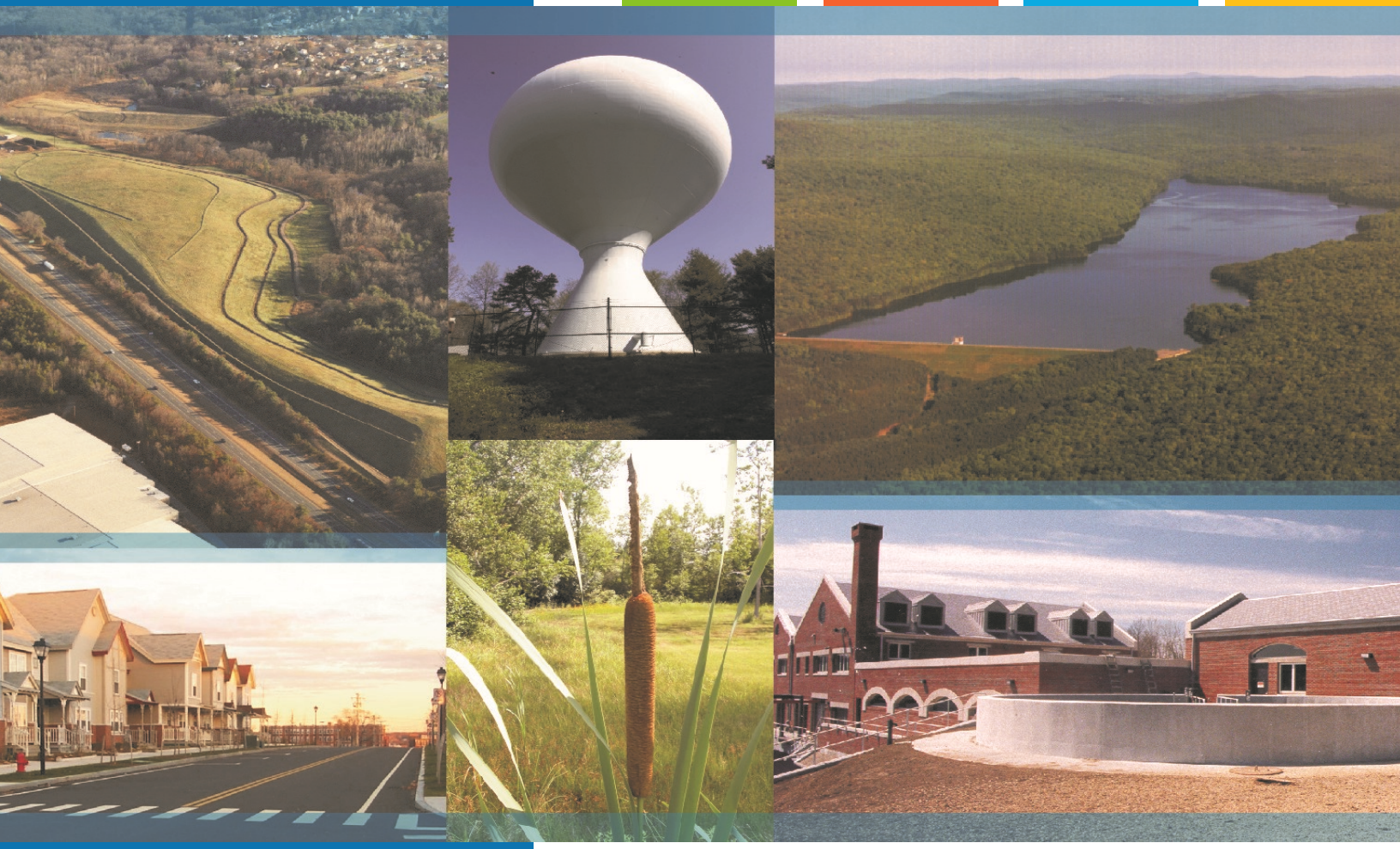

Connecticut Proton Therapy Center
Wallingford, CT

ENGINEERING REPORT

Prepared for:
Proton International, LLC
922 Hawkhorn Court
Alpharetta, Georgia 30005

December 1, 2020

Tighe&Bond

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Table of Contents

Section 1
Introduction and Site Conditions

Tighe & Bond has prepared this report for a new Proton Therapy Center in Wallingford, CT, by Proton International. The proposed facility is located on a parcel bounded by McDonald Lane to the north, Northtrop Road to the west, Interstate I-91 to the east, and private property to the south. The proposed development consists of the construction of a new 18,000 square foot Proton Therapy Center, surface parking, utilities, landscaping, lighting, and a stormwater management system. Please refer to **Figure 1**, Site Location Map, in **Appendix A,** for the project location.

Tighe & Bond is familiar with the property, and has reviewed available soils, drainage, utility, wetland, and topographic information. Drainage calculations and stormwater management plans have been prepared in accordance with the Town of Wallingford drainage requirements, Plainville 2010 Low Impact Development and Stormwater Management Design Manual, The Connecticut Department of Transportation (CTDOT) Drainage Manual, and the Connecticut Department of Energy and Environmental (DEEP) Protection 2004 Stormwater Quality Manual. The drainage calculations include a hydrologic and hydraulic analysis of the existing conditions and the proposed development. More specifically, the calculations include an analysis of the on-site stormwater management measures and their performance in handling peak flow attenuation and suspended solids removal rates. Lastly, the report also includes a description of the existing and proposed utilities, the soil erosion and sedimentation control measures and the drainage and stormwater management maintenance and inspection schedules.

1.1 Existing Conditions

The property is approximately 11.79 acres and is located within the Interchange District (I5) zone and in the Wallingford Watershed Protection District (WPD) as shown on the Wallingford Zoning Map. The site is entirely wooded and generally slopes to the south. Rainfall runoff also generally flows from the north to the south through an existing drainage swale located on the western portion of the site. A small portion of the site drains to the northeast.

