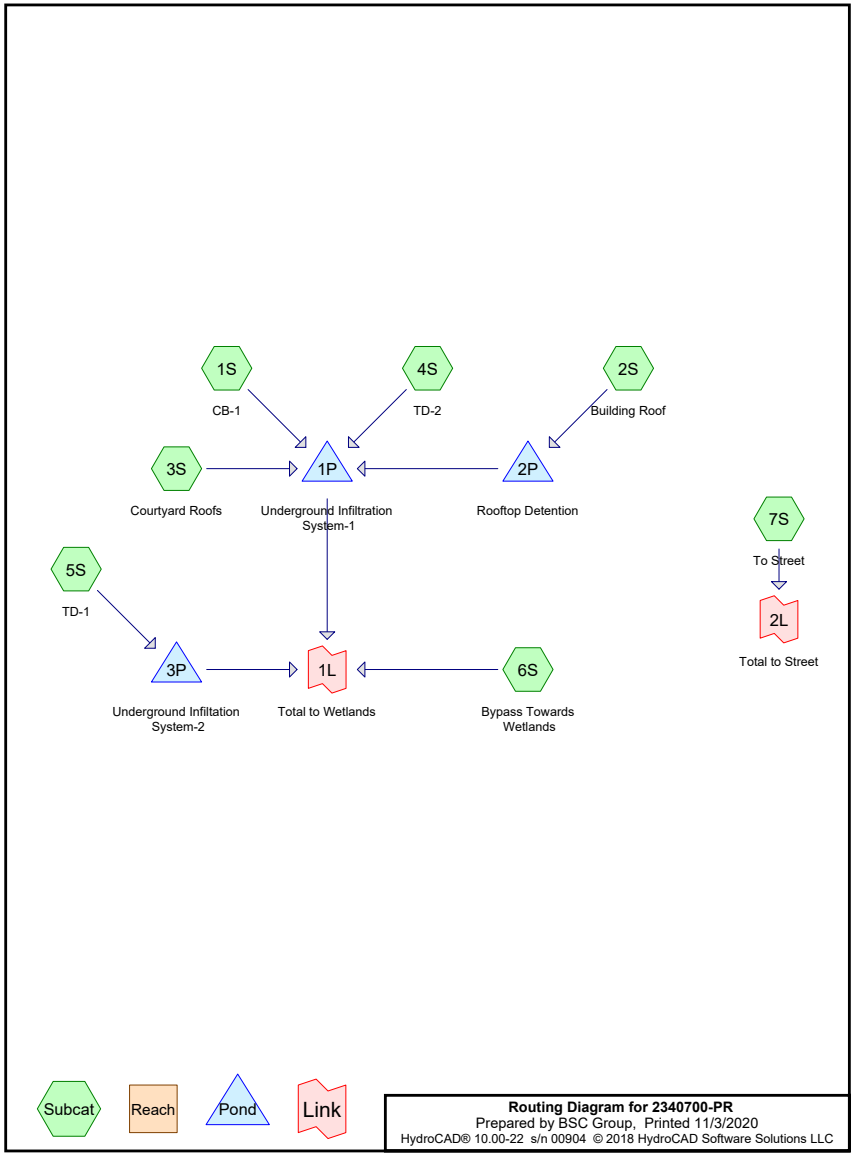
NOVEMBER 3, 2020

PREPARED FOR:
ARLINGTON LAND REALTY
84 SHERMAN STREET
CAMBRIDGE, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 23407.00 Date: 11/3/2020
Scale: 1" = 60' Revised:
Dwg No: PRW
File: C\DRAINAGE DESIGN\2340700-PRW

5.04 PROPOSED HYDROLOGY CALCULATIONS (HYDROCAD™ PRINTOUTS)



Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.369	74	>75% Grass cover, Good, HSG C (1S, 5S, 6S, 7S)
0.479	98	Paved parking, HSG C (1S, 4S, 5S, 7S)
1.552	98	Roofs, HSG C (2S, 3S, 5S)
0.155	70	Woods, Good, HSG C (6S)
3.555	**88**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
3.555	HSG C	1S, 2S, 3S, 4S, 5S, 6S, 7S
0.000	HSG D	
0.000	Other	
3.555		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.369	0.000	0.000	1.369	>75% Grass cover, Good	1S, 5S, 6S, 7S
0.000	0.000	0.479	0.000	0.000	0.479	Paved parking	1S, 4S, 5S, 7S
0.000	0.000	1.552	0.000	0.000	1.552	Roofs	2S, 3S, 5S
0.000	0.000	0.155	0.000	0.000	0.155	Woods, Good	6S
0.000	**0.000**	**3.555**	**0.000**	**0.000**	**3.555**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CB-1 Runoff Area=13,149 sf 83.09% Impervious Runoff Depth>2.57"
Tc=6.0 min CN=94 Runoff=0.9 cfs 0.065 af

Subcatchment 2S: Building Roof Runoff Area=51,814 sf 100.00% Impervious Runoff Depth>2.99"
Tc=6.0 min CN=98 Runoff=3.7 cfs 0.297 af

Subcatchment 3S: Courtyard Roofs Runoff Area=14,820 sf 100.00% Impervious Runoff Depth>2.99"
Tc=6.0 min CN=98 Runoff=1.1 cfs 0.085 af

Subcatchment 4S: TD-2 Runoff Area=6,330 sf 100.00% Impervious Runoff Depth>2.99"
Tc=6.0 min CN=98 Runoff=0.5 cfs 0.036 af

Subcatchment 5S: TD-1 Runoff Area=11,872 sf 34.45% Impervious Runoff Depth>1.56"
Tc=6.0 min CN=82 Runoff=0.5 cfs 0.035 af

Subcatchment 6S: Bypass Towards Runoff Area=50,395 sf 0.00% Impervious Runoff Depth>1.00"
Tc=0.0 min CN=73 Runoff=1.6 cfs 0.097 af

Subcatchment 7S: To Street Runoff Area=6,474 sf 7.57% Impervious Runoff Depth>1.17"
Tc=6.0 min CN=76 Runoff=0.2 cfs 0.015 af

Pond 1P: Underground Infiltration System-1 Peak Elev=6.51' Storage=6,223 cf Inflow=2.4 cfs 0.186 af
Discarded=0.0 cfs 0.044 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.044 af

Pond 2P: Rooftop Detention Peak Elev=57.34' Storage=12,931 cf Inflow=3.7 cfs 0.297 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0200 '/' Outflow=0.0 cfs 0.000 af

Pond 3P: Underground Infiltation System-2 Peak Elev=8.40' Storage=449 cf Inflow=0.5 cfs 0.035 af
12.0" Round Culvert n=0.013 L=44.0' S=0.0050 '/' Outflow=0.5 cfs 0.025 af

Link 1L: Total to Wetlands Inflow=1.6 cfs 0.122 af
Primary=1.6 cfs 0.122 af

Link 2L: Total to Street Inflow=0.2 cfs 0.015 af
Primary=0.2 cfs 0.015 af

Total Runoff Area = 3.555 ac Runoff Volume = 0.629 af Average Runoff Depth = 2.12"
42.87% Pervious = 1.524 ac 57.13% Impervious = 2.031 ac

Summary for Subcatchment 1S: CB-1

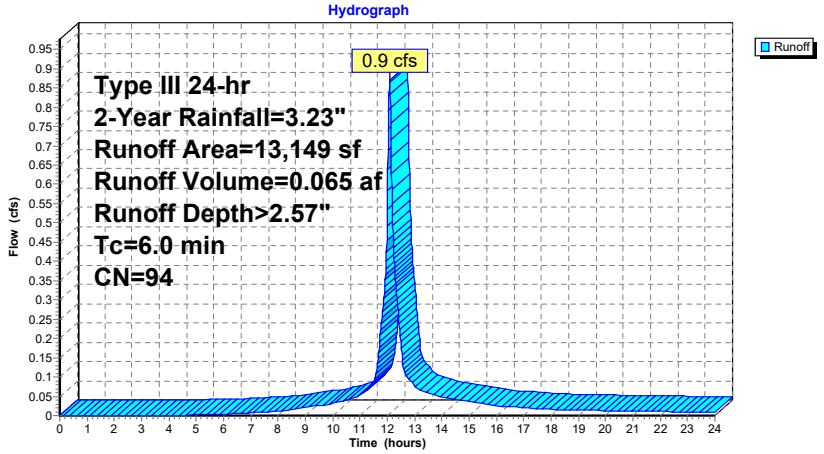
Runoff = 0.9 cfs @ 12.08 hrs, Volume= 0.065 af, Depth> 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
10,925	98	Paved parking, HSG C
2,224	74	>75% Grass cover, Good, HSG C
13,149	94	Weighted Average
2,224		16.91% Pervious Area
10,925		83.09% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

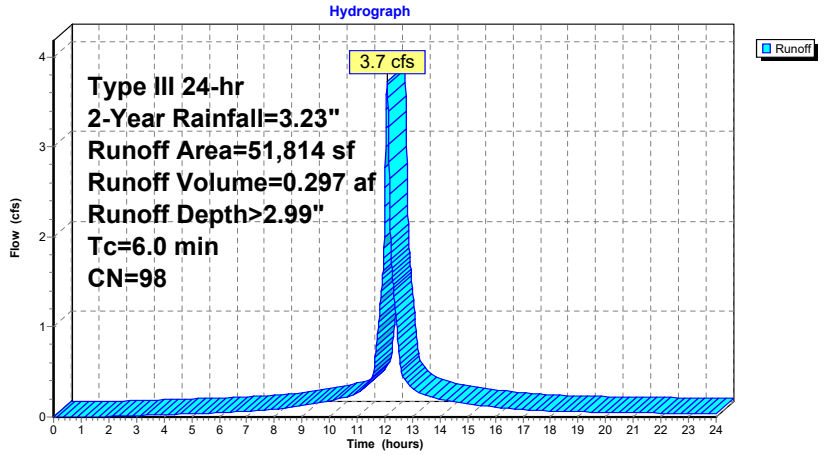
Runoff = 3.7 cfs @ 12.08 hrs, Volume= 0.297 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
51,814	98	Roofs, HSG C
51,814		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3S: Courtyard Roofs

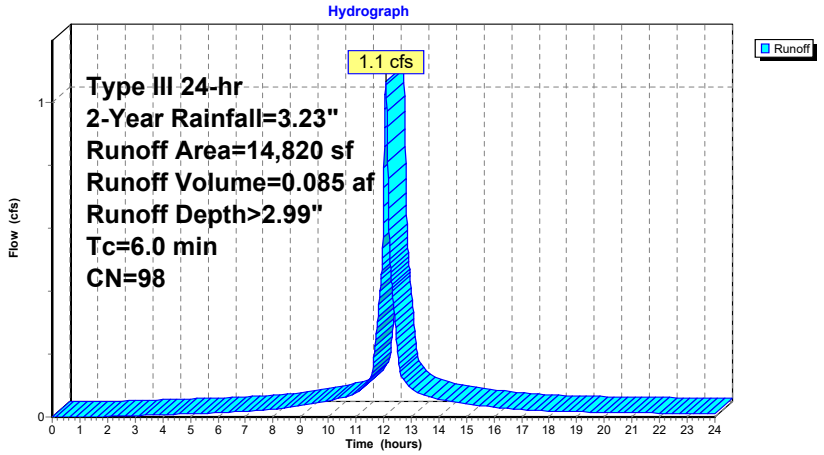
Runoff = 1.1 cfs @ 12.08 hrs, Volume= 0.085 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
14,820	98	Roofs, HSG C
14,820		100.00% Impervious Area

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

Subcatchment 3S: Courtyard Roofs



Summary for Subcatchment 4S: TD-2

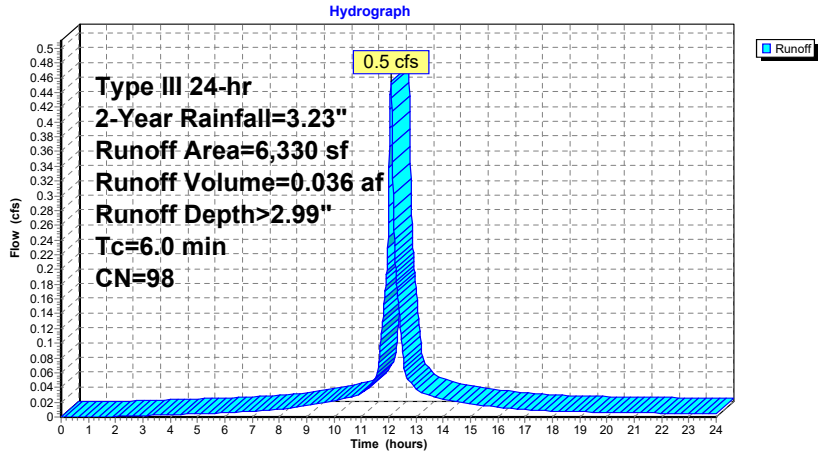
Runoff = 0.5 cfs @ 12.08 hrs, Volume= 0.036 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
6,330	98	Paved parking, HSG C
6,330		100.00% Impervious Area

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

Subcatchment 4S: TD-2



Summary for Subcatchment 5S: TD-1

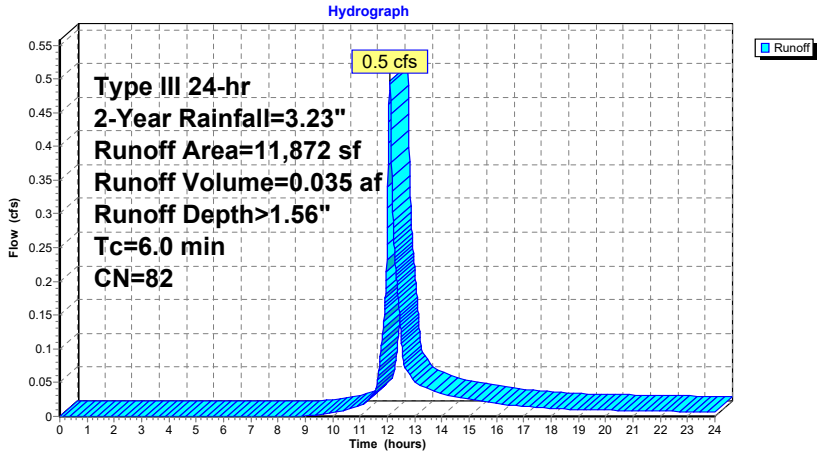
Runoff = 0.5 cfs @ 12.09 hrs, Volume= 0.035 af, Depth> 1.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
980	98	Roofs, HSG C
3,110	98	Paved parking, HSG C
7,782	74	>75% Grass cover, Good, HSG C
11,872	82	Weighted Average
7,782		65.55% Pervious Area
4,090		34.45% Impervious Area

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

Subcatchment 5S: TD-1



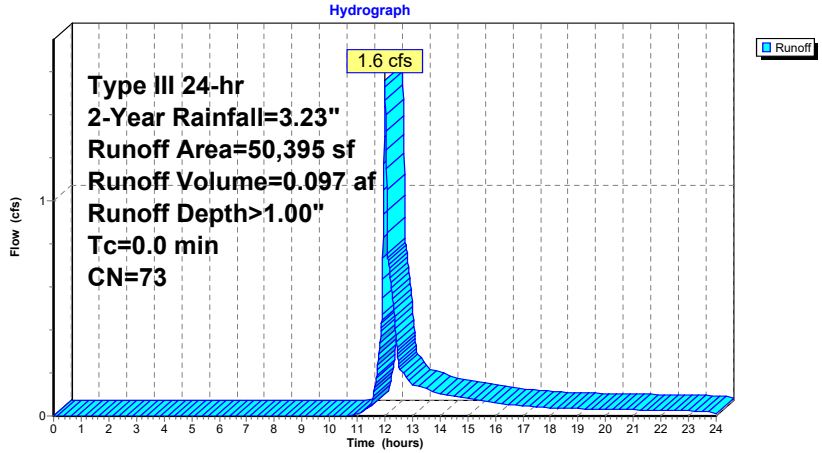
Summary for Subcatchment 6S: Bypass Towards Wetlands

Runoff = 1.6 cfs @ 12.00 hrs, Volume= 0.097 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
6,751	70	Woods, Good, HSG C
43,644	74	>75% Grass cover, Good, HSG C
50,395	73	Weighted Average
50,395		100.00% Pervious Area

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

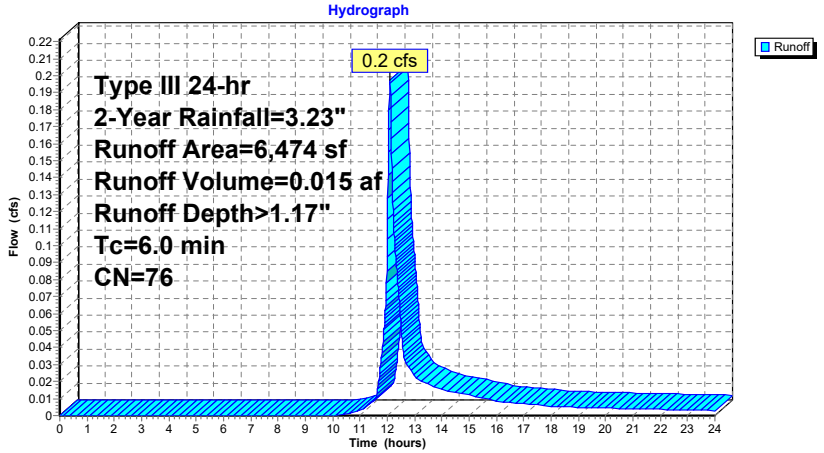
Runoff = 0.2 cfs @ 12.09 hrs, Volume= 0.015 af, Depth> 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.23"

Area (sf)	CN	Description
490	98	Paved parking, HSG C
5,984	74	>75% Grass cover, Good, HSG C
6,474	76	Weighted Average
5,984		92.43% Pervious Area
490		7.57% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Underground Infiltration System-1

Inflow Area = 1.977 ac, 97.42% Impervious, Inflow Depth > 1.13" for 2-Year event
Inflow = 2.4 cfs @ 12.08 hrs, Volume= 0.186 af
Outflow = 0.0 cfs @ 8.21 hrs, Volume= 0.044 af, Atten= 99%, Lag= 0.0 min
Discarded = 0.0 cfs @ 8.21 hrs, Volume= 0.044 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 6.51' @ 21.34 hrs Surf.Area= 4,692 sf Storage= 6,223 cf