There is an existing 24” storm sewer located along the southern property line that collects flow from the on-site swale and conveys stormwater south.

1.2 Proposed Conditions

Proton International is proposing to build an approximately 18,000 square foot Proton Therapy Center in Wallingford, Connecticut. The proposed building and site improvements will occupy approximately 4.8 acres at the south end of the parcel. The building will be approximately centered along the southern property line and the site will be accessed from a driveway off Northrop Road.

The proposed development includes 50 parking spaces with the majority of the spaces located on the east side of the building. To the west is the loading dock and exterior utility area while to the north is the building's front entrance and passenger drop-off area and

to the south is the ambulatory drop-off area. The proposed site is 14.5% impervious consisting of the proposed building, driveways, parking areas, sidewalks, and curbing.

Stormwater management will be accommodated on-site. Surface runoff will be collected in catch basins and yard drains and conveyed in below ground storm sewers to oil/grit separators and then into sand filter basins. The stormwater management system utilizes a "treatment train" approach which incorporates low impact development (LID) techniques to treat the first one inch of runoff also known as the Water Quality Volume. The stormwater management system will meet the 80% total suspended solids removal and reduce peak flow and volume.

1.3 Site Soils

The U.S. Department of Agriculture's National Resource Conservation Service (NRCS) Web Soil Survey indicates the following soil types are present on the site:

Watchaug fine sandy loam (Map Unit 55B): Watchaug soils are common on hills on upland and till plains on uplands. The parent material consists of course-loamy melt-out till derived from basalt and/or sandstone and shale. The natural drainage class is moderately well drained and does not meet hydric criteria.

Cheshire fine sandy loam (Map Unit 63B, C): Cheshire soils are typically found on hills on uplands and till plains on upland. The parent material consists of coarse-loamy melt-out till derived from basalt and/or sandstone and shale. Natural drainage class is well drained and does not meet hydric criteria.

Tighe & Bond performed a double ring infiltrometer test on site to confirm the physical properties of the soils and for sizing the on-site stormwater management system. The infiltration rate was measured to be 0.75 inches per hour in the Watchaug fine sandy loam and 1.5 inches per hour in the Cheshire fine sandy loam. The report and the results of the infiltration tests can be found in **Appendix B**.

Tighe & Bond conducted a field investigation at 932 Northrop Road, located in Wallingford, Connecticut to identify the presence or absence of state and federal wetlands and watercourses. The field investigation was conducted on September 03, 2019 by a Certified Professional Soil Scientist and Professional Wetland Scientist. No wetlands or watercourses were identified on site or within fifty feet of the site boundary during the investigation. The Wetland and Watercourse Survey Memorandum is attached in **Appendix B**.

Section 2
Stormwater Management

2.1 Existing Site Hydrologic Analysis

Under existing conditions, stormwater runoff from the site flows in two directions. The majority of the site flows south to an existing 24" storm sewer located along the southern property line that collects flow from the on-site swale and conveys stormwater south. The remaining 10% of the site flows towards the northeast corner of the site.

A hydrologic study was performed for the existing conditions. The site was delineated into four watershed areas. These watersheds are summarized below:

- **EX-WS-01** drains to the existing 24" storm sewer located along the southern property line.
- **EX-WS-02** drains northeast towards the eastern limits of the site.

Watershed EX-WS-01 was analyzed as Design Point A. Watershed EX-WS-02 was analyzed as Design Point B.

See **WM-01** in **Appendix C** for the Existing Conditions Watersheds and Design Points.

Impervious and pervious areas, weighted curve numbers, and times of concentration were calculated for each watershed and inputted into a hydrologic model to determine the project's peak flow and volume as part of the comparative hydrology analysis.

A breakdown of exiting watershed areas, existing volumetric hydrographs, and existing watershed map are included in **Appendix C** of this report.

2.1.1 Floodplain Management

The Federal Emergency Management Agency's Flood Insurance Rate Map (FIRM) for the Town of Wallingford, effective May 16, 2017, shows that the site lies within an area of minimal flood hazard (Zone X), as shown in **Figure 2** in **Appendix A**.

2.2 Proposed Site Hydrologic and Hydraulic Analysis

The proposed stormwater management system will utilize a series of catch basins, yard drains, roof leaders, oil/grit separators, sand filter basins, and an infiltration basin. The stormwater management system will maintain existing drainage patterns while providing Low Impact Development techniques and Best Management Practices for stormwater treatment.

In the proposed condition, the majority of the site will continue to flow south to the existing 24" storm sewer located along the southern property line. The remaining 10% of the site will continue to flow towards the northeast corner of the site.

Stormwater runoff from the proposed building and site will be collected and conveyed to the 24" storm sewer via roof drains, catch basins, yard drains, and manholes. The building's roof will be piped directly to an underground infiltration system to reduce the

peak flow off site and promote groundwater recharge. The stormwater runoff from the proposed drive and parking areas will be piped to two sand filter basins as well as two oil/grit separators to treat the stormwater prior to discharge from the site.

2.2.1 Peak Rate Attenuation

The proposed stormwater management system will utilize a series of catch basins, yard drains, roof leaders, oil/grit separators, sand filter basins, and an infiltration basin. The system has been designed to retain and treat the Water Quality Volume in addition to reducing peak flow. Table 1 below shows the in peak discharge from existing to proposed for the 2, 10, 25, 50 and 100-year storm events.

Table 1
Summary of Stormwater Peak Discharge (CFS)

Discharge Location	Condition	2	10	25	50	100
Design Point A	Existing	1.700	6.660	10.570	13.700	16.850
	Proposed	1.700	6.160	9.860	12.730	16.720
Design Point B	Existing	1.491	0.760	1.310	1.770	2.300
	Proposed	1.491	0.760	1.310	1.770	2.300

Table 2 below shows the reduction in volumetric runoff from existing to proposed for the 2, 10, 25, 50 and 100-year storm events.

Table 2
Summary of Stormwater Volumetric Runoff (Cu. Ft.)

Discharge Location	Condition	2	10	25	50	100
Design Point A	Existing	21,274	62,197	93,370	118,445	147,341
	Proposed	19,872	87,345	87,796	112,035	139,828
Design Point B	Existing	1,491	5,382	8,549	11,166	14,235
	Proposed	1,491	5,382	8,549	11,166	14,235

A breakdown of proposed watershed areas, volumetric hydrographs, and watershed maps are included in **Appendix D**.

2.2.2 Water Quality Volume

The Water Quality Volume (WQV) is equivalent to the amount of stormwater runoff from the one-inch storm and is captured and treated in order to remove a majority of stormwater pollutants on an average annual basis. Two WQVs have been calculated for water quality areas on-site and are included in Table 2, along with the provided WQVs for each respective area.

WQV calculations are included in **Appendix F**.

Table 2
Summary of Water Quality Volumes (Cu. Ft.)

Discharge Location	Condition	
Water Quality Area 01	Required	1,630
	Provided	1,690
Water Quality Area 02	Required	4,392
	Provided	5,742

The sand filter basins will be installed per the Town of Wallingford requirements. The sand filter basins will treat the 1" water quality volume and flows up to the 25-year storm event. Flows in excess of the 25-year storm event will bypass the sand filter basins via an upstream bypass structure.

2.2.3 Hydraulic Capacity and Outlet Velocity

The stormwater collection system was designed to convey the 25-year storm event as required by the Town of Wallingford Watershed Protection regulations. The system was designed by analyzing sub-areas that correspond to each drainage collection structure and calculating the coefficient of imperviousness (C) and the time of concentration (Tc) values. The calculations were entered into the Hydraflow Storm Sewers Extension for AutoCAD Civil 3D 2015 by Autodesk Inc., Version 10.4. Results of the hydraulic analysis can be found in **Appendix E**.

Preformed scour holes and riprap aprons have been designed to reduce outlet velocities and prevent scour at outlets. These calculations meet the requirements of the CTDOT Drainage Manual, Chapter 7, and are found in **Appendix E.**

2.3 Method of Hydrology and Hydraulic Analysis

The following storm drainage design criteria were used for all pipe systems:

1. Design storm rainfall data was used per NOAA Atlas 14 data.
2. Stormwater management system is designed for the 2, 10, 25, 50, and 100-year storm events.
3. Piped storm drainage system and the outlets are designed for a 25-year storm event.
4. Minimum time of concentration = 5 minutes.
5. For SCS peak flow calculations, Curve Number were as follows:
    a. Impervious (Pavement/Roof Areas) = 98

   b. Wooded (HSG B) = 55

   c. Landscaped and Lawn (HSG B) = 61

   d. Wooded (HSG C) = 70

   e. Landscaped and Lawn (HSG C) = 74

6. For rational peak flow calculations, runoff coefficients were as follows:

   a. Impervious (Pavement/Roof) areas = 0.95

   b. Landscaped areas = 0.30

7. Minimum diameter pipes, excluding roof leaders, underdrains and foundation drains = 12 inches

8. Minimum pipe slope = 0.5 percent

9. The storm water management Plan for the site is designed to treat the Water Quality Volume, remove Total Suspended Solids and promote groundwater recharge while reducing peak flow.

10. Watershed areas delineated using polylines in AutoCAD Civil 3D 2018.

11. Comparative hydrology analyzed using HydroCAD Stormwater Modeling software Version 10.00-20.

12. Storm drainage system analyzed using AutoCAD Civil 3D 2018 Hydraflow Storm Sewers software Version 10.40 by Autodesk.

Runoff computations, storm sewer calculations, suspended solids removal rate and existing and proposed conditions are included in **Appendices C & D**.

2.4 Low Impact Development and Best Management Practices

The proposed stormwater management measures have been designed to remove a high percentage of sediments in accordance with the Connecticut Department of Energy and Environmental Protection Stormwater Quality Manual.

Best Management Practices (BMPs) are incorporated in the design to meet or exceed the Connecticut DEEP's goal of 80% removal of total suspended solids and other pollutants.

The BMPs include:

Oil/Grit Separators: Oil/grit separators serve as pretreatment and prevent transport of oils and sediment further downstream The proposed stormwater management system incorporates oil/grit separators upstream of the sand filter basins. The proposed

stormwater management system utilizes a oil/grit separators upstream of the sand filter basins. The oil/grit separators have been sized in accordance with the Town of Wallingford 2014 Water Technical. Sizing calculations are provided in **Appendix F.**

Sand Filter Basins: Sand filter basins capture and store stormwater runoff and pass it through a sand filtering media for pollutant removal. A sand filter is primarily a water quality control measure designed to remove particulate pollutants and, to a lesser degree, bacteria and nutrients. Two sand filter basins are proposed on site. The sand filter basins have been sized in accordance with the Town of Wallingford Watershed Protection Regulations to treat the first one inch of runoff or the Water Quality Volume. Sizing calculations are provided in **Appendix F.**

Underground Infiltration: Underground Infiltration serves as a primary treatment practice, reduces peak flow rates and promotes groundwater recharge. The proposed stormwater management system utilizes concrete and plastic chambers surrounded by stone and filter fabric and an outlet control structure designed to attenuate peak flows.

Preformed Scour Holes: Preformed scour holes serve as a secondary treatment practice that are utilized to reduce stormwater discharge velocities to non-erosive levels.

2.5 Stormwater Maintenance and Inspection Schedule

The initial inspection will be made during an intense rainfall to check the adequacy of the catch basins, roof leaders, piping, oil/grit separators, sand filter basins, underground infiltration, and system outlet.

The following is a checklist of items that will be checked and maintained during scheduled maintenance operations.

Drainage Structures: The Owner will be responsible for cleaning the catch basins, yard drains, manholes, piping, and outlet protection on their property. A Connecticut licensed hauler shall clean the sumps, and legally dispose of removed sand at an off-site location. The road sand may not be reused or stored on-site. As part of the hauling contract, the hauler shall notify the Owner in writing where the material is being disposed.