Plug-Flow detention time= 329.0 min calculated for 0.044 af (24% of inflow)
Center-of-Mass det. time= 126.7 min (893.0 - 766.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	0 cf	**38.75'W x 121.08'L x 3.00'H Field A** 14,076 cf Overall - 14,076 cf Embedded = 0 cf x 40.0% Voids
#2A	5.00'	10,260 cf	**StormTrap ST2 SingleTrap 2-6** x 21 Inside #1 Inside= 101.7"W x 30.0"H => 18.82 sf x 15.40'L = 289.8 cf Outside= 101.7"W x 36.0"H => 25.44 sf x 15.40'L = 391.6 cf 3 Rows of 7 Chambers 25.44' x 107.77' Core + 6.66' Border = 38.75' x 121.08' System
#3	5.00'	141 cf	**6.00'D x 5.00'H OCS-1**-Impervious
		10,401 cf	Total Available Storage

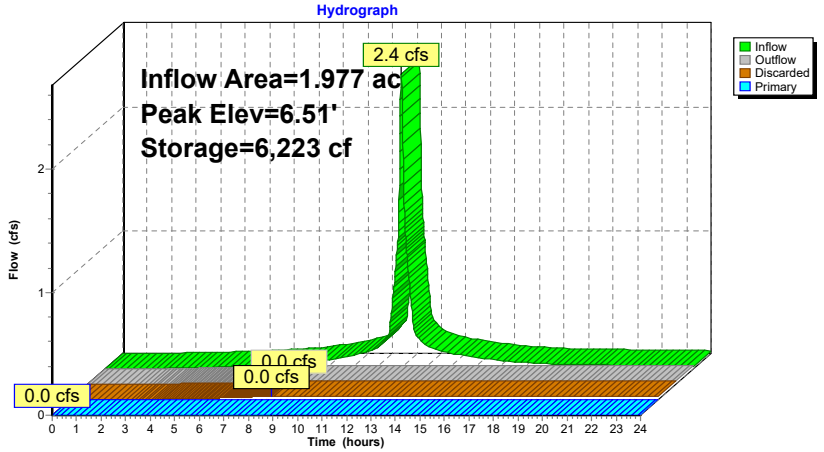
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.20'	**15.0" Round Culvert** L= 130.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.20' / 6.55' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.0 cfs @ 8.21 hrs HW=5.05' (Free Discharge)
↳**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=5.00' (Free Discharge)
↳**2=Culvert** (Controls 0.0 cfs)

Pond 1P: Underground Infiltration System-1



Summary for Pond 2P: Rooftop Detention

Inflow Area = 1.189 ac,100.00% Impervious, Inflow Depth > 2.99" for 2-Year event
Inflow = 3.7 cfs @ 12.08 hrs, Volume= 0.297 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.34' @ 24.00 hrs Surf.Area= 38,000 sf Storage= 12,931 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

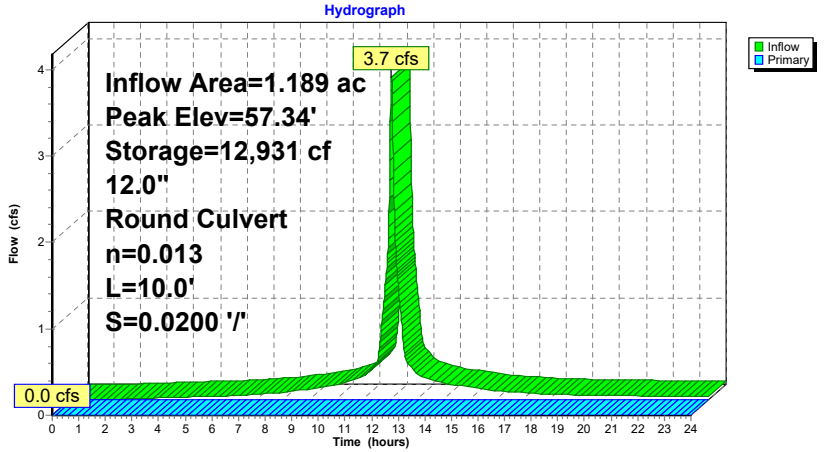
Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	38,000 cf	**Rooftop Detention (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	38,000	0	0
58.00	38,000	38,000	38,000

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Roof Drain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.00' / 57.80' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=57.00' (Free Discharge)
↳**1=Roof Drain** (Controls 0.0 cfs)

Pond 2P: Rooftop Detention



Summary for Pond 3P: Underground Infiltation System-2

Inflow Area = 0.273 ac, 34.45% Impervious, Inflow Depth > 1.56" for 2-Year event
Inflow = 0.5 cfs @ 12.09 hrs, Volume= 0.035 af
Outflow = 0.5 cfs @ 12.12 hrs, Volume= 0.025 af, Atten= 0%, Lag= 2.0 min
Primary = 0.5 cfs @ 12.12 hrs, Volume= 0.025 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 8.40' @ 12.12 hrs Surf.Area= 388 sf Storage= 449 cf

Plug-Flow detention time= 150.1 min calculated for 0.025 af (71% of inflow)
Center-of-Mass det. time= 54.0 min (889.0 - 835.0)

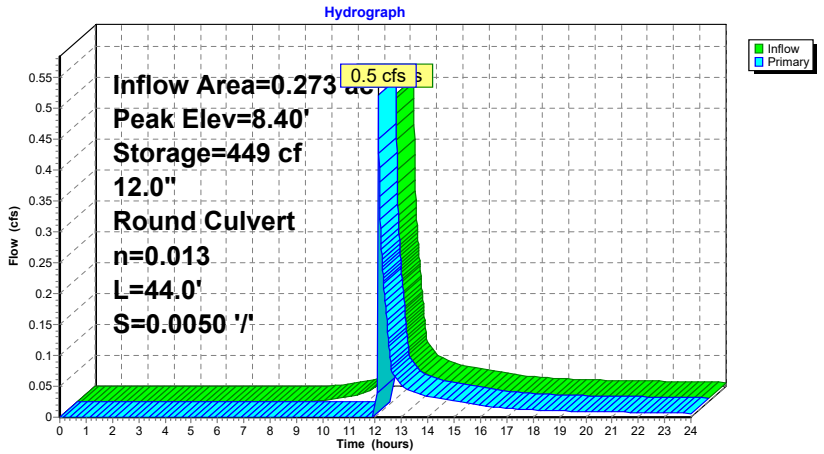
Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	204 cf	**21.50'W x 17.44'L x 1.83'H Field A** 687 cf Overall - 177 cf Embedded = 511 cf x 40.0% Voids
#2A	3.00'	177 cf	**ADS_StormTech SC-310 +Cap** x 12 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 6 Rows of 2 Chambers
#3	3.00'	75 cf	**4.00'D x 6.00'H OCS**
		457 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.00'	**12.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.78' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.5 cfs @ 12.12 hrs HW=8.40' (Free Discharge)
└**1=Culvert** (Barrel Controls 0.5 cfs @ 2.33 fps)

Pond 3P: Underground Infiltation System-2

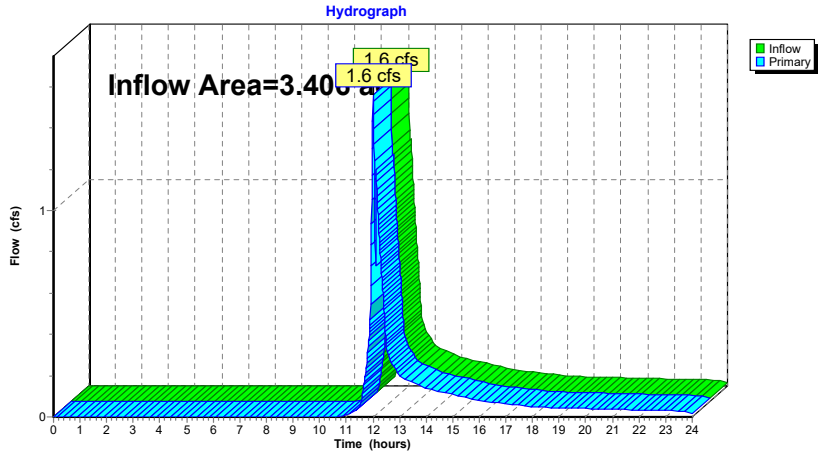


Summary for Link 1L: Total to Wetlands

Inflow Area = 3.406 ac, 59.29% Impervious, Inflow Depth > 0.43" for 2-Year event
Inflow = 1.6 cfs @ 12.00 hrs, Volume= 0.122 af
Primary = 1.6 cfs @ 12.00 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetlands

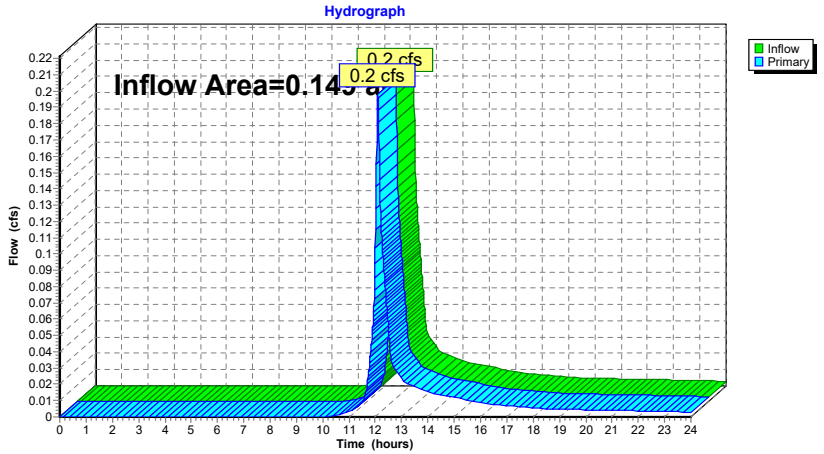


Summary for Link 2L: Total to Street

Inflow Area = 0.149 ac, 7.57% Impervious, Inflow Depth > 1.17" for 2-Year event
Inflow = 0.2 cfs @ 12.09 hrs, Volume= 0.015 af
Primary = 0.2 cfs @ 12.09 hrs, Volume= 0.015 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Total to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CB-1 Runoff Area=13,149 sf 83.09% Impervious Runoff Depth>4.21"
Tc=6.0 min CN=94 Runoff=1.4 cfs 0.106 af

Subcatchment 2S: Building Roof Runoff Area=51,814 sf 100.00% Impervious Runoff Depth>4.66"
Tc=6.0 min CN=98 Runoff=5.7 cfs 0.462 af

Subcatchment 3S: Courtyard Roofs Runoff Area=14,820 sf 100.00% Impervious Runoff Depth>4.66"
Tc=6.0 min CN=98 Runoff=1.6 cfs 0.132 af

Subcatchment 4S: TD-2 Runoff Area=6,330 sf 100.00% Impervious Runoff Depth>4.66"
Tc=6.0 min CN=98 Runoff=0.7 cfs 0.056 af

Subcatchment 5S: TD-1 Runoff Area=11,872 sf 34.45% Impervious Runoff Depth>2.99"
Tc=6.0 min CN=82 Runoff=1.0 cfs 0.068 af

Subcatchment 6S: Bypass Towards Runoff Area=50,395 sf 0.00% Impervious Runoff Depth>2.20"
Tc=0.0 min CN=73 Runoff=3.6 cfs 0.212 af

Subcatchment 7S: To Street Runoff Area=6,474 sf 7.57% Impervious Runoff Depth>2.45"
Tc=6.0 min CN=76 Runoff=0.4 cfs 0.030 af

Pond 1P: Underground Infiltration System-1 Peak Elev=7.34' Storage=9,685 cf Inflow=3.7 cfs 0.294 af
Discarded=0.0 cfs 0.048 af Primary=0.1 cfs 0.032 af Outflow=0.1 cfs 0.080 af

Pond 2P: Rooftop Detention Peak Elev=57.53' Storage=20,119 cf Inflow=5.7 cfs 0.462 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0200 '/' Outflow=0.0 cfs 0.000 af

Pond 3P: Underground Infiltation System-2 Peak Elev=8.60' Storage=451 cf Inflow=1.0 cfs 0.068 af
12.0" Round Culvert n=0.013 L=44.0' S=0.0050 '/' Outflow=1.0 cfs 0.058 af

Link 1L: Total to Wetlands Inflow=4.2 cfs 0.302 af
Primary=4.2 cfs 0.302 af

Link 2L: Total to Street Inflow=0.4 cfs 0.030 af
Primary=0.4 cfs 0.030 af

Total Runoff Area = 3.555 ac Runoff Volume = 1.067 af Average Runoff Depth = 3.60"
42.87% Pervious = 1.524 ac 57.13% Impervious = 2.031 ac

Summary for Subcatchment 1S: CB-1

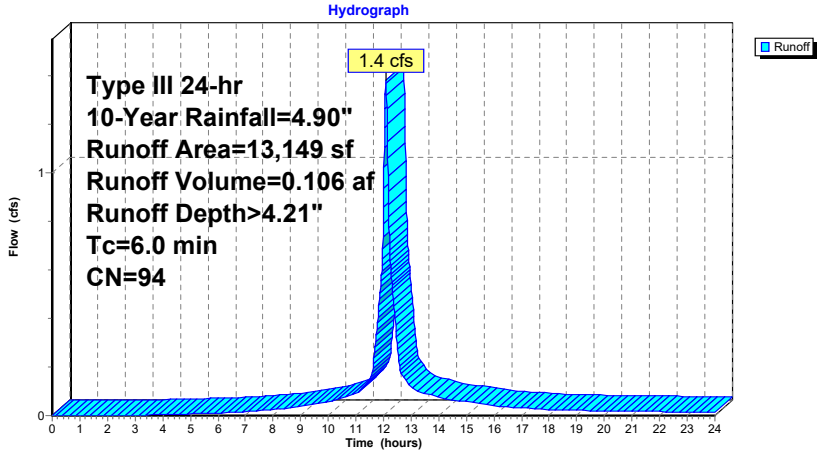
Runoff = 1.4 cfs @ 12.08 hrs, Volume= 0.106 af, Depth> 4.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
10,925	98	Paved parking, HSG C
2,224	74	>75% Grass cover, Good, HSG C
13,149	94	Weighted Average
2,224		16.91% Pervious Area
10,925		83.09% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

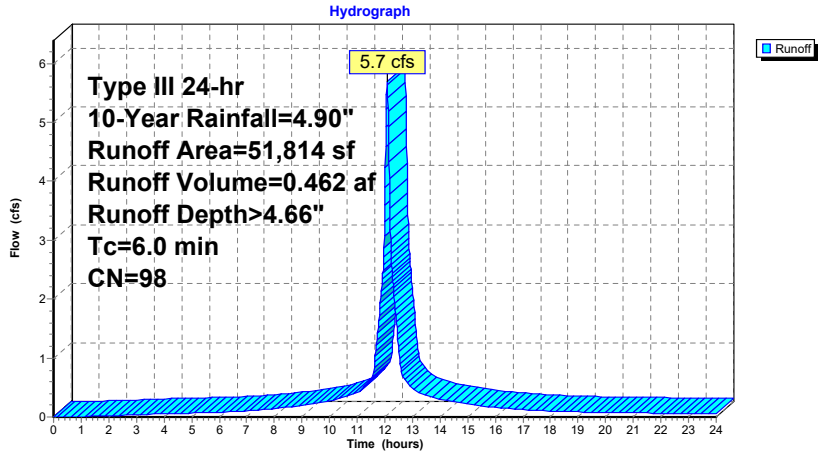
Runoff = 5.7 cfs @ 12.08 hrs, Volume= 0.462 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
51,814	98	Roofs, HSG C
51,814		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3S: Courtyard Roofs

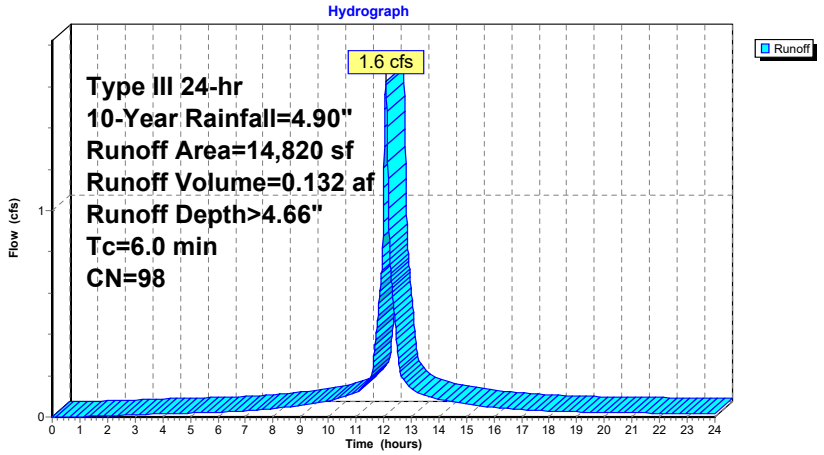
Runoff = 1.6 cfs @ 12.08 hrs, Volume= 0.132 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
14,820	98	Roofs, HSG C
14,820		100.00% Impervious Area

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

Subcatchment 3S: Courtyard Roofs



Summary for Subcatchment 4S: TD-2

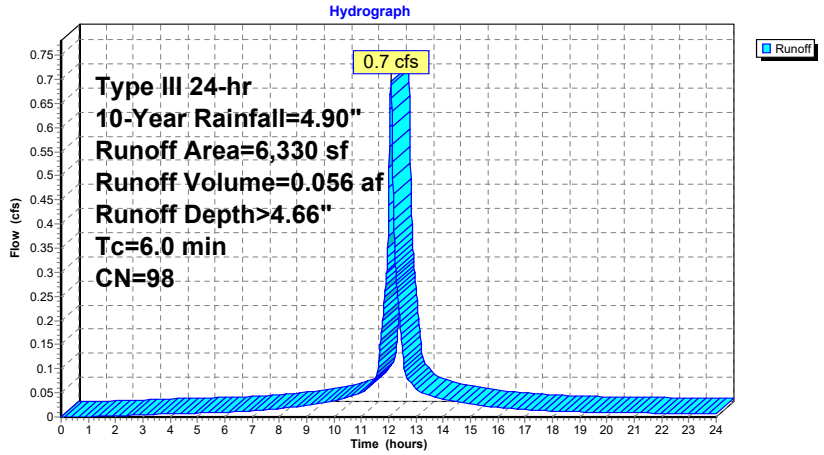
Runoff = 0.7 cfs @ 12.08 hrs, Volume= 0.056 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
6,330	98	Paved parking, HSG C
6,330		100.00% Impervious Area

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

Subcatchment 4S: TD-2



Summary for Subcatchment 5S: TD-1

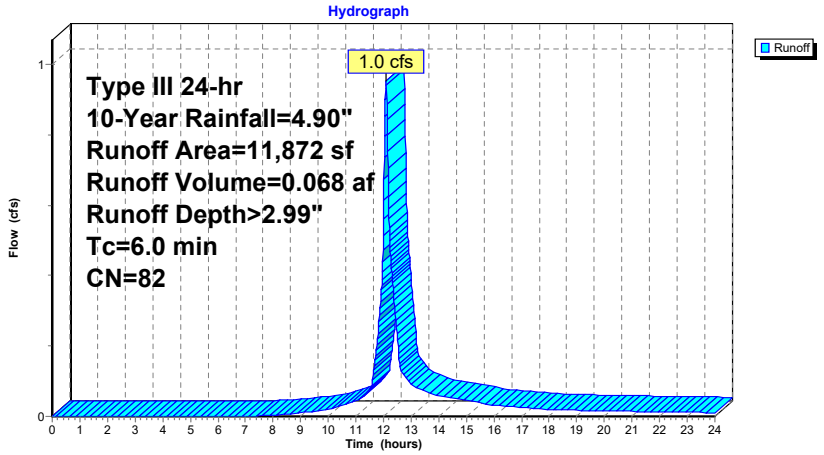
Runoff = 1.0 cfs @ 12.09 hrs, Volume= 0.068 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
980	98	Roofs, HSG C
3,110	98	Paved parking, HSG C
7,782	74	>75% Grass cover, Good, HSG C
11,872	82	Weighted Average
7,782		65.55% Pervious Area
4,090		34.45% Impervious Area

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

Subcatchment 5S: TD-1



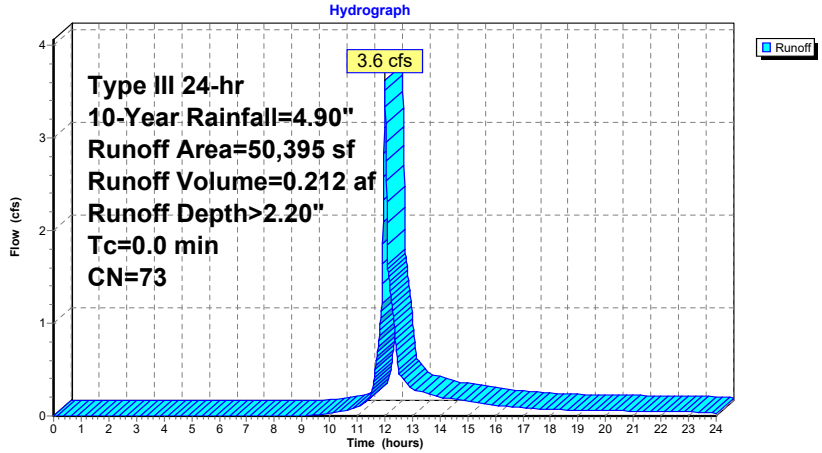
Summary for Subcatchment 6S: Bypass Towards Wetlands

Runoff = 3.6 cfs @ 12.00 hrs, Volume= 0.212 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
6,751	70	Woods, Good, HSG C
43,644	74	>75% Grass cover, Good, HSG C
50,395	73	Weighted Average
50,395		100.00% Pervious Area

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

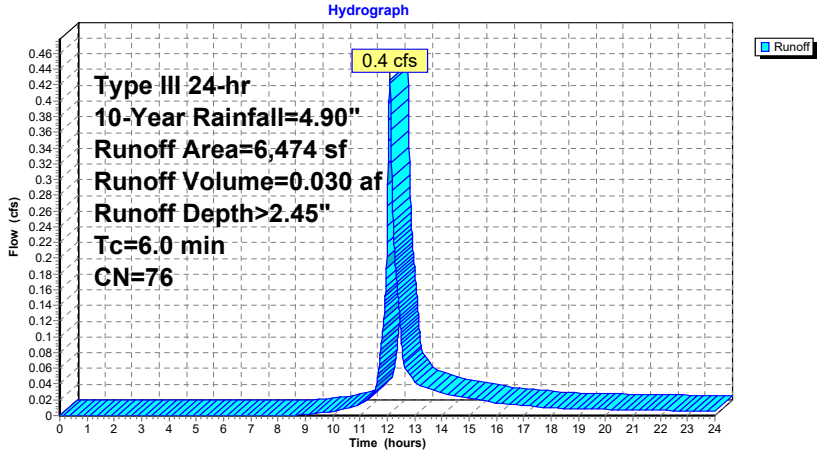
Runoff = 0.4 cfs @ 12.09 hrs, Volume= 0.030 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.90"

Area (sf)	CN	Description
490	98	Paved parking, HSG C
5,984	74	>75% Grass cover, Good, HSG C
6,474	76	Weighted Average
5,984		92.43% Pervious Area
490		7.57% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Underground Infiltration System-1

Inflow Area = 1.977 ac, 97.42% Impervious, Inflow Depth > 1.79" for 10-Year event
Inflow = 3.7 cfs @ 12.08 hrs, Volume= 0.294 af
Outflow = 0.1 cfs @ 16.13 hrs, Volume= 0.080 af, Atten= 97%, Lag= 243.0 min
Discarded = 0.0 cfs @ 6.28 hrs, Volume= 0.048 af
Primary = 0.1 cfs @ 16.13 hrs, Volume= 0.032 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 7.34' @ 16.13 hrs Surf.Area= 4,692 sf Storage= 9,685 cf

Plug-Flow detention time= 382.7 min calculated for 0.080 af (27% of inflow)
Center-of-Mass det. time= 185.0 min (942.1 - 757.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	0 cf	**38.75'W x 121.08'L x 3.00'H Field A** 14,076 cf Overall - 14,076 cf Embedded = 0 cf x 40.0% Voids
#2A	5.00'	10,260 cf	**StormTrap ST2 SingleTrap 2-6** x 21 Inside #1 Inside= 101.7"W x 30.0"H => 18.82 sf x 15.40'L = 289.8 cf Outside= 101.7"W x 36.0"H => 25.44 sf x 15.40'L = 391.6 cf 3 Rows of 7 Chambers 25.44' x 107.77' Core + 6.66' Border = 38.75' x 121.08' System
#3	5.00'	141 cf	**6.00'D x 5.00'H OCS-1**-Impervious
		10,401 cf	Total Available Storage

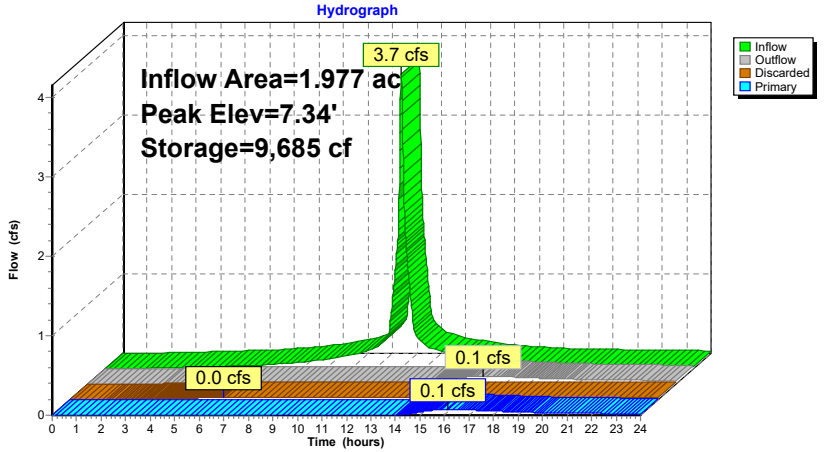
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.20'	**15.0" Round Culvert** L= 130.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.20' / 6.55' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.0 cfs @ 6.28 hrs HW=5.05' (Free Discharge)
↳**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 16.13 hrs HW=7.34' (Free Discharge)
↳**2=Culvert** (Barrel Controls 0.1 cfs @ 1.35 fps)

Pond 1P: Underground Infiltration System-1



Summary for Pond 2P: Rooftop Detention

Inflow Area = 1.189 ac,100.00% Impervious, Inflow Depth > 4.66" for 10-Year event
Inflow = 5.7 cfs @ 12.08 hrs, Volume= 0.462 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.53' @ 24.00 hrs Surf.Area= 38,000 sf Storage= 20,119 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

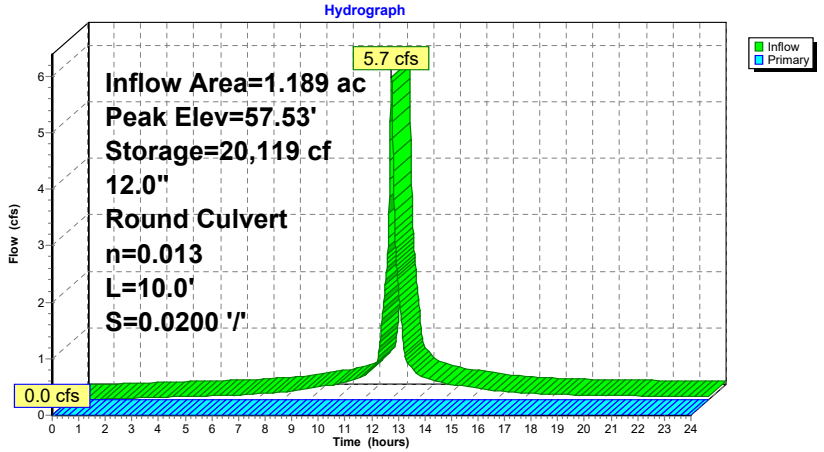
Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	38,000 cf	**Rooftop Detention (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	38,000	0	0
58.00	38,000	38,000	38,000

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Roof Drain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.00' / 57.80' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=57.00' (Free Discharge)
↑**1=Roof Drain** (Controls 0.0 cfs)

Pond 2P: Rooftop Detention



Summary for Pond 3P: Underground Infiltation System-2

Inflow Area = 0.273 ac, 34.45% Impervious, Inflow Depth > 2.99" for 10-Year event
Inflow = 1.0 cfs @ 12.09 hrs, Volume= 0.068 af
Outflow = 1.0 cfs @ 12.09 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.1 min
Primary = 1.0 cfs @ 12.09 hrs, Volume= 0.058 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 8.60' @ 12.09 hrs Surf.Area= 388 sf Storage= 451 cf

Plug-Flow detention time= 93.6 min calculated for 0.058 af (85% of inflow)
Center-of-Mass det. time= 29.4 min (845.9 - 816.4)

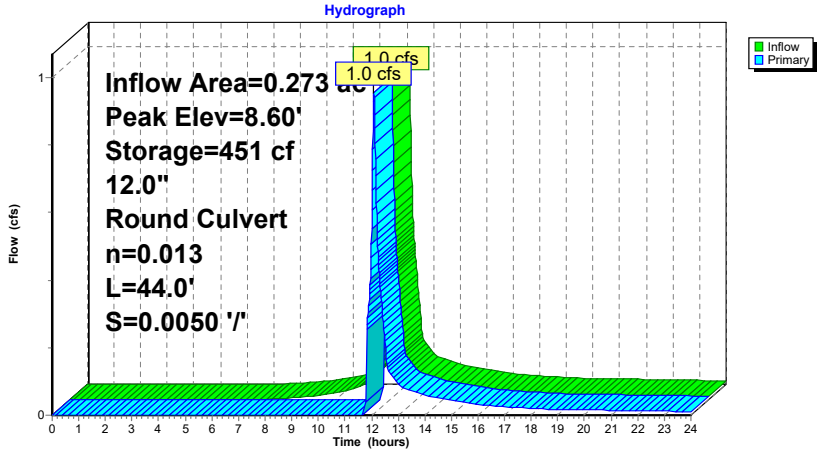
Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	204 cf	**21.50'W x 17.44'L x 1.83'H Field A** 687 cf Overall - 177 cf Embedded = 511 cf x 40.0% Voids
#2A	3.00'	177 cf	**ADS_StormTech SC-310 +Cap** x 12 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 6 Rows of 2 Chambers
#3	3.00'	75 cf	**4.00'D x 6.00'H OCS**
		457 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.00'	**12.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.78' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.0 cfs @ 12.09 hrs HW=8.60' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.0 cfs @ 2.80 fps)

Pond 3P: Underground Infiltation System-2

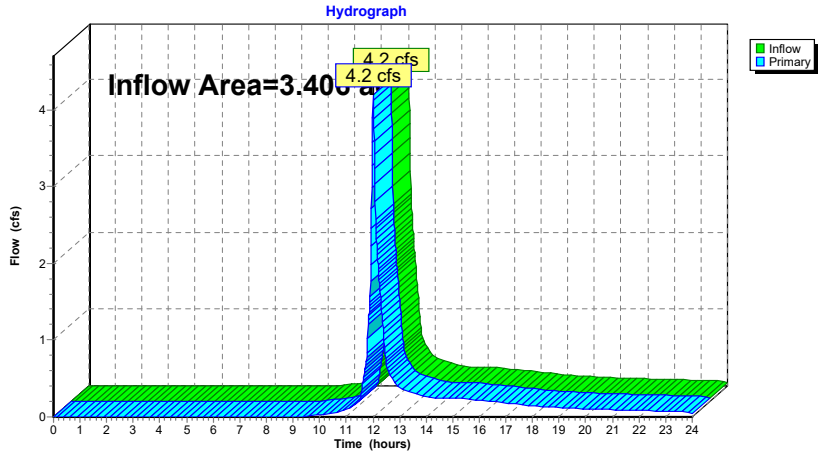


Summary for Link 1L: Total to Wetlands

Inflow Area = 3.406 ac, 59.29% Impervious, Inflow Depth > 1.06" for 10-Year event
Inflow = 4.2 cfs @ 12.00 hrs, Volume= 0.302 af
Primary = 4.2 cfs @ 12.00 hrs, Volume= 0.302 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetlands

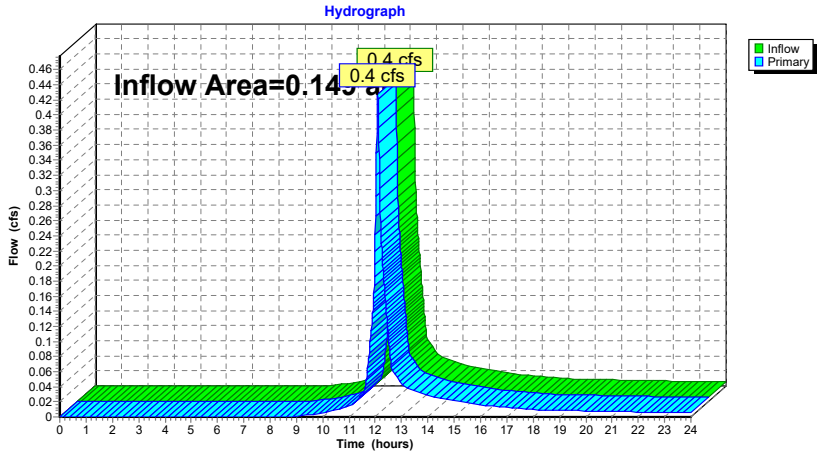


Summary for Link 2L: Total to Street

Inflow Area = 0.149 ac, 7.57% Impervious, Inflow Depth > 2.45" for 10-Year event
Inflow = 0.4 cfs @ 12.09 hrs, Volume= 0.030 af
Primary = 0.4 cfs @ 12.09 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Total to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CB-1 Runoff Area=13,149 sf 83.09% Impervious Runoff Depth>5.49"
Tc=6.0 min CN=94 Runoff=1.8 cfs 0.138 af

Subcatchment 2S: Building Roof Runoff Area=51,814 sf 100.00% Impervious Runoff Depth>5.96"
Tc=6.0 min CN=98 Runoff=7.2 cfs 0.590 af

Subcatchment 3S: Courtyard Roofs Runoff Area=14,820 sf 100.00% Impervious Runoff Depth>5.96"
Tc=6.0 min CN=98 Runoff=2.1 cfs 0.169 af

Subcatchment 4S: TD-2 Runoff Area=6,330 sf 100.00% Impervious Runoff Depth>5.96"
Tc=6.0 min CN=98 Runoff=0.9 cfs 0.072 af

Subcatchment 5S: TD-1 Runoff Area=11,872 sf 34.45% Impervious Runoff Depth>4.17"
Tc=6.0 min CN=82 Runoff=1.3 cfs 0.095 af

Subcatchment 6S: Bypass Towards Runoff Area=50,395 sf 0.00% Impervious Runoff Depth>3.26"
Tc=0.0 min CN=73 Runoff=5.4 cfs 0.314 af

Subcatchment 7S: To Street Runoff Area=6,474 sf 7.57% Impervious Runoff Depth>3.55"
Tc=6.0 min CN=76 Runoff=0.6 cfs 0.044 af

Pond 1P: Underground Infiltration System-1 Peak Elev=7.56' Storage=10,332 cf Inflow=4.7 cfs 0.379 af
Discarded=0.0 cfs 0.050 af Primary=0.5 cfs 0.112 af Outflow=0.5 cfs 0.163 af

Pond 2P: Rooftop Detention Peak Elev=57.68' Storage=25,720 cf Inflow=7.2 cfs 0.590 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0200 '/' Outflow=0.0 cfs 0.000 af

Pond 3P: Underground Infiltation System-2 Peak Elev=8.72' Storage=453 cf Inflow=1.3 cfs 0.095 af
12.0" Round Culvert n=0.013 L=44.0' S=0.0050 '/' Outflow=1.3 cfs 0.084 af