Each catch basin and yard drain shall be inspected every four months, with one inspection occurring during the month of April. Any debris occurring within one foot from the bottom of each sump shall be removed by Vacuum "Vactor" type of maintenance equipment. Maintain a log of inspections. Remove organic matter, sand and debris from catch basins as necessary and dispose of legally.

Oil/grit Separator: The oil/grit separator will be skimmed and oil and scum removed. In a separate operation, silt, sand and sediment will be removed. Once the structure is cleaned of debris, the chamber will be refilled with clean water to prevent wash through of debris and oil during next storm event.

Underground Infiltration: The underground infiltration system will be cleaned of all silt, debris and sediment from the inlet structure, outlet structure and the chamber lengths.

The outlet control structure will be inspected and cleaned to make sure nothing is clogging the discharge pipe.

Preformed Scour Holes: The preformed scour holes shall be inspected two times annually. Regular maintenance includes removing accumulated debris and sediment, checking for erosion, vegetative bare spots, and removing invasive plant species or tree saplings.

Sand Filter Basins: Sand filter basins will be cleaned of all silt, debris, and sediment within the basin and from the inlet structure.

Pavement: Paved areas shall be swept periodically by the Owner to clean trash and other debris. The Owner will sweep paved areas on its property in the spring to remove winter accumulations of road sand.

Perform a visual inspection of paved areas four times per year with one inspection after the last snowfall, but no later than April 1. Sweep accumulated sediment and debris from the paved areas. Clean paved areas as necessary during the remainder of the year.

A Stormwater Pollution Prevention Plan, including forms and checklists, for the proposed project can be found in **Appendix G.**

Section 3 Site Utility Services

3.1 Water and Fire Protection Services

Water and Fire Protection service for the proposed building will be provided by Town of Wallingford Department of Public Utilities-Water Division. Domestic and fire protection service will be supplied from the existing 12" main in Northrop Road.

A hydrant flow test was performed on October 8, 2020 by the Wallingford Water Division. The flow rate was reported at 860 gallons per minute with a residual pressure of 54 pounds per square inch.

3.2 Natural Gas Services

Natural Gas service for the proposed building will be provided by Eversource. Gas service will be supplied from the existing 12" gas main in Northrop Road.

3.3 Electric Service

Electric service for the proposed building will be provided by Town of Wallingford Department of Public Utilities-Electric Division. Underground electric lines will be installed from a pole along the northbound lane of Northrop Road to a proposed transformer that will power the building. The exact location of the service connections will be coordinated with Wallingford Electric Division prior to construction. Emergency Power will be provided to the building by means of an on-site generator.

3.4 Tel-Data Services

Redundant telephone and data services to the proposed building will be provided underground from an two existing service poles along the northbound lane of Northrop Road. The exact location of the service connections will be coordinated with Frontier prior to construction.

3.5 Sanitary Sewer Services

There is an existing sanitary sewer system within Northrop Road. This system will be used to tie the proposed building to the Wallingford sanitary sewer network.

Section 4
Soil Erosion and Sedimentation Control

4.1 SESC Narrative

The proposed development is entitled "Connecticut Proton Therapy Center" in Wallingford, Connecticut.

The project will include the Proton Therapy Building, sanitary sewer service, domestic water and fire protection service, underground electric and tel-data utilities, stormwater management system, bituminous concrete driveway and surface parking area, curbs, landscaping, lighting, and sidewalks.

Stormwater Management Systems shall conform to the standards outlined the Connecticut Department of Energy and Environmental Protection (CTDEEP) 2004 Connecticut Stormwater Quality Manual and the Town of Wallingford Watershed Protection Regulations. Stormwater management will be accommodated on-site. Surface runoff will be collected in catch basins and conveyed through an oil grit separator, sand filter and infiltration basin. Roof runoff will be collected in a roof leader system prior to being discharged into underground infiltration systems. The stormwater collection system will utilize a "treatment train" approach and include low impact development (LID) systems to treat the one inch of the required Water Quality Volume, remove total suspended solids and reduce peak flow.

The project is proposed to be constructed in a single phase. Approximately 4.8 acres will be disturbed.

Construction Start: Spring 2021
Construction End: Summer 2022

Soil Erosion and Sedimentation Control measures shall conform to the standards outlined in the Connecticut Department of Energy and Environmental protection (CTDEEP), "2002 Connecticut Guidelines for Soil Erosion and Sediment Control", latest revision.

Construction Sequence

1. Field stake the limits of construction.

2. Conduct a preconstruction meeting with the owner or owner's representative, town engineer, design engineer, contractor and site superintendent to establish the limits of construction, construction procedures, and material stockpile areas. Contractor to "call before you dig" (1-800-922-4455) prior to holding preconstruction meeting,

3. Install all applicable soil and erosion control measures around the perimeter of the site to the extent possible. This will include hay bale and siltation fence around the project as shown on the plans or as directed by the engineer.

4. Install anti-tracking pad in the areas as shown on the plans. All construction access shall be into the site through the anti-tracking pads.

5. Establish temporary sediment traps 01 and 02 and associated stone lined swales.

6. Clear remaining trees within the project limits. Chip brush and slash, stockpile chips for future use or remove off-site.

7. Establish temporary stockpile area and staging area. Provide silt fence/haybale barrier around soil stockpile area.

8. Make necessary cuts and fills required and establish the subgrade for the building and all paved surfaces. Stabilize area.

9. Begin construction of the building and all utilities within 5' of the building.

10. Upon completion of the building foundation and remove sediment trap 01 to accommodate grading and utility construction west of the building.

11. Install all drainage to the maximum extent practicable. Grade the area around the storm drainage system as necessary to provide positive drainage towards 24" storm drain.