Link 1L: Total to Wetlands Inflow=6.2 cfs 0.511 af
Primary=6.2 cfs 0.511 af

Link 2L: Total to Street Inflow=0.6 cfs 0.044 af
Primary=0.6 cfs 0.044 af

Total Runoff Area = 3.555 ac Runoff Volume = 1.422 af Average Runoff Depth = 4.80"
42.87% Pervious = 1.524 ac 57.13% Impervious = 2.031 ac

Summary for Subcatchment 1S: CB-1

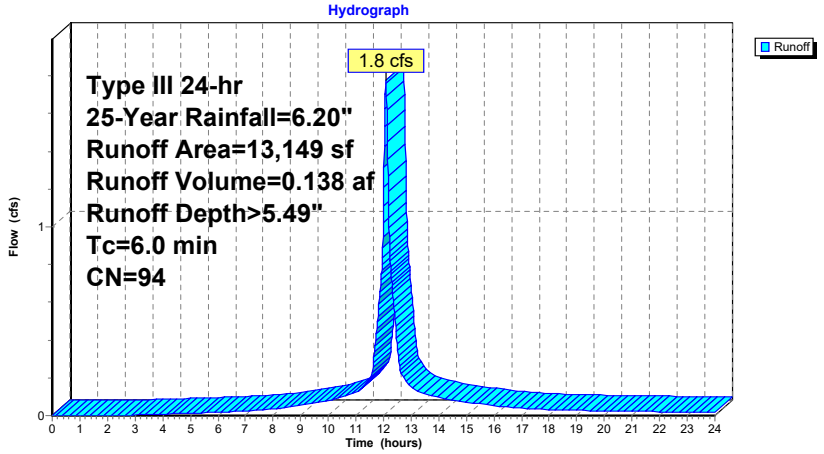
Runoff = 1.8 cfs @ 12.08 hrs, Volume= 0.138 af, Depth> 5.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
10,925	98	Paved parking, HSG C
2,224	74	>75% Grass cover, Good, HSG C
13,149	94	Weighted Average
2,224		16.91% Pervious Area
10,925		83.09% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

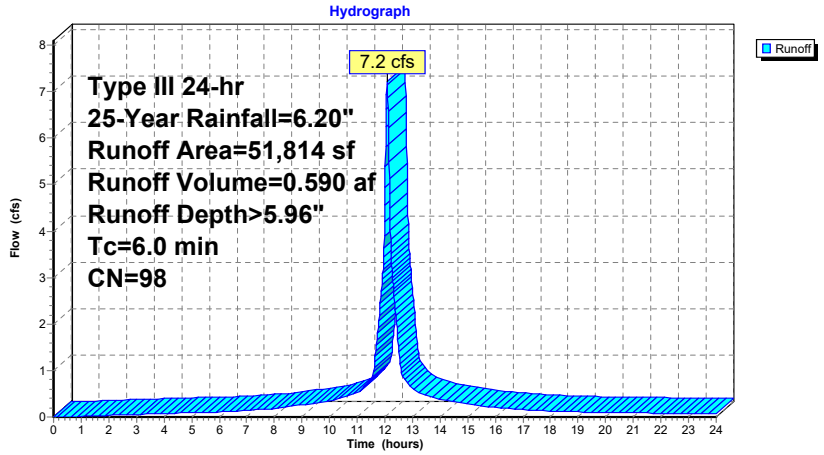
Runoff = 7.2 cfs @ 12.08 hrs, Volume= 0.590 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
51,814	98	Roofs, HSG C
51,814		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3S: Courtyard Roofs

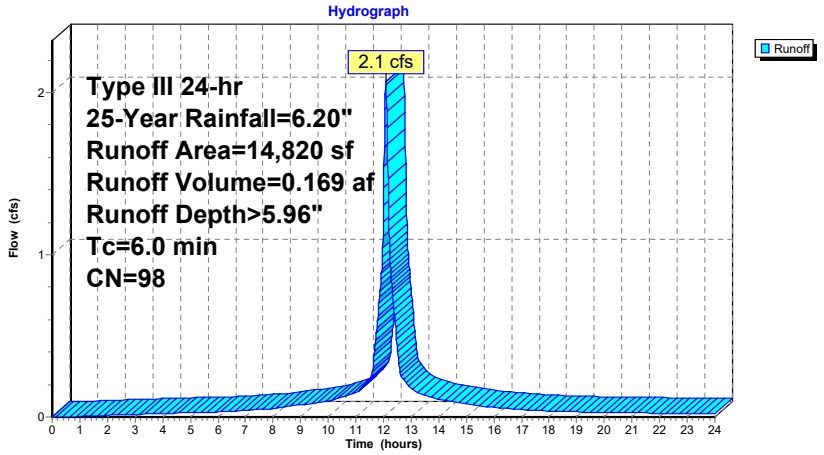
Runoff = 2.1 cfs @ 12.08 hrs, Volume= 0.169 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
14,820	98	Roofs, HSG C
14,820		100.00% Impervious Area

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

Subcatchment 3S: Courtyard Roofs



Summary for Subcatchment 4S: TD-2

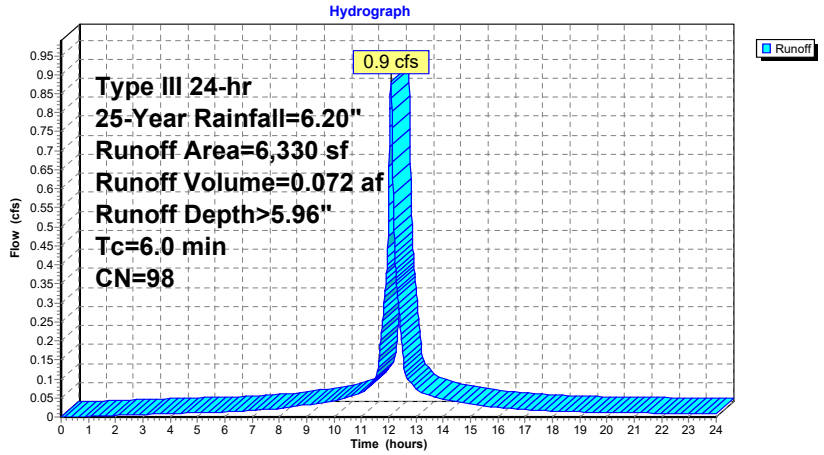
Runoff = 0.9 cfs @ 12.08 hrs, Volume= 0.072 af, Depth> 5.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
6,330	98	Paved parking, HSG C
6,330		100.00% Impervious Area

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

Subcatchment 4S: TD-2



Summary for Subcatchment 5S: TD-1

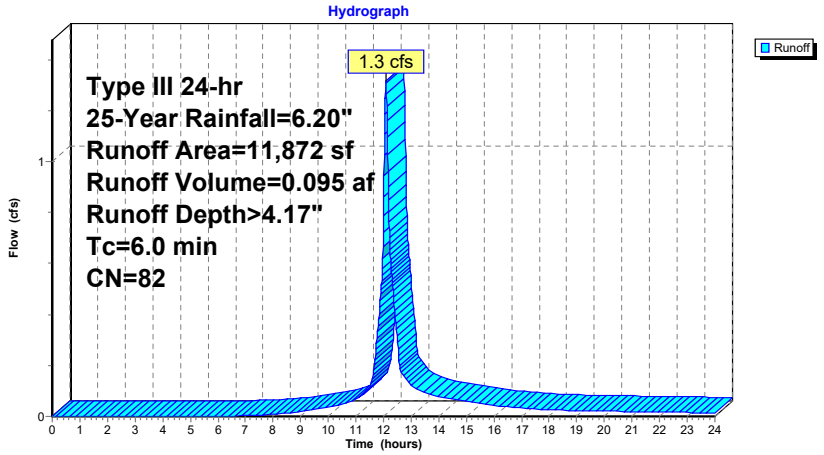
Runoff = 1.3 cfs @ 12.09 hrs, Volume= 0.095 af, Depth> 4.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
980	98	Roofs, HSG C
3,110	98	Paved parking, HSG C
7,782	74	>75% Grass cover, Good, HSG C
11,872	82	Weighted Average
7,782		65.55% Pervious Area
4,090		34.45% Impervious Area

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

Subcatchment 5S: TD-1



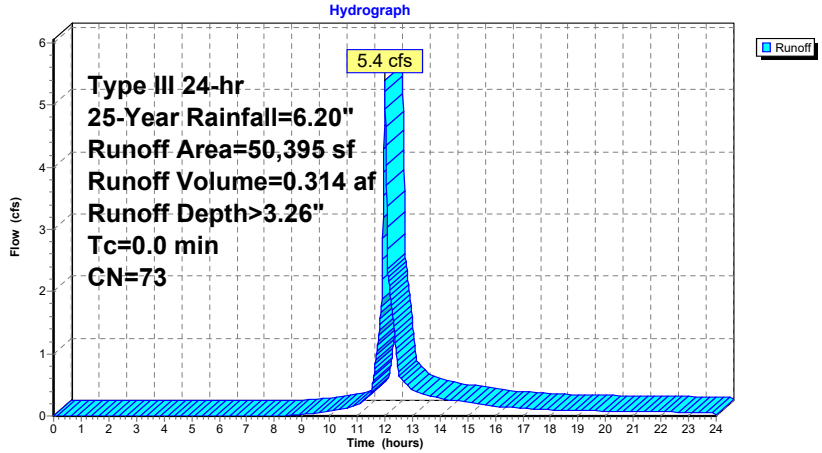
Summary for Subcatchment 6S: Bypass Towards Wetlands

Runoff = 5.4 cfs @ 12.00 hrs, Volume= 0.314 af, Depth> 3.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
6,751	70	Woods, Good, HSG C
43,644	74	>75% Grass cover, Good, HSG C
50,395	73	Weighted Average
50,395		100.00% Pervious Area

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

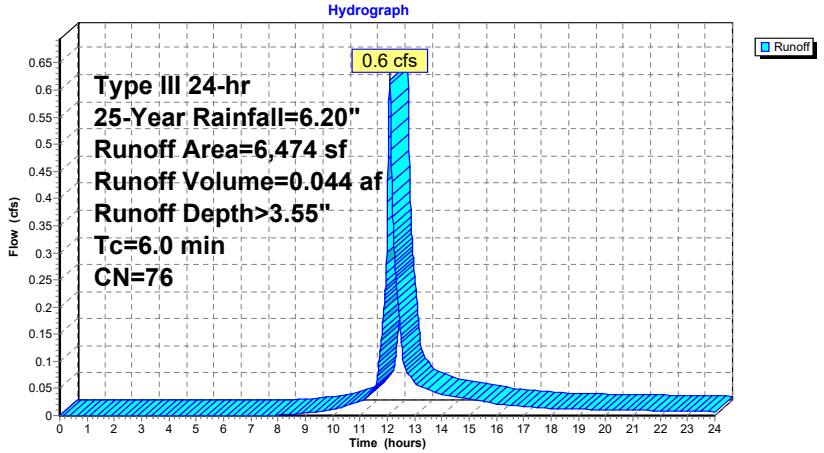
Runoff = 0.6 cfs @ 12.09 hrs, Volume= 0.044 af, Depth> 3.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=6.20"

Area (sf)	CN	Description
490	98	Paved parking, HSG C
5,984	74	>75% Grass cover, Good, HSG C
6,474	76	Weighted Average
5,984		92.43% Pervious Area
490		7.57% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Underground Infiltration System-1

Inflow Area = 1.977 ac, 97.42% Impervious, Inflow Depth > 2.30" for 25-Year event
Inflow = 4.7 cfs @ 12.08 hrs, Volume= 0.379 af
Outflow = 0.5 cfs @ 12.79 hrs, Volume= 0.163 af, Atten= 90%, Lag= 42.2 min
Discarded = 0.0 cfs @ 5.04 hrs, Volume= 0.050 af
Primary = 0.5 cfs @ 12.79 hrs, Volume= 0.112 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 7.56' @ 12.79 hrs Surf.Area= 4,692 sf Storage= 10,332 cf

Plug-Flow detention time= 293.3 min calculated for 0.163 af (43% of inflow)
Center-of-Mass det. time= 149.9 min (902.4 - 752.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	0 cf	**38.75'W x 121.08'L x 3.00'H Field A** 14,076 cf Overall - 14,076 cf Embedded = 0 cf x 40.0% Voids
#2A	5.00'	10,260 cf	**StormTrap ST2 SingleTrap 2-6** x 21 Inside #1 Inside= 101.7"W x 30.0"H => 18.82 sf x 15.40'L = 289.8 cf Outside= 101.7"W x 36.0"H => 25.44 sf x 15.40'L = 391.6 cf 3 Rows of 7 Chambers 25.44' x 107.77' Core + 6.66' Border = 38.75' x 121.08' System
#3	5.00'	141 cf	**6.00'D x 5.00'H OCS-1**-Impervious
		10,401 cf	Total Available Storage

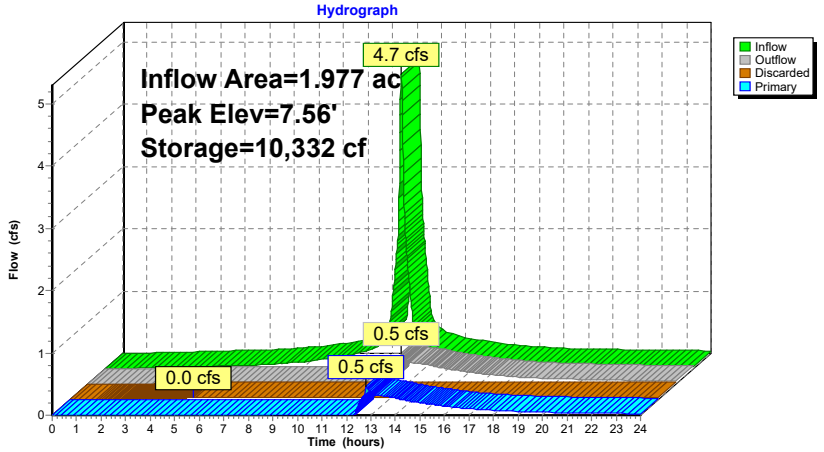
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.20'	**15.0" Round Culvert** L= 130.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.20' / 6.55' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.0 cfs @ 5.04 hrs HW=5.05' (Free Discharge)
↳**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.5 cfs @ 12.79 hrs HW=7.56' (Free Discharge)
↳**2=Culvert** (Barrel Controls 0.5 cfs @ 2.34 fps)

Pond 1P: Underground Infiltration System-1



Summary for Pond 2P: Rooftop Detention

Inflow Area = 1.189 ac,100.00% Impervious, Inflow Depth > 5.96" for 25-Year event
Inflow = 7.2 cfs @ 12.08 hrs, Volume= 0.590 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.68' @ 24.00 hrs Surf.Area= 38,000 sf Storage= 25,720 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

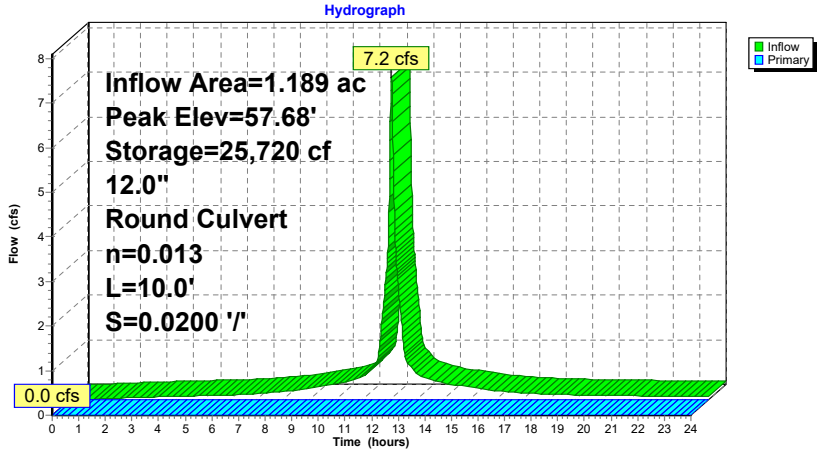
Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	38,000 cf	**Rooftop Detention (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	38,000	0	0
58.00	38,000	38,000	38,000

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Roof Drain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.00' / 57.80' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=57.00' (Free Discharge)
↳**1=Roof Drain** (Controls 0.0 cfs)

Pond 2P: Rooftop Detention



Summary for Pond 3P: Underground Infiltation System-2

Inflow Area = 0.273 ac, 34.45% Impervious, Inflow Depth > 4.17" for 25-Year event
Inflow = 1.3 cfs @ 12.09 hrs, Volume= 0.095 af
Outflow = 1.3 cfs @ 12.09 hrs, Volume= 0.084 af, Atten= 0%, Lag= 0.1 min
Primary = 1.3 cfs @ 12.09 hrs, Volume= 0.084 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 8.72' @ 12.09 hrs Surf.Area= 388 sf Storage= 453 cf

Plug-Flow detention time= 75.4 min calculated for 0.084 af (89% of inflow)
Center-of-Mass det. time= 24.6 min (831.6 - 807.0)

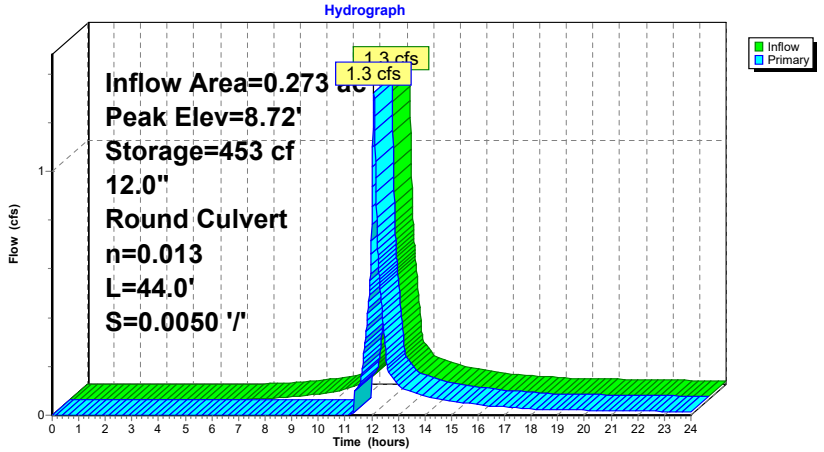
Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	204 cf	**21.50'W x 17.44'L x 1.83'H Field A** 687 cf Overall - 177 cf Embedded = 511 cf x 40.0% Voids
#2A	3.00'	177 cf	**ADS_StormTech SC-310 +Cap** x 12 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 6 Rows of 2 Chambers
#3	3.00'	75 cf	**4.00'D x 6.00'H OCS**
		457 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.00'	**12.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.78' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.3 cfs @ 12.09 hrs HW=8.72' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.3 cfs @ 3.04 fps)

Pond 3P: Underground Infiltation System-2

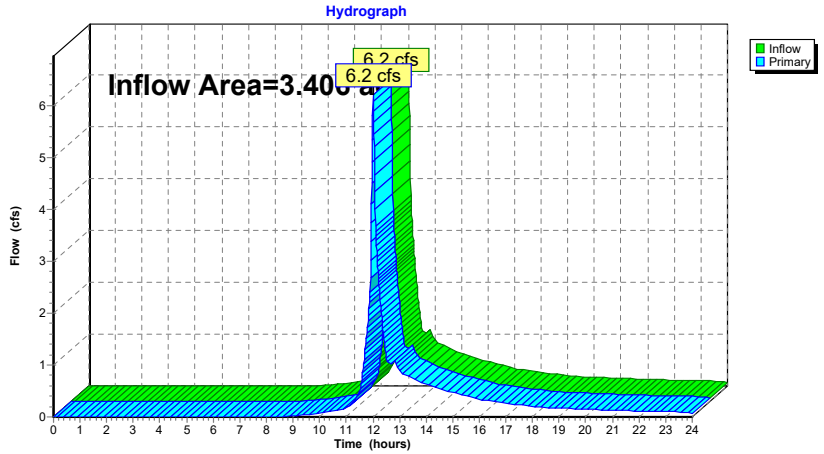


Summary for Link 1L: Total to Wetlands

Inflow Area = 3.406 ac, 59.29% Impervious, Inflow Depth > 1.80" for 25-Year event
Inflow = 6.2 cfs @ 12.00 hrs, Volume= 0.511 af
Primary = 6.2 cfs @ 12.00 hrs, Volume= 0.511 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetlands

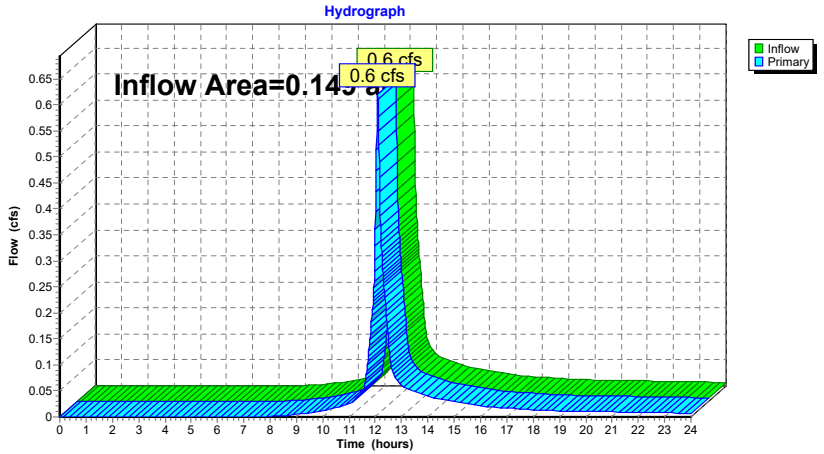


Summary for Link 2L: Total to Street

Inflow Area = 0.149 ac, 7.57% Impervious, Inflow Depth > 3.55" for 25-Year event
Inflow = 0.6 cfs @ 12.09 hrs, Volume= 0.044 af
Primary = 0.6 cfs @ 12.09 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Total to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CB-1 Runoff Area=13,149 sf 83.09% Impervious Runoff Depth>6.71"
Tc=6.0 min CN=94 Runoff=2.2 cfs 0.169 af

Subcatchment 2S: Building Roof Runoff Area=51,814 sf 100.00% Impervious Runoff Depth>7.19"
Tc=6.0 min CN=98 Runoff=8.7 cfs 0.712 af

Subcatchment 3S: Courtyard Roofs Runoff Area=14,820 sf 100.00% Impervious Runoff Depth>7.19"
Tc=6.0 min CN=98 Runoff=2.5 cfs 0.204 af

Subcatchment 4S: TD-2 Runoff Area=6,330 sf 100.00% Impervious Runoff Depth>7.19"
Tc=6.0 min CN=98 Runoff=1.1 cfs 0.087 af

Subcatchment 5S: TD-1 Runoff Area=11,872 sf 34.45% Impervious Runoff Depth>5.32"
Tc=6.0 min CN=82 Runoff=1.7 cfs 0.121 af

Subcatchment 6S: Bypass Towards Runoff Area=50,395 sf 0.00% Impervious Runoff Depth>4.31"
Tc=0.0 min CN=73 Runoff=7.2 cfs 0.415 af

Subcatchment 7S: To Street Runoff Area=6,474 sf 7.57% Impervious Runoff Depth>4.64"
Tc=6.0 min CN=76 Runoff=0.8 cfs 0.057 af

Pond 1P: Underground Infiltration System-1 Peak Elev=8.28' Storage=10,352 cf Inflow=5.7 cfs 0.460 af
Discarded=0.0 cfs 0.051 af Primary=3.1 cfs 0.190 af Outflow=3.2 cfs 0.241 af

Pond 2P: Rooftop Detention Peak Elev=57.82' Storage=31,022 cf Inflow=8.7 cfs 0.712 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0200 '/' Outflow=0.0 cfs 0.000 af

Pond 3P: Underground Infiltation System-2 Peak Elev=8.84' Storage=454 cf Inflow=1.7 cfs 0.121 af
12.0" Round Culvert n=0.013 L=44.0' S=0.0050 '/' Outflow=1.7 cfs 0.111 af

Link 1L: Total to Wetlands Inflow=8.2 cfs 0.716 af
Primary=8.2 cfs 0.716 af

Link 2L: Total to Street Inflow=0.8 cfs 0.057 af
Primary=0.8 cfs 0.057 af

Total Runoff Area = 3.555 ac Runoff Volume = 1.765 af Average Runoff Depth = 5.96"
42.87% Pervious = 1.524 ac 57.13% Impervious = 2.031 ac

Summary for Subcatchment 1S: CB-1

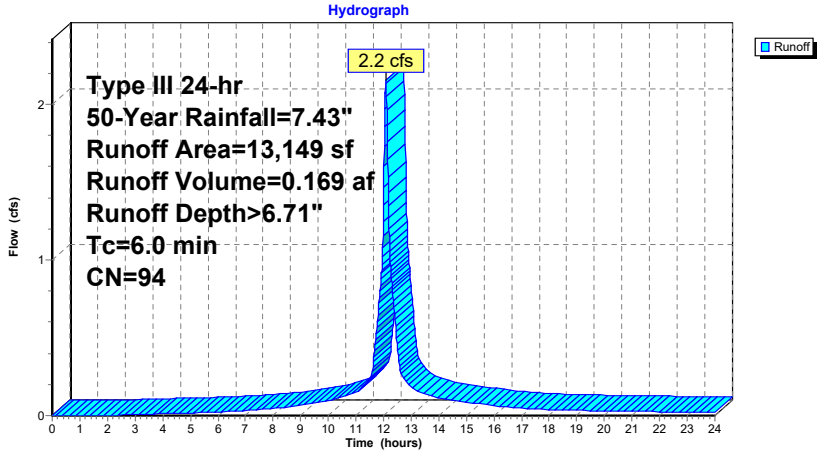
Runoff = 2.2 cfs @ 12.08 hrs, Volume= 0.169 af, Depth> 6.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
10,925	98	Paved parking, HSG C
2,224	74	>75% Grass cover, Good, HSG C
13,149	94	Weighted Average
2,224		16.91% Pervious Area
10,925		83.09% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

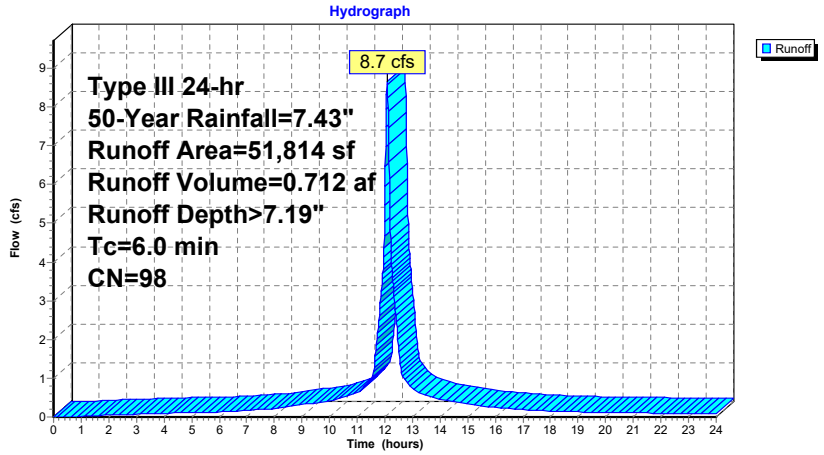
Runoff = 8.7 cfs @ 12.08 hrs, Volume= 0.712 af, Depth> 7.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
51,814	98	Roofs, HSG C
51,814		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3S: Courtyard Roofs

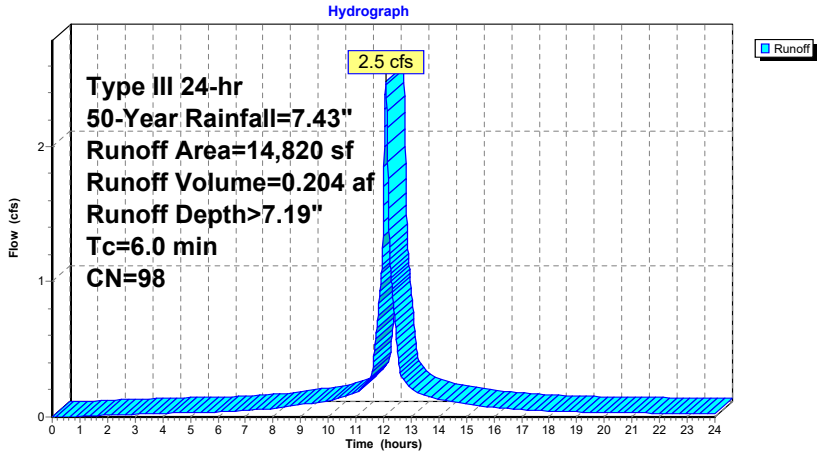
Runoff = 2.5 cfs @ 12.08 hrs, Volume= 0.204 af, Depth> 7.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
14,820	98	Roofs, HSG C
14,820		100.00% Impervious Area

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

Subcatchment 3S: Courtyard Roofs



Summary for Subcatchment 4S: TD-2

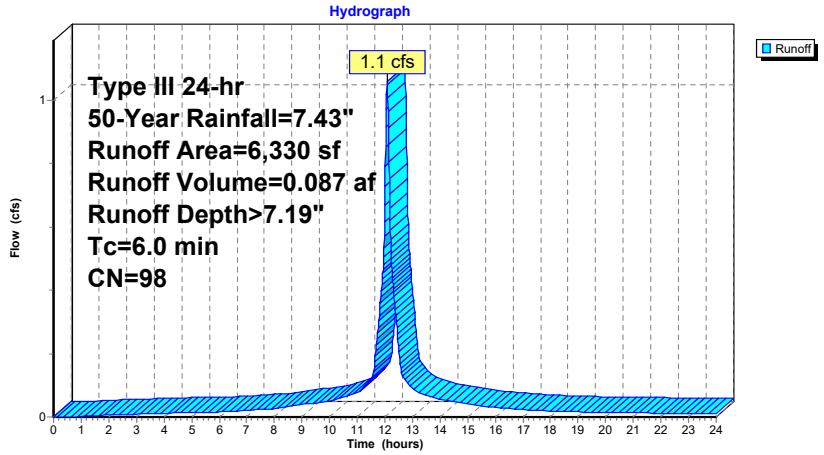
Runoff = 1.1 cfs @ 12.08 hrs, Volume= 0.087 af, Depth> 7.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
6,330	98	Paved parking, HSG C
6,330		100.00% Impervious Area

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

Subcatchment 4S: TD-2



Summary for Subcatchment 5S: TD-1

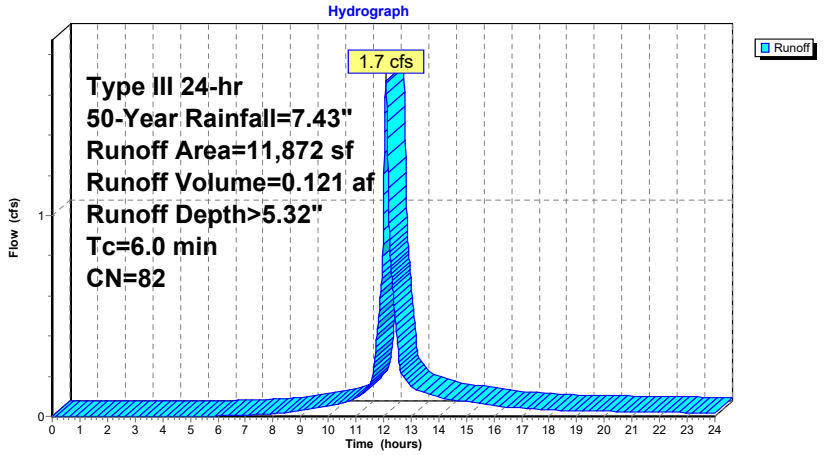
Runoff = 1.7 cfs @ 12.09 hrs, Volume= 0.121 af, Depth> 5.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
980	98	Roofs, HSG C
3,110	98	Paved parking, HSG C
7,782	74	>75% Grass cover, Good, HSG C
11,872	82	Weighted Average
7,782		65.55% Pervious Area
4,090		34.45% Impervious Area

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

Subcatchment 5S: TD-1



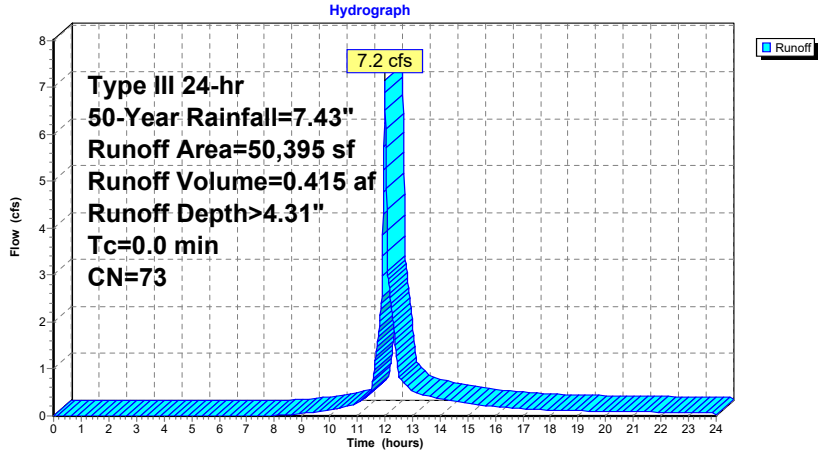
Summary for Subcatchment 6S: Bypass Towards Wetlands

Runoff = 7.2 cfs @ 12.00 hrs, Volume= 0.415 af, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
6,751	70	Woods, Good, HSG C
43,644	74	>75% Grass cover, Good, HSG C
50,395	73	Weighted Average
50,395		100.00% Pervious Area

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

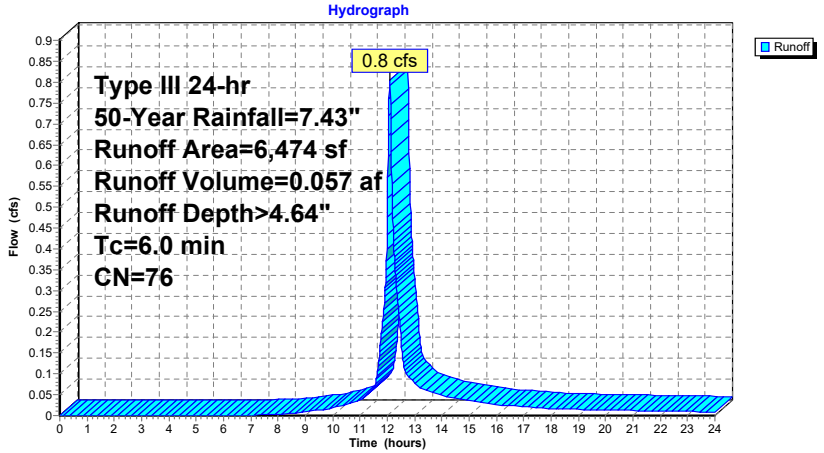
Runoff = 0.8 cfs @ 12.09 hrs, Volume= 0.057 af, Depth> 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 50-Year Rainfall=7.43"

Area (sf)	CN	Description
490	98	Paved parking, HSG C
5,984	74	>75% Grass cover, Good, HSG C
6,474	76	Weighted Average
5,984		92.43% Pervious Area
490		7.57% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Underground Infiltration System-1

Inflow Area = 1.977 ac, 97.42% Impervious, Inflow Depth > 2.79" for 50-Year event
Inflow = 5.7 cfs @ 12.08 hrs, Volume= 0.460 af
Outflow = 3.2 cfs @ 12.22 hrs, Volume= 0.241 af, Atten= 44%, Lag= 8.5 min
Discarded = 0.0 cfs @ 4.23 hrs, Volume= 0.051 af
Primary = 3.1 cfs @ 12.22 hrs, Volume= 0.190 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 8.28' @ 12.22 hrs Surf.Area= 4,692 sf Storage= 10,352 cf