12. Install all site lighting and utilities.

13. Rough grade site walkways, driveways, and parking areas.

14. Complete all remaining drainage for the entire project area.

15. Fine grade and establish all walkways and curbing for the entire project area.

16. Fine grade parking and driveway areas for the entire project area.

17. Pave first course of pavement in all parking and driveways.

18. Fine grade, rake, seed, and mulch within 2 feet of curbing.

19. Place topsoil where required, complete perimeter landscape plantings.

20. When all other work has been completed, repair and sweep all paved areas for the final course of paving. Inspect drainage system and clean as needed.

21. Install final course of pavement.

22. Remove temporary erosion and sediment controls (silt fence, haybale, etc.).

4.2 Soil Erosion and Sedimentation Control Notes

1. All sedimentation and erosion control measures shall be in accordance with the standards and specification of the "2002 Connecticut Guidelines for Soil Erosion and Sediment Control" DEEP Bulletin No. 34, and all amendments and addenda thereto as published by the Connecticut Department of Energy and Environmental Protection.

2. All erosion control measures shall be installed as shown on the plans and elsewhere as ordered by the owner's representative, or the Town of Wallingford.

3. All catch basins shall be protected with silt sacks, haybale ring, silt fence or block and stone inlet protection throughout the construction period and until all disturbed areas are thoroughly stabilized.

4. Wherever possible, erosion and sediment control measures shall be installed prior to construction.

5. Additional control measures shall be installed during construction period as ordered by the owner's representative, or the town of Wallingford. The procurement, installation and maintenance of additional soil erosion and sedimentation control measures to replace damaged measures, emergency repairs, and to meet conditions of the site as construction progresses shall be included in contractors lump sum bid price.

6. All sedimentation and erosion control measures shall be maintained in effective condition throughout the construction period.

7. Sediment removed shall be disposed of legally offsite.

8. The contractor shall be responsible for construction and maintenance of all erosion control measures throughout the construction period.

9. The contractor shall maintain a supply of silt fence/haybales and anti-tracking crushed stone on-site for emergency repairs.

10. The contractor shall utilize approved methods/materials for preventing the blowing and movement of dust from exposed soil surfaces onto adjacent properties and site areas.

11. All drainage structures shall be inspected weekly by the contractor and cleaned to prevent the build-up of silt.

12. The contractor shall carefully coordinate the placement of erosion control measures with the phasing of construction.

13. Keep all paved roadways clean. Sweep before forecasted storms or weekly as necessary.

14. Treat all unpaved surfaces in accordance with landscape plans.

15. Haybale barriers and silt fencing shall be installed along the toe of critical cut and fill slopes as shown on the plans and as directed by the Town of Wallingford.

16. All trucks leaving the site must be covered.

17. Disturbed slopes greater than 3:1 or as shown on the plans shall be immediately stabilized with erosion control blanket, North American green sc150bn or approved equivalent.

18. All sedimentation and erosion controls shall be checked weekly and after each rainfall event. Necessary repairs shall be made without delay.

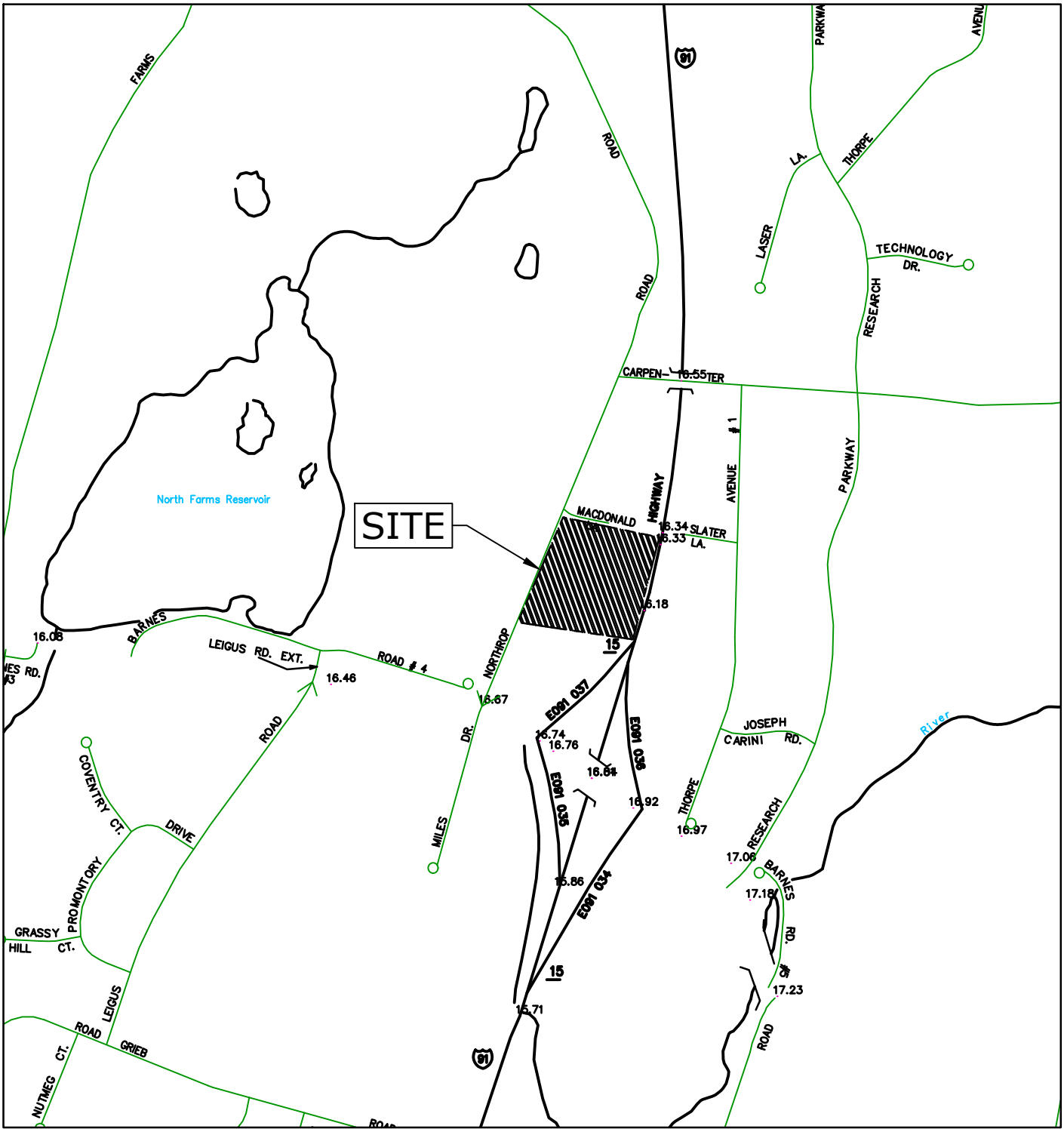
19. Prior to any forecasted rainfall, erosion and sediment controls shall be inspected and repaired as necessary.