Plug-Flow detention time= 243.1 min calculated for 0.241 af (53% of inflow)
Center-of-Mass det. time= 119.7 min (869.0 - 749.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	0 cf	**38.75'W x 121.08'L x 3.00'H Field A** 14,076 cf Overall - 14,076 cf Embedded = 0 cf x 40.0% Voids
#2A	5.00'	10,260 cf	**StormTrap ST2 SingleTrap 2-6** x 21 Inside #1 Inside= 101.7"W x 30.0"H => 18.82 sf x 15.40'L = 289.8 cf Outside= 101.7"W x 36.0"H => 25.44 sf x 15.40'L = 391.6 cf 3 Rows of 7 Chambers 25.44' x 107.77' Core + 6.66' Border = 38.75' x 121.08' System
#3	5.00'	141 cf	**6.00'D x 5.00'H OCS-1**-Impervious
		10,401 cf	Total Available Storage

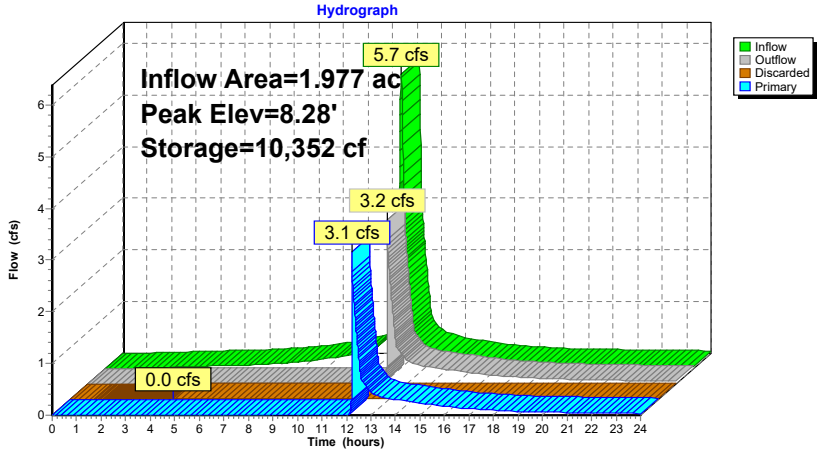
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.20'	**15.0" Round Culvert** L= 130.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.20' / 6.55' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.0 cfs @ 4.23 hrs HW=5.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=2.8 cfs @ 12.22 hrs HW=8.19' (Free Discharge)
↑**2=Culvert** (Barrel Controls 2.8 cfs @ 3.73 fps)

Pond 1P: Underground Infiltration System-1



Summary for Pond 2P: Rooftop Detention

Inflow Area = 1.189 ac,100.00% Impervious, Inflow Depth > 7.19" for 50-Year event
Inflow = 8.7 cfs @ 12.08 hrs, Volume= 0.712 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.82' @ 24.00 hrs Surf.Area= 38,000 sf Storage= 31,022 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

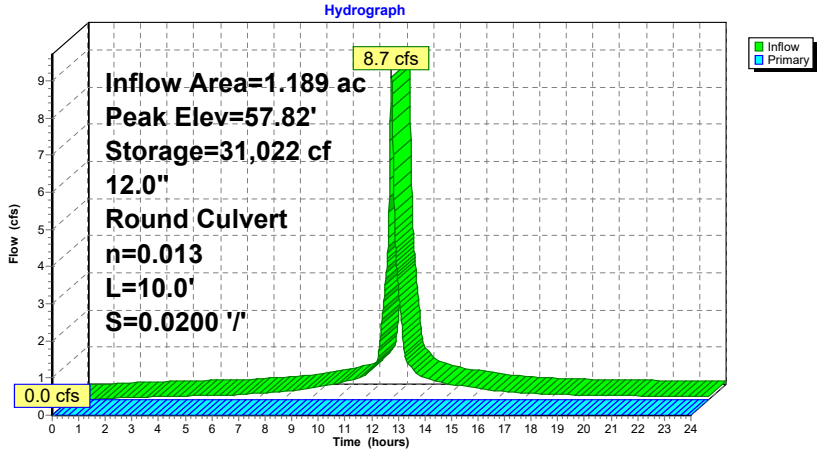
Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	38,000 cf	**Rooftop Detention (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	38,000	0	0
58.00	38,000	38,000	38,000

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Roof Drain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.00' / 57.80' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=57.00' (Free Discharge)
↳**1=Roof Drain** (Controls 0.0 cfs)

Pond 2P: Rooftop Detention



Summary for Pond 3P: Underground Infiltation System-2

Inflow Area = 0.273 ac, 34.45% Impervious, Inflow Depth > 5.32" for 50-Year event
Inflow = 1.7 cfs @ 12.09 hrs, Volume= 0.121 af
Outflow = 1.7 cfs @ 12.09 hrs, Volume= 0.111 af, Atten= 0%, Lag= 0.1 min
Primary = 1.7 cfs @ 12.09 hrs, Volume= 0.111 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 8.84' @ 12.09 hrs Surf.Area= 388 sf Storage= 454 cf

Plug-Flow detention time= 64.4 min calculated for 0.110 af (92% of inflow)
Center-of-Mass det. time= 22.0 min (822.2 - 800.2)

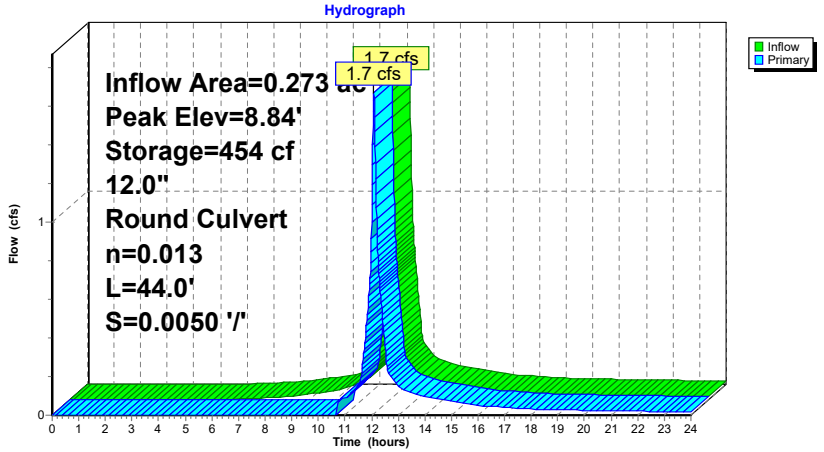
Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	204 cf	**21.50'W x 17.44'L x 1.83'H Field A** 687 cf Overall - 177 cf Embedded = 511 cf x 40.0% Voids
#2A	3.00'	177 cf	**ADS_StormTech SC-310 +Cap** x 12 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 6 Rows of 2 Chambers
#3	3.00'	75 cf	**4.00'D x 6.00'H OCS**
		457 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.00'	**12.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.78' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=1.7 cfs @ 12.09 hrs HW=8.83' (Free Discharge)
└**1=Culvert** (Barrel Controls 1.7 cfs @ 3.22 fps)

Pond 3P: Underground Infiltation System-2

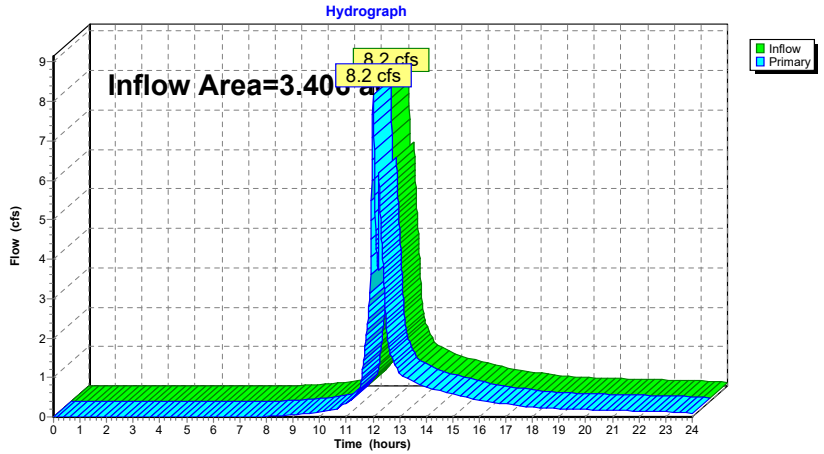


Summary for Link 1L: Total to Wetlands

Inflow Area = 3.406 ac, 59.29% Impervious, Inflow Depth > 2.52" for 50-Year event
Inflow = 8.2 cfs @ 12.00 hrs, Volume= 0.716 af
Primary = 8.2 cfs @ 12.00 hrs, Volume= 0.716 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetlands

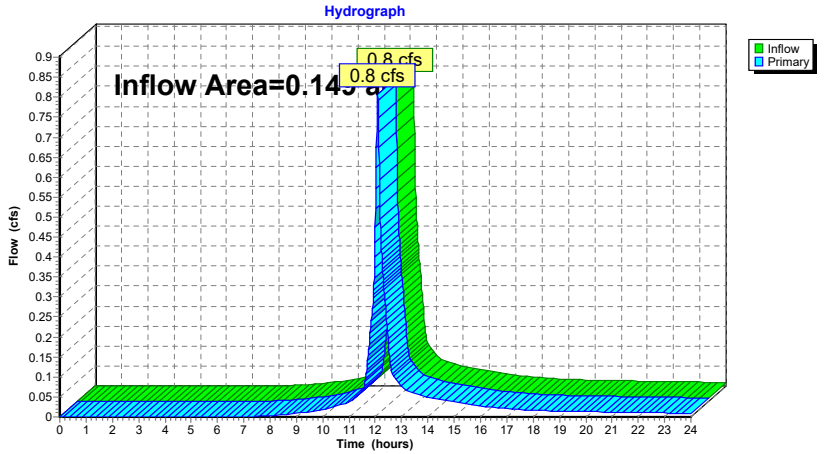


Summary for Link 2L: Total to Street

Inflow Area = 0.149 ac, 7.57% Impervious, Inflow Depth > 4.64" for 50-Year event
Inflow = 0.8 cfs @ 12.09 hrs, Volume= 0.057 af
Primary = 0.8 cfs @ 12.09 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Total to Street



Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: CB-1 Runoff Area=13,149 sf 83.09% Impervious Runoff Depth>8.16"
Tc=6.0 min CN=94 Runoff=2.6 cfs 0.205 af

Subcatchment 2S: Building Roof Runoff Area=51,814 sf 100.00% Impervious Runoff Depth>8.64"
Tc=6.0 min CN=98 Runoff=10.4 cfs 0.857 af

Subcatchment 3S: Courtyard Roofs Runoff Area=14,820 sf 100.00% Impervious Runoff Depth>8.64"
Tc=6.0 min CN=98 Runoff=3.0 cfs 0.245 af

Subcatchment 4S: TD-2 Runoff Area=6,330 sf 100.00% Impervious Runoff Depth>8.64"
Tc=6.0 min CN=98 Runoff=1.3 cfs 0.105 af

Subcatchment 5S: TD-1 Runoff Area=11,872 sf 34.45% Impervious Runoff Depth>6.70"
Tc=6.0 min CN=82 Runoff=2.1 cfs 0.152 af

Subcatchment 6S: Bypass Towards Runoff Area=50,395 sf 0.00% Impervious Runoff Depth>5.61"
Tc=0.0 min CN=73 Runoff=9.3 cfs 0.540 af

Subcatchment 7S: To Street Runoff Area=6,474 sf 7.57% Impervious Runoff Depth>5.97"
Tc=6.0 min CN=76 Runoff=1.0 cfs 0.074 af

Pond 1P: Underground Infiltration System-1 Peak Elev=9.88' Storage=10,398 cf Inflow=6.8 cfs 0.555 af
Discarded=0.0 cfs 0.053 af Primary=6.6 cfs 0.284 af Outflow=6.6 cfs 0.336 af

Pond 2P: Rooftop Detention Peak Elev=57.98' Storage=37,318 cf Inflow=10.4 cfs 0.857 af
12.0" Round Culvert n=0.013 L=10.0' S=0.0200 '/' Outflow=0.0 cfs 0.000 af

Pond 3P: Underground Infiltation System-2 Peak Elev=8.97' Storage=456 cf Inflow=2.1 cfs 0.152 af
12.0" Round Culvert n=0.013 L=44.0' S=0.0050 '/' Outflow=2.1 cfs 0.142 af

Link 1L: Total to Wetlands Inflow=12.6 cfs 0.966 af
Primary=12.6 cfs 0.966 af

Link 2L: Total to Street Inflow=1.0 cfs 0.074 af
Primary=1.0 cfs 0.074 af

Total Runoff Area = 3.555 ac Runoff Volume = 2.178 af Average Runoff Depth = 7.35"
42.87% Pervious = 1.524 ac 57.13% Impervious = 2.031 ac

Summary for Subcatchment 1S: CB-1

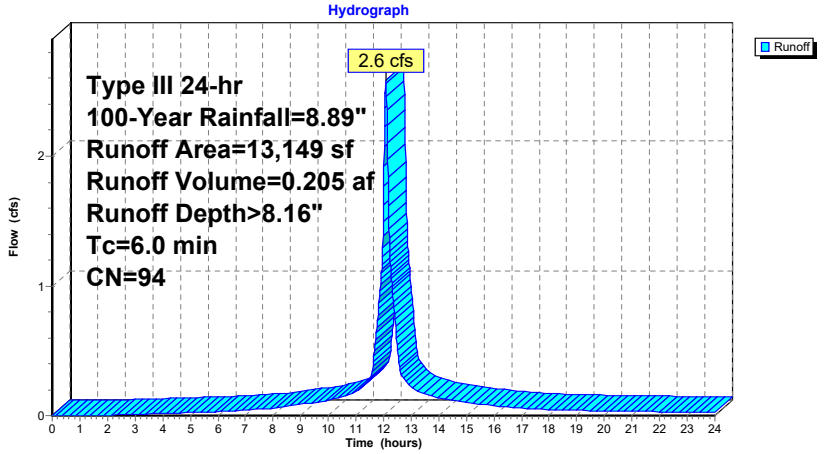
Runoff = 2.6 cfs @ 12.08 hrs, Volume= 0.205 af, Depth> 8.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
10,925	98	Paved parking, HSG C
2,224	74	>75% Grass cover, Good, HSG C
13,149	94	Weighted Average
2,224		16.91% Pervious Area
10,925		83.09% Impervious Area

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

Subcatchment 1S: CB-1



Summary for Subcatchment 2S: Building Roof

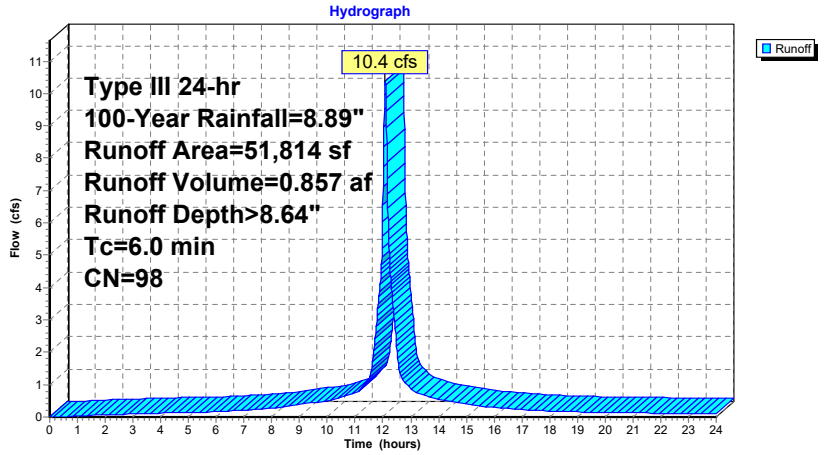
Runoff = 10.4 cfs @ 12.08 hrs, Volume= 0.857 af, Depth> 8.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
51,814	98	Roofs, HSG C
51,814		100.00% Impervious Area

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

Subcatchment 2S: Building Roof



Summary for Subcatchment 3S: Courtyard Roofs

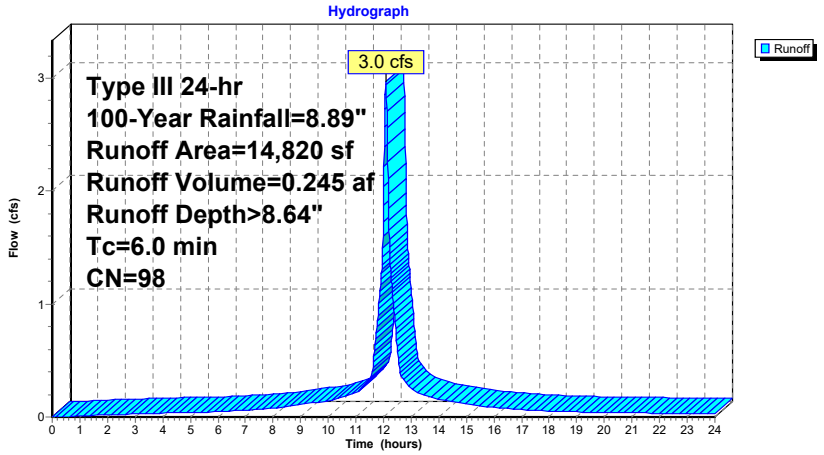
Runoff = 3.0 cfs @ 12.08 hrs, Volume= 0.245 af, Depth> 8.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
14,820	98	Roofs, HSG C
14,820		100.00% Impervious Area

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

Subcatchment 3S: Courtyard Roofs



Summary for Subcatchment 4S: TD-2

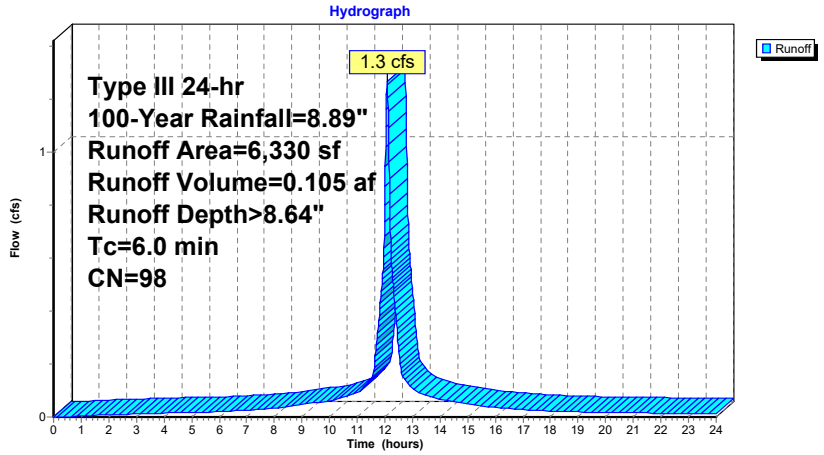
Runoff = 1.3 cfs @ 12.08 hrs, Volume= 0.105 af, Depth> 8.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
6,330	98	Paved parking, HSG C
6,330		100.00% Impervious Area

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

Subcatchment 4S: TD-2



Summary for Subcatchment 5S: TD-1

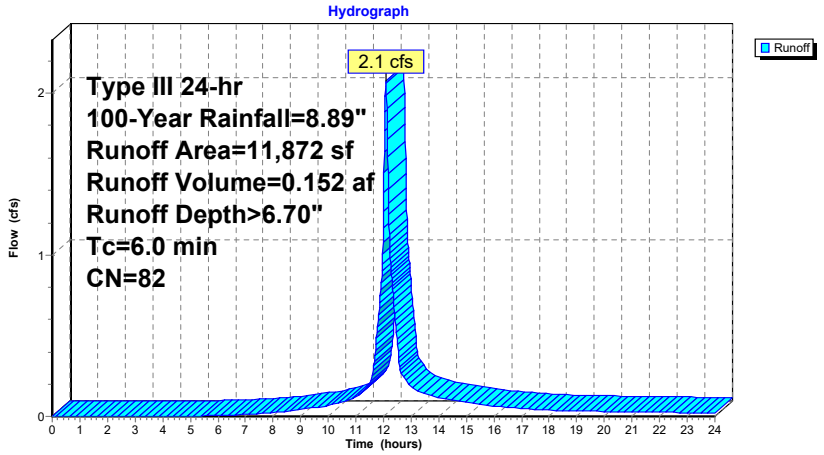
Runoff = 2.1 cfs @ 12.09 hrs, Volume= 0.152 af, Depth> 6.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
980	98	Roofs, HSG C
3,110	98	Paved parking, HSG C
7,782	74	>75% Grass cover, Good, HSG C
11,872	82	Weighted Average
7,782		65.55% Pervious Area
4,090		34.45% Impervious Area

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

Subcatchment 5S: TD-1



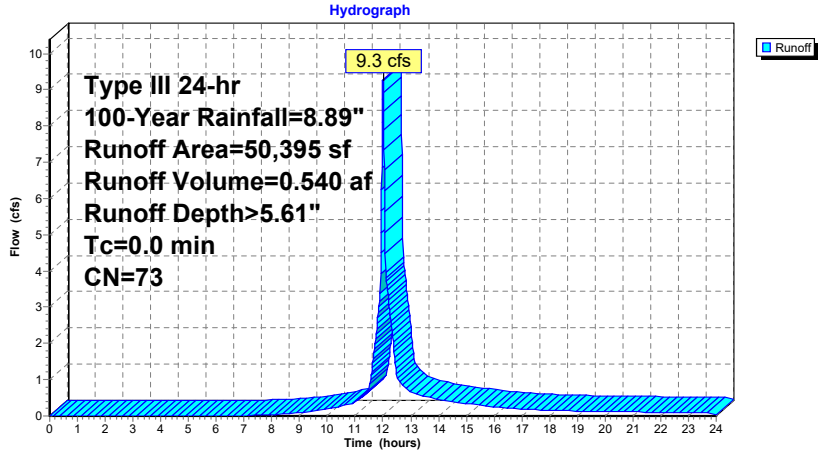
Summary for Subcatchment 6S: Bypass Towards Wetlands

Runoff = 9.3 cfs @ 12.00 hrs, Volume= 0.540 af, Depth> 5.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
6,751	70	Woods, Good, HSG C
43,644	74	>75% Grass cover, Good, HSG C
50,395	73	Weighted Average
50,395		100.00% Pervious Area

Subcatchment 6S: Bypass Towards Wetlands



Summary for Subcatchment 7S: To Street

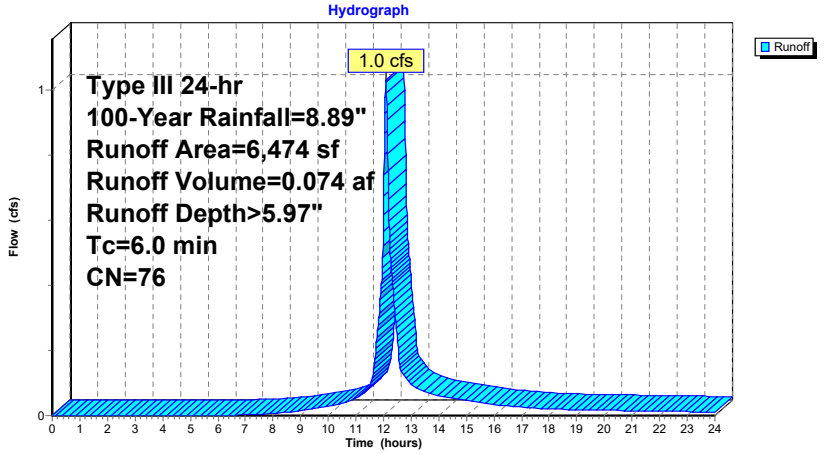
Runoff = 1.0 cfs @ 12.09 hrs, Volume= 0.074 af, Depth> 5.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.89"

Area (sf)	CN	Description
490	98	Paved parking, HSG C
5,984	74	>75% Grass cover, Good, HSG C
6,474	76	Weighted Average
5,984		92.43% Pervious Area
490		7.57% Impervious Area

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

Subcatchment 7S: To Street



Summary for Pond 1P: Underground Infiltration System-1

Inflow Area = 1.977 ac, 97.42% Impervious, Inflow Depth > 3.37" for 100-Year event
Inflow = 6.8 cfs @ 12.08 hrs, Volume= 0.555 af
Outflow = 6.6 cfs @ 12.10 hrs, Volume= 0.336 af, Atten= 3%, Lag= 1.0 min
Discarded = 0.0 cfs @ 3.54 hrs, Volume= 0.053 af
Primary = 6.6 cfs @ 12.10 hrs, Volume= 0.284 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 9.88' @ 12.10 hrs Surf.Area= 4,692 sf Storage= 10,398 cf

Plug-Flow detention time= 211.4 min calculated for 0.336 af (61% of inflow)
Center-of-Mass det. time= 101.5 min (847.9 - 746.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	0 cf	**38.75'W x 121.08'L x 3.00'H Field A** 14,076 cf Overall - 14,076 cf Embedded = 0 cf x 40.0% Voids
#2A	5.00'	10,260 cf	**StormTrap ST2 SingleTrap 2-6** x 21 Inside #1 Inside= 101.7"W x 30.0"H => 18.82 sf x 15.40'L = 289.8 cf Outside= 101.7"W x 36.0"H => 25.44 sf x 15.40'L = 391.6 cf 3 Rows of 7 Chambers 25.44' x 107.77' Core + 6.66' Border = 38.75' x 121.08' System
#3	5.00'	141 cf	**6.00'D x 5.00'H OCS-1**-Impervious
		10,401 cf	Total Available Storage

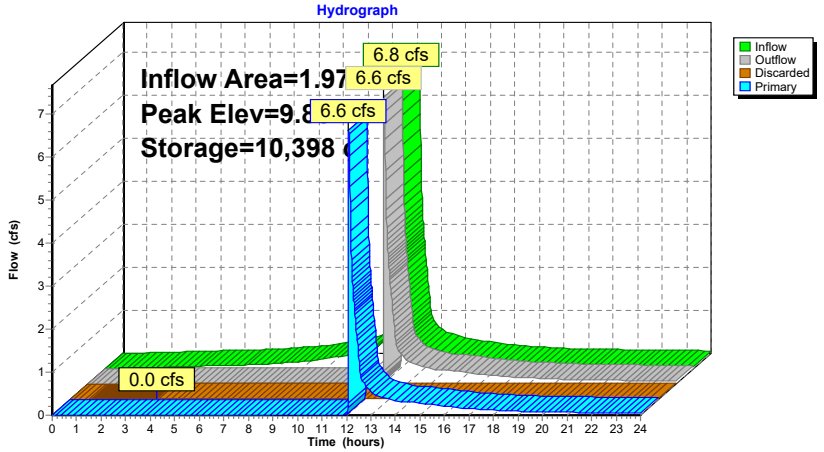
Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.20'	**15.0" Round Culvert** L= 130.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.20' / 6.55' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.0 cfs @ 3.54 hrs HW=5.05' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=6.6 cfs @ 12.10 hrs HW=9.85' (Free Discharge)
↑**2=Culvert** (Barrel Controls 6.6 cfs @ 5.39 fps)

Pond 1P: Underground Infiltration System-1



Summary for Pond 2P: Rooftop Detention

Inflow Area = 1.189 ac,100.00% Impervious, Inflow Depth > 8.64" for 100-Year event
Inflow = 10.4 cfs @ 12.08 hrs, Volume= 0.857 af
Outflow = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 57.98' @ 24.00 hrs Surf.Area= 38,000 sf Storage= 37,318 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

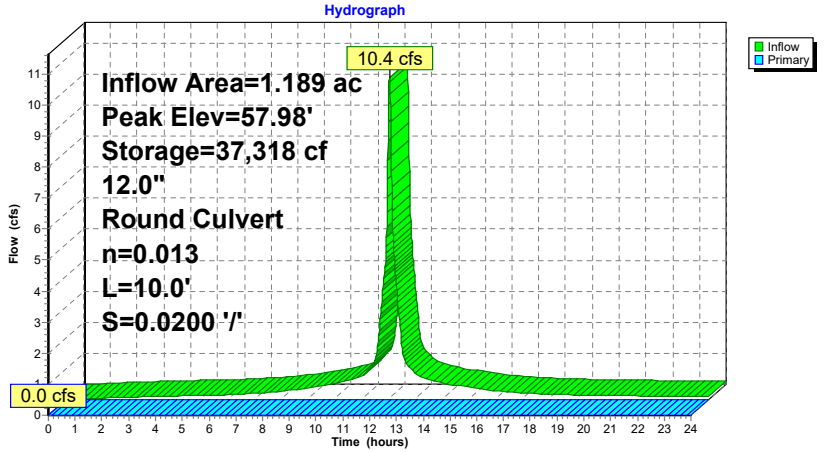
Volume	Invert	Avail.Storage	Storage Description
#1	57.00'	38,000 cf	**Rooftop Detention (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	38,000	0	0
58.00	38,000	38,000	38,000

Device	Routing	Invert	Outlet Devices
#1	Primary	58.00'	**12.0" Round Roof Drain** L= 10.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 58.00' / 57.80' S= 0.0200 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=57.00' (Free Discharge)
↑**1=Roof Drain** (Controls 0.0 cfs)

Pond 2P: Rooftop Detention



Summary for Pond 3P: Underground Infiltation System-2

Inflow Area = 0.273 ac, 34.45% Impervious, Inflow Depth > 6.70" for 100-Year event
Inflow = 2.1 cfs @ 12.09 hrs, Volume= 0.152 af
Outflow = 2.1 cfs @ 12.09 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.1 min
Primary = 2.1 cfs @ 12.09 hrs, Volume= 0.142 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 8.97' @ 12.09 hrs Surf.Area= 388 sf Storage= 456 cf

Plug-Flow detention time= 55.3 min calculated for 0.142 af (93% of inflow)
Center-of-Mass det. time= 19.8 min (813.5 - 793.7)

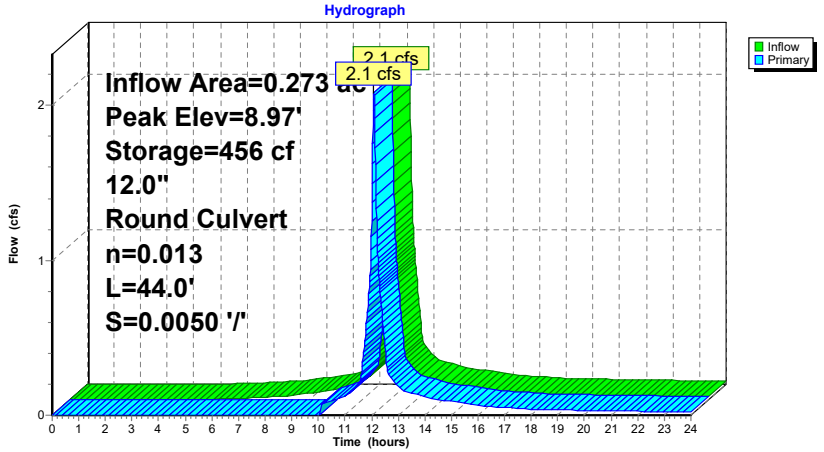
Volume	Invert	Avail.Storage	Storage Description
#1A	3.00'	204 cf	**21.50'W x 17.44'L x 1.83'H Field A** 687 cf Overall - 177 cf Embedded = 511 cf x 40.0% Voids
#2A	3.00'	177 cf	**ADS_StormTech SC-310 +Cap** x 12 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 6 Rows of 2 Chambers
#3	3.00'	75 cf	**4.00'D x 6.00'H OCS**
		457 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	8.00'	**12.0" Round Culvert** L= 44.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 8.00' / 7.78' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf

Primary OutFlow Max=2.1 cfs @ 12.09 hrs HW=8.97' (Free Discharge)
└**1=Culvert** (Barrel Controls 2.1 cfs @ 3.39 fps)

Pond 3P: Underground Infiltation System-2

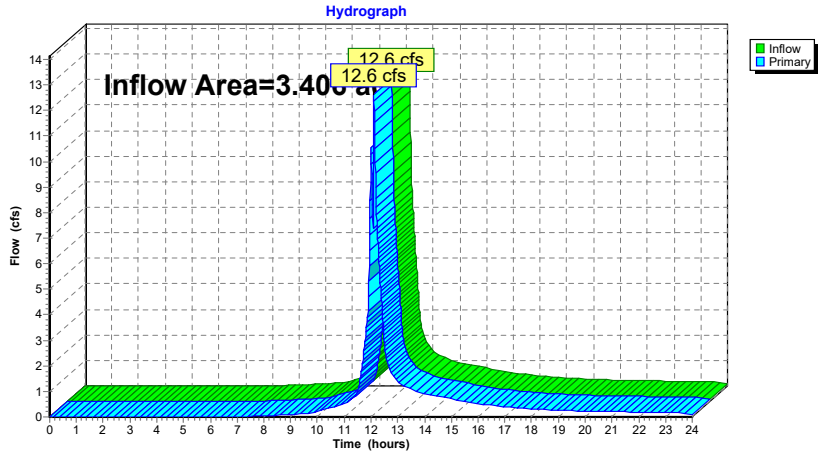


Summary for Link 1L: Total to Wetlands

Inflow Area = 3.406 ac, 59.29% Impervious, Inflow Depth > 3.40" for 100-Year event
Inflow = 12.6 cfs @ 12.10 hrs, Volume= 0.966 af
Primary = 12.6 cfs @ 12.10 hrs, Volume= 0.966 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 1L: Total to Wetlands

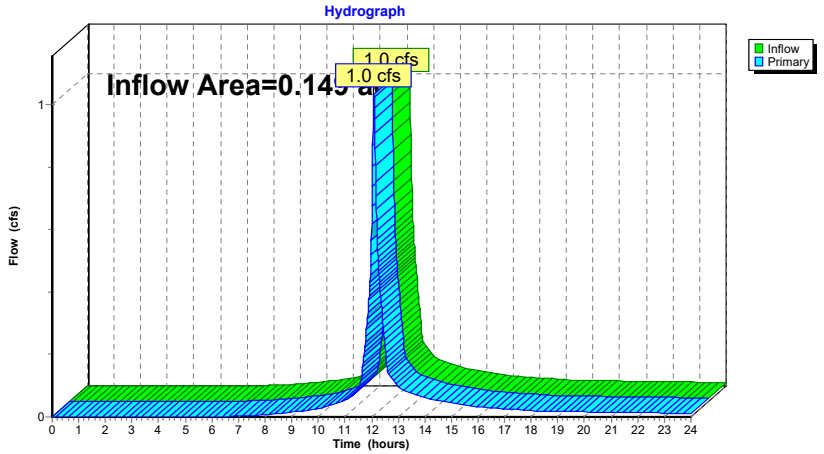


Summary for Link 2L: Total to Street

Inflow Area = 0.149 ac, 7.57% Impervious, Inflow Depth > 5.97" for 100-Year event
Inflow = 1.0 cfs @ 12.09 hrs, Volume= 0.074 af
Primary = 1.0 cfs @ 12.09 hrs, Volume= 0.074 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Link 2L: Total to Street



SECTION 6.0

ADDITIONAL DRAINAGE CALCULATIONS

6.01 TSS REMOVAL CALCULATIONS

TSS Removal Calculation Worksheet

Location: Thorndike Place, Arlington, MA

Project: 23407.00

BSC GROUP

Prepared By: D. Rinaldi

Date: 11/02/20

AREA 1 - CB-1

Total Impervious Area, Acres= 0.251

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Deep Sump and Hooded Catchbasins	0.25	1.00	0.25	0.75
Hydrodynamic Separator	0.7	0.75	0.53	0.23
Infiltration Basin	0.8	0.23	0.18	0.05

TSS Removal = 0.96

AREA 2 - TD-1

Total Impervious Area, Acres= 0.094

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Hydrodynamic Separator	0.7	1.00	0.70	0.30

TSS Removal = 0.70

AREA 3 - TD-2

Total Impervious Area, Acres= 0.145

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load*	Amount Removed (BxC)	Remaining Load (C-D)
Hydrodynamic Separator	0.7	1.00	0.70	0.30
Infiltration Basin	0.8	0.30	0.24	0.06

TSS Removal = 0.94

AREA 4 - Bypass to Street

Total Impervious Area, Acres= 0.011

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

TSS Removal =

Weighted Annual Average TSS Removal Rate

[TSS Removal-1 (Area-1) + TSS Revoval-2 (Area-2)+ ….] / [Area-1 + Area-2 + ...] = 0.88

Project Site TSS Removal = 0.88

6.02 GROUNDWATER RECHARGE VOLUME CALCULATIONS

Required Recharge Volume

Rv = F x Impervious Area

Where:

Rv = Recharge Volume

F=Target Depth Factor associated with each Hydrologic Soil Group

(F=0.25-inch for Soil Type C)

Impervious Area = Proposed Pavement and Rooftop area on-site

$$Rv = \left(\frac{0.25in}{12}\right)(88{,}469sft) =$$

Rv = 1,844 cf (required recharge volume)

As not all impervious surfaces are directed to an infiltration BMP, an adjusted Required Volume must be provided. The adjusted Required Volume (Rva) is calculated as:

$$Rva = \frac{Total\ Imp.Area}{Imp.Area\ to\ BMP}(\text{Rv}) =$$

$$Rva = \left(\frac{88{,}469sft}{83{,}889sft}\right)(1{,}844cf) =$$

$$Rva = 1{,}945\ cf$$

Storage Provided

- Underground Infiltration System-1 = 9,084 cubic feet provided.
  Refer to the HydroCAD calculations provided for more information.