20. After all disturbed areas have been stabilized, erosion controls may be removed once authorization to do so has been secured from the Town. Disturbed areas shall be seeded and mulched.

21. All drainage swales and sediment basins shall be stabilized with erosion control blanket, North American green sc150bn or approved equivalent.

22. Contractor is to comply with the requirements of the soil erosion and sedimentation control plan, details, and specifications.

APPENDIX A



CONNECTICUT PROTON THERAPY CENTER

WALLINGFORD, CT

SITE LOCATION MAP

NORTH

1" = 1000'

FIGURE 01

Tighe&Bond

Engineers | Environmental Specialists

National Flood Hazard Layer FIRMette

FEMA

72°46'33"W 41°29'21"N

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

1:6,000

72°45'56"W 41°28'54"N

Legend

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

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

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

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

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

OTHER FEATURES
- 20.2 / 17.5 — Cross Sections with 1% Annual Chance / Water Surface Elevation
- Coastal Transect
- 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.

CONNECTICUT PROTON THERAPY CENTER
WALLINGFORD, CT

FEMA FLOOD MAP

DATE: 10/19/2020
SCALE: NO SCALE
FIGURE: 02

Tighe&Bond
Engineers | Environmental Specialists

APPENDIX B

United States Department of Agriculture

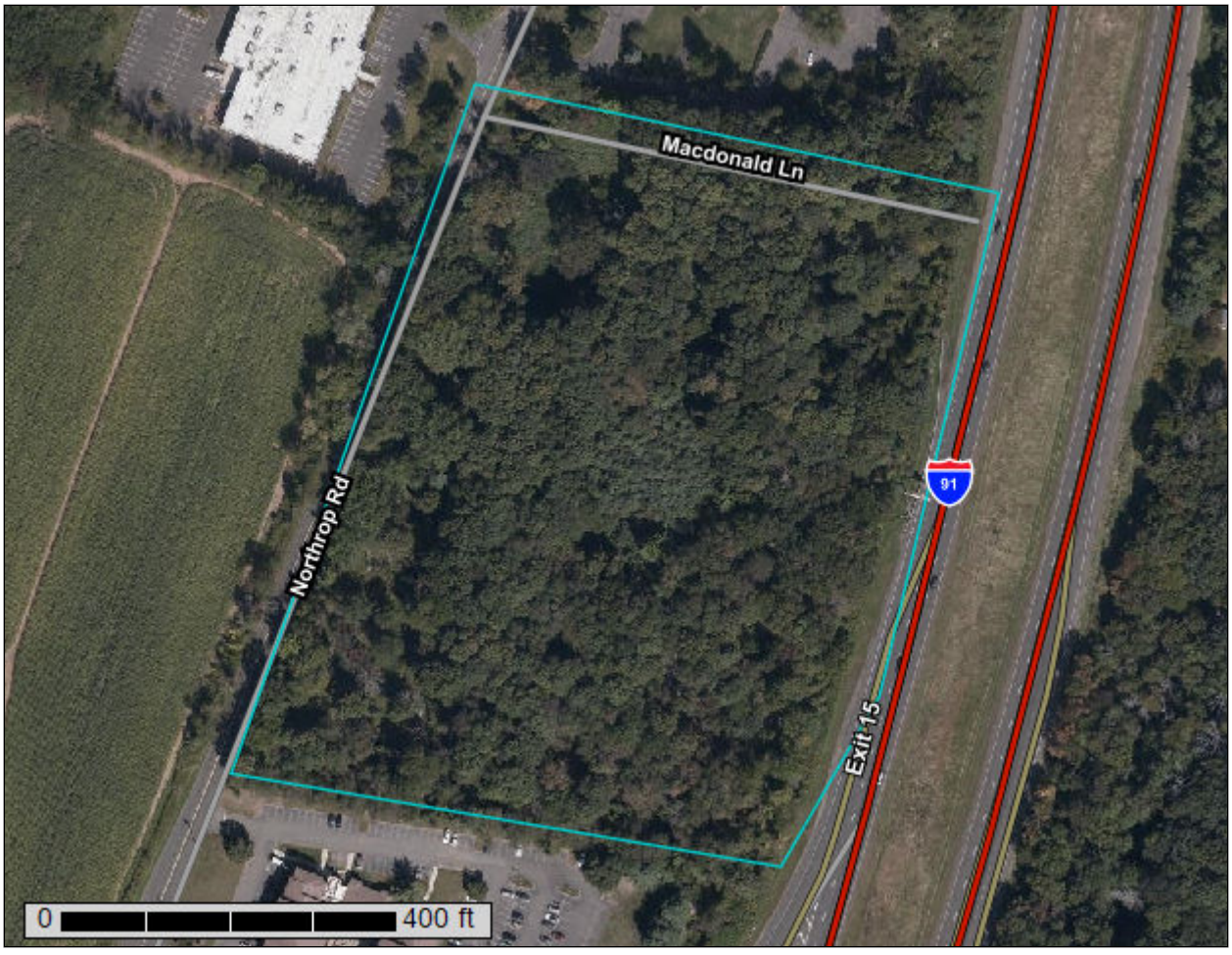
NRCS

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 State of Connecticut

CT Proton Therapy Center



November 19, 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.

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

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Contents

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.

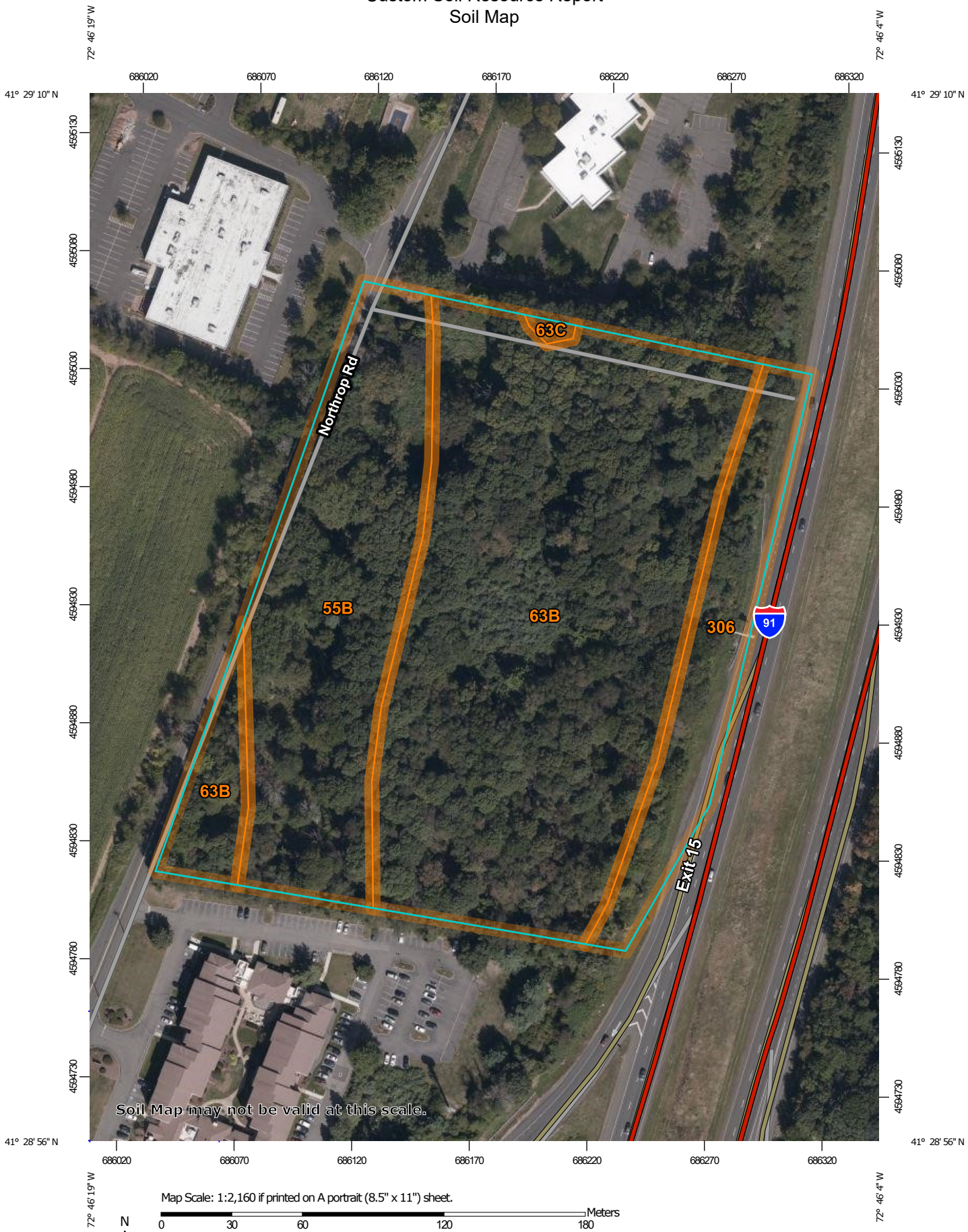
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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: 1:2,160 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: State of Connecticut
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: Aug 30, 2019—Oct 15, 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
55B	Watchaug fine sandy loam, 3 to 8 percent slopes	3.5	26.5%
63B	Cheshire fine sandy loam, 3 to 8 percent slopes	8.1	61.6%
63C	Cheshire fine sandy loam, 8 to 15 percent slopes	0.0	0.3%
306	Udorthents-Urban land complex	1.5	11.6%
Totals for Area of Interest		**13.2**	**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.

State of Connecticut

55B—Watchaug fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9lpb
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 52 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Watchaug

Setting

Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Coarse-loamy melt-out till derived from basalt and/or sandstone and shale

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 18 inches: fine sandy loam
Bw2 - 18 to 24 inches: fine sandy loam
C - 24 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: F144AY008CT - Moist Till Uplands
Hydric soil rating: No

Minor Components

Cheshire

Percent of map unit: 5 percent
Landform: Hills, till plains

Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Wilbraham

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Unnamed, stony surface

Percent of map unit: 3 percent
Hydric soil rating: No

Ludlow

Percent of map unit: 3 percent
Landform: Drumlins, hills
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Menlo

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Unnamed, silt loam surface

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

63B—Cheshire fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 9lpw
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Cheshire

Setting

Landform: Till plains, hills

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy melt-out till derived from basalt and/or sandstone and shale

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 16 inches: fine sandy loam
Bw2 - 16 to 26 inches: fine sandy loam
C - 26 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F145XY013CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Wilbraham

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Yalesville

Percent of map unit: 3 percent
Landform: Hills, ridges
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Watchaug

Percent of map unit: 3 percent
Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Wethersfield

Percent of map unit: 3 percent
Landform: Drumlins, hills
Down-slope shape: Linear
Across-slope shape: Convex