Summary for Pond 1P: Underground Infiltration System-1

Inflow Area = 1.977 ac, 97.42% Impervious, Inflow Depth > 1.55" for Rv event
Inflow = 3.2 cfs @ 12.08 hrs, Volume= 0.255 af
Outflow = 0.0 cfs @ 6.92 hrs, Volume= 0.047 af, Atten= 99%, Lag= 0.0 min
Discarded = 0.0 cfs @ 6.92 hrs, Volume= 0.047 af
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0.000 af

9,084 cu.ft. storage below outlet exceeds required recharge volume

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 7.20' @ 23.95 hrs Surf.Area= 4,692 sf Storage= 9,084 cf

Plug-Flow detention time= 349.3 min calculated for 0.047 af (18% of inflow)
Center-of-Mass det. time= 98.5 min (858.3 - 759.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	5.00'	0 cf	**38.75'W x 121.08'L x 3.00'H Field A** 14,076 cf Overall - 14,076 cf Embedded = 0 cf x 40.0% Voids
#2A	5.00'	10,260 cf	**StormTrap ST2 SingleTrap 2-6** x 21 Inside #1 Inside= 101.7"W x 30.0"H => 18.82 sf x 15.40'L = 289.8 cf Outside= 101.7"W x 36.0"H => 25.44 sf x 15.40'L = 391.6 cf 3 Rows of 7 Chambers 25.44' x 107.77' Core + 6.66' Border = 38.75' x 121.08' System
#3	5.00'	141 cf	**6.00'D x 5.00'H OCS-1**-Impervious
		10,401 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	5.00'	**0.270 in/hr Exfiltration over Surface area**
#2	Primary	7.20'	**15.0" Round Culvert** L= 130.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 7.20' / 6.55' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Discarded OutFlow Max=0.0 cfs @ 6.92 hrs HW=5.05' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=5.00' (Free Discharge)
↑—**2=Culvert** (Controls 0.0 cfs)

6.03 WATER QUALITY VOLUME CALCULATIONS

Water Quality Volume Calculation

V_{WQ} = (D_{WQ}/12 inches/foot) * (A_{IMP} square feet)

V_{WQ} = Required Water Quality Volume (in cubic feet)
D_{WQ} = Water Quality Depth: **0.5-inch**
A_{IMP} = Total Impervious Area (in acres) used for driveways, parking, etc.

Underground Infiltration Systems and Bio-Retention Areas

A_{IMP} = 88,469 sq.ft.

V_{WQ} = (1 inches/12 inches/foot) * (88,469 sq.ft.)

V_{WQ} = 7,372 cubic feet (required volume), provided volume = 9,084 cubic feet (refer to the HydroCAD calculations provided in groundwater recharge section)

6.04 RIP-RAP OUTLET PROTECTION SIZING

OUTLET PROTECTION SIZING

BSC GROUP

Project No.	83669.00	**Calc By**	EAD
Subject	Outlet Protection Sizing Calcs	**Date**	11/2/2020
Location	Arlington, MA	**Checked by**	DRR
		Date	11/3/2020

FES-1

Q=Design Discharge, (ft^3/s)	=	6.6	cfs
D=Culvert Diameter, (ft)	=	1.25	ft
TW=Tailwater Depth, (ft)	=	0.5	ft, (0.4xD for unknow tailwater, or enter known tailwater)
			(Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D\left[\frac{Q}{\sqrt{gD^{2.5}}}\right]^{4/3}\left[\frac{D}{TW}\right]$$

g=32.2 fps

D_{50} = median rock size, ft

$$D_{50} = 0.28\,\frac{6.60}{9.91}\,(4/3)\,\frac{1.25}{0.50} = 0.41 \text{ ft}$$

= 4.88 inches

Table 1 : Riprap Classes and Apron Dimensions

Class	D_{50} (in)	Apron Length	Apron Depth	
1	**5**	**4D**	**$3.5D_{50}$**	**Use Class 1**
2	6	4D	$3.5D_{50}$	
3	10	5D	$3.3D_{50}$	
4	14	6D	$2.2D_{50}$	
5	20	7D	$2.0D_{50}$	
6	22	8D	$2.0D_{50}$	

Apron Dimensions

Length, L=5D	=	**6 ft**	
Depth=$3.3D_{50}$	=	**16.50 Inches**	
Width=3D+(2/3)L	=	**7.92 ft**	(at apron end)

Riprap Rock Sizing Gradation

Given Size	Size of Stone, inches		
100	**8**	to	**10**
85	**7**	to	**9**
50	**5**	to	**8**
15	**3**	to	**7**

Reference Note: Sizing based in accordance with HEC #14 as required by MassHighway Design Manual

OUTLET PROTECTION SIZING

BSC GROUP

Project No. 83669.00
Subject Outlet Protection Sizing Calcs
Location Arlington, MA

Calc By EAD
Date 11/2/2020
Checked by DRR
Date 11/3/2020

FES-2

Q=Design Discharge, (ft^3/s) = 2.1 cfs
D=Culvert Diameter, (ft) = 1.00 ft
TW=Tailwater Depth, (ft) = 0.4 ft, (0.4xD for unknow tailwater, or enter known tailwater)
(Tailwater depth is to be limited to between 0.4D and 1.0D)

Riprap Rock Sizing

$$D_{50} = 0.2D\left[\frac{Q}{\sqrt{gD^{2.5}}}\right]^{4/3}\left[\frac{D}{TW}\right]$$

g=32.2 fps
D_{50} = median rock size, ft

$$D_{50} = 0.28\,\frac{2.10}{5.67}\,(4/3)\,\frac{1.00}{0.40} = 0.19 \text{ ft}$$

= **2.23 inches**

Table 1 : Riprap Classes and Apron Dimensions

Class	D_{50} (in)	Apron Length	Apron Depth	
1	**5**	**4D**	**3.5D_{50}**	**Use Class 1**
2	6	4D	3.5D_{50}	
3	10	5D	3.3D_{50}	
4	14	6D	2.2D_{50}	
5	20	7D	2.0D_{50}	
6	22	8D	2.0D_{50}	

Apron Dimensions

Length, L=5D = **5 ft**
Depth=3.3D_{50} = **16.50 Inches**
Width=3D+(2/3)L = **6.33 ft** (at apron end)

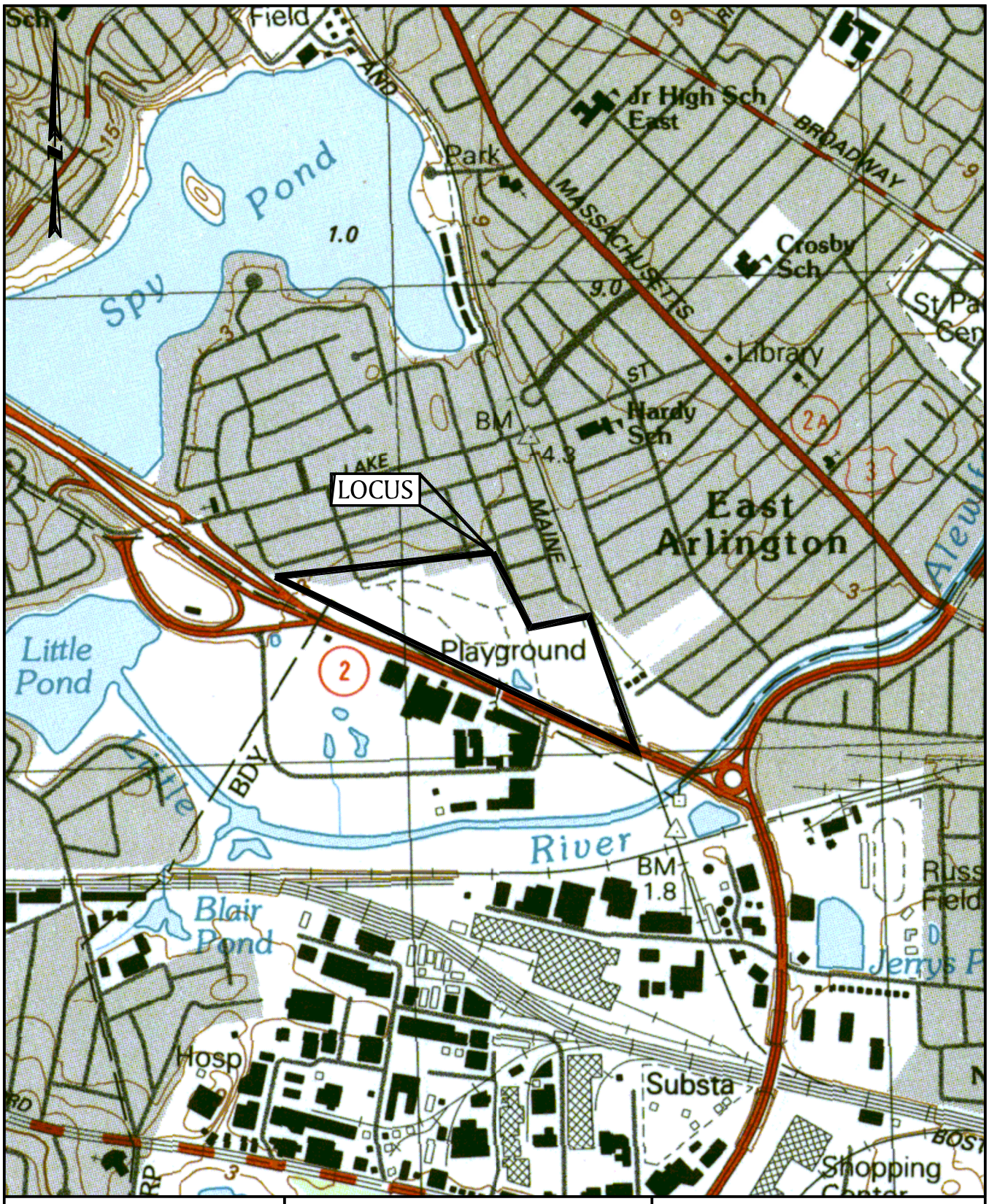
Riprap Rock Sizing Gradation

Given Size	Size of Stone, inches		
100	**8**	to	**10**
85	**7**	to	**9**
50	**5**	to	**8**
15	**3**	to	**7**

Reference Note: Sizing based in accordance with HEC #14 as required by MassHighway Design Manual

APPENDIX A

USGS LOCUS MAP



PREPARED FOR:

ARLINGTON LAND REALTY, LLC
84 SHERMAN ST, 2ND FLOOR
CAMBRIDGE, MA 02140

USGS LOCUS MAP

THORNDIKE PLACE
DOROTHY ROAD
ARLINGTON, MA

BSC GROUP
803 Summer Street
Boston, Massachusetts
02127
617 896 4300

Job No.: 23407.00 Date: 11/3/2020
Scale: 1"=1,000' Revised:
Dwg. No: Figure: 1 OF 1

File: 2340700\C\Drainage\2340700-EX WATERSHED

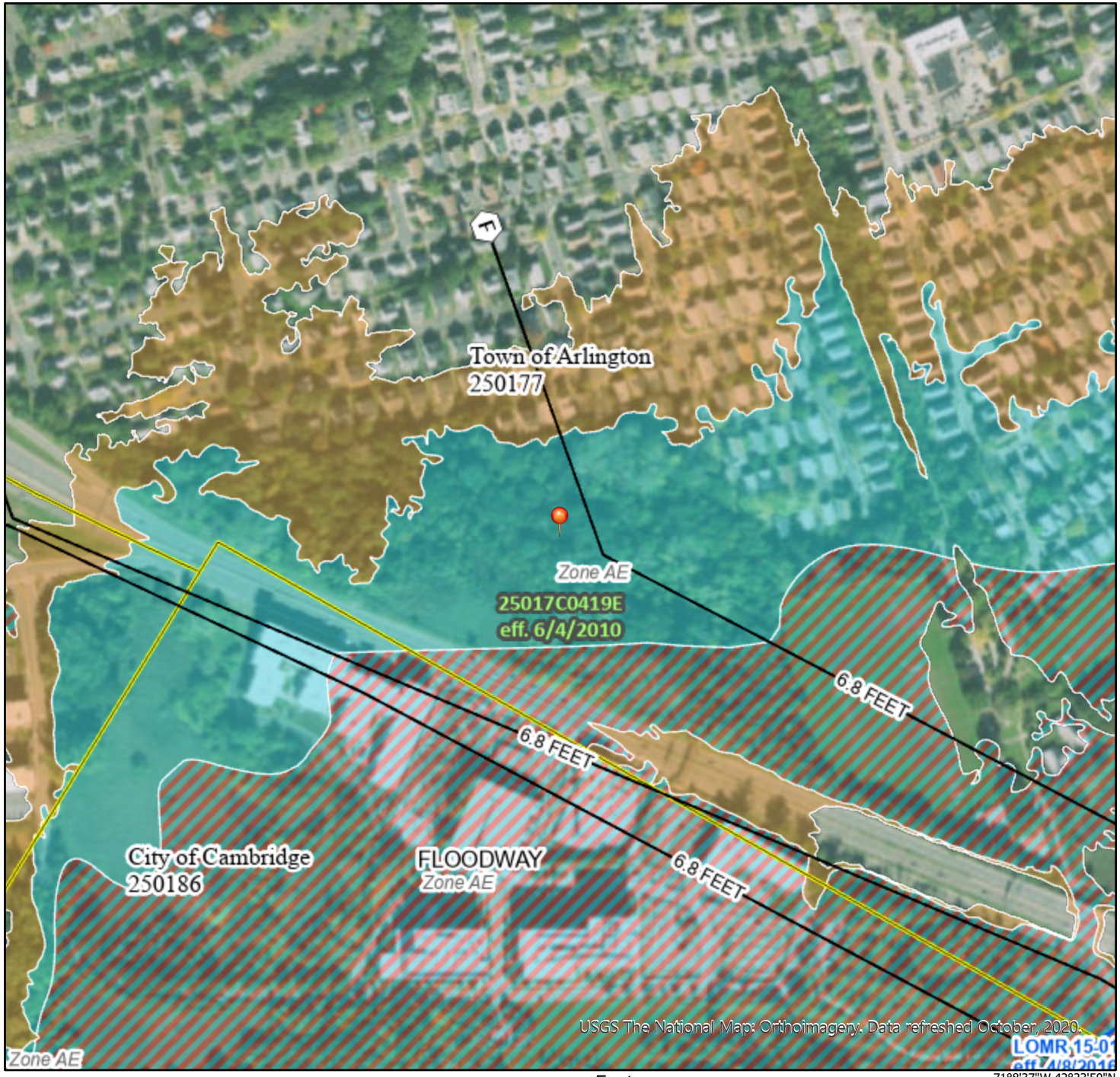
APPENDIX B

FEMA MAP

National Flood Hazard Layer FIRMette

FEMA

71°9'15"W 42°24'17"N



71°8'37"W 42°23'50"N

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 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 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 11/2/2020 at 3:34 PM 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.

APPENDIX C

WEB SOIL SURVEY

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Middlesex County, Massachusetts

November 2, 2020

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.

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626B—Merrimac-Urban land complex, 0 to 8 percent slopes.....16
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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

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: 1:4,500 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: Middlesex County, Massachusetts
Survey Area Data: Version 20, Jun 9, 2020

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

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

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
51A	Swansea muck, 0 to 1 percent slopes	4.3	4.6%
52A	Freetown muck, 0 to 1 percent slopes	10.4	11.2%
603	Urban land, wet substratum	32.1	34.5%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	14.3	15.4%
655	Udorthents, wet substratum	31.9	34.3%
Totals for Area of Interest		**92.9**	**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.

Middlesex County, Massachusetts

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 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

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

Description of Swansea

Setting

Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
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: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Bogs, swamps

Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 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

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Depressions, depressions, bogs, marshes, kettles, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
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: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Kettles, depressions, depressions, marshes, swamps, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

603—Urban land, wet substratum

Map Unit Setting

National map unit symbol: 9951
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Excavated and filled land over alluvium and/or marine deposits

Minor Components

Udorthents, loamy

Percent of map unit: 10 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 5 percent
Landform: Ledges
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Head slope
Down-slope shape: Concave
Across-slope shape: Concave

626B—Merrimac-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyr9
Elevation: 0 to 820 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Merrimac and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Eskers, moraines, outwash terraces, outwash plains, kames
Landform position (two-dimensional): Backslope, footslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water capacity: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Windsor

Percent of map unit: 5 percent
Landform: Dunes, outwash terraces, deltas, outwash plains
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Eskers, kames, deltas, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

655—Udorthents, wet substratum

Map Unit Setting

National map unit symbol: vr1n
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 110 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents, wet substratum, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents, Wet Substratum

Setting

Parent material: Loamy alluvium and/or sandy glaciofluvial deposits and/or loamy glaciolacustrine deposits and/or loamy marine deposits and/or loamy basal till and/or loamy lodgment till

Properties and qualities

Slope: 0 to 8 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: 8 percent
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear

Freetown

Percent of map unit: 4 percent
Landform: Depressions, bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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