Hydric soil rating: No

Menlo

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Unnamed, brown subsoil

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

Unnamed, less sloping

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

63C—Cheshire fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 9lpx
Elevation: 0 to 1,200 feet
Mean annual precipitation: 43 to 54 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 140 to 185 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Cheshire

Setting

Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Coarse-loamy melt-out till derived from basalt and/or sandstone and shale

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 16 inches: fine sandy loam
Bw2 - 16 to 26 inches: fine sandy loam
C - 26 to 65 inches: gravelly sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: F145XY013CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Wilbraham

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wethersfield

Percent of map unit: 5 percent
Landform: Drumlins, hills
Down-slope shape: Linear
Across-slope shape: Convex
Hydric soil rating: No

Yalesville

Percent of map unit: 5 percent
Landform: Hills, ridges
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Watchaug

Percent of map unit: 3 percent
Landform: Hills, till plains
Down-slope shape: Linear
Across-slope shape: Concave
Hydric soil rating: No

Menlo

Percent of map unit: 2 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

306—Udorthents-Urban land complex

Map Unit Setting

National map unit symbol: 9lmg
Elevation: 0 to 2,000 feet
Mean annual precipitation: 43 to 56 inches
Mean annual air temperature: 45 to 55 degrees F
Frost-free period: 120 to 185 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 50 percent
Urban land: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Drift

Typical profile

A - 0 to 5 inches: loam
C1 - 5 to 21 inches: gravelly loam
C2 - 21 to 80 inches: very gravelly sandy loam

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to high (0.00 to 1.98 in/hr)
Depth to water table: About 54 to 72 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Description of Urban Land

Typical profile

H - 0 to 6 inches: material

Interpretive groups

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

Minor Components

Unnamed, undisturbed soils

Percent of map unit: 8 percent
Hydric soil rating: No

Udorthents, wet substratum

Percent of map unit: 5 percent
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Rock outcrop

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

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Tighe&Bond
Engineers | Environmental Specialists

Project Name: **Proton International Northrop Road Facility**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Soil Infiltration Test**
Performed By: **EG** Date: **November 13, 2020** Checked By: **APW**

Test No: **IT-01**
Method: Double Ring Infiltrometer
Location: 60' South of B-123
Depth: 24" Below Grade

Time	Δ Time (min)	Δ Depth Inner Ring (in)	Rate (in/min)	Rate (in/hr)	Δ Depth Outer Ring (in)	Comments
						Pre-soak
2:30 PM						Topped Off
2:50 PM					0	
		0				Refilled and Start Test
2:50 PM						Start Test
2:55 PM	5.00	1/2	0.10	6.00	1/4	Topped Off
3:00 PM	5.00	3/8	0.08	4.50	3/8	Topped Off
3:05 PM	5.00	3/8	0.08	4.50	3/8	Topped Off
3:10 PM	5.00	1/4	0.05	3.00	1/8	Topped Off
3:15 PM	5.00	1/16	0.01	0.75	1/8	Topped Off
3:20 PM	5.00	1/16	0.01	0.75	1/8	Topped Off
3:25 PM	5.00	1/16	0.01	0.75	1/16	Topped Off
3:30 PM	5.00	3/16	0.04	2.25	2/16	Topped Off
3:35 PM	5.00	1/8	0.03	1.50	3/16	Topped Off
3:40 PM	5.00	1/16	0.01	0.75	1/16	Topped Off
3:45 PM	5.00	1/16	0.01	0.75	1/16	Topped Off
3:50 PM	5.00	1/16	0.01	0.75	1/16	End Test

Result **Avg. Infiltration Rate** **0.01** **0.75**

Project Name: **Proton International Northrop Road Facility**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Soil Infiltration Test**
Performed By: **NDG** Date: **November 19, 2020** Checked By: **APW**

Test No: **IT-02**
Method: Double Ring Infiltrometer
Location: South East of Proposed Building TP-C1
Depth: 36" Below Grade

Time	Δ Time (min)	Δ Depth Inner Ring (in)	Rate (in/min)	Rate (in/hr)	Δ Depth Outer Ring (in)	Comments
						Pre-soak
8:18 AM						Topped Off
9:18 AM	60.00	3 1/2			3 1/2	
						Refilled and Start Test
9:18 AM		0				
9:48 AM	30.00	3/8	0.01	0.75	0	
10:18 AM	30.00	3/4	0.01	0.75	3/8	
10:48 AM	30.00	1 1/8	0.01	0.75	1 1/4	
11:08 AM	30.00	1 1/2	0.01	0.75	1 5/8	End Test
Result	**Avg. Infiltration Rate**		**0.01**	**0.75**		

Project Name: **Proton International Northrop Road Facility**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Soil Infiltration Test**
Performed By: **NDG** Date: **November 19, 2020** Checked By: **APW**

Test No: **IT-03**
Method: Double Ring Infiltrometer
Location: South East of Proposed Building TP-C2
Depth: 36" Below Grade

Time	Δ Time (min)	Δ Depth Inner Ring (in)	Rate (in/min)	Rate (in/hr)	Δ Depth Outer Ring (in)	Comments
						Pre-soak
11:05 AM		0			0	Topped Off
11:20 AM	15.00	1/2	0.03	2.00	3/4	
11:35 AM	15.00	1 3/8	0.06	3.50	1 5/8	
11:50 AM	15.00	1 1/2	0.01	0.50	1 1/2	Refilled
11:50 AM	15.00	0			0	
12:05 PM	15.00	3/8	0.03	1.50	1/2	
12:20 PM	15.00	3/4	0.03	1.50	1	
12:35 PM	15.00	1 1/8	0.03	1.50	1 1/2	
12:50 PM	15.00	1 1/2	0.03	1.50	2	End Test

Result **Avg. Infiltration Rate** **0.03** **1.50**

Project Name: **Proton International Northrop Road Facility**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Soil Infiltration Test**
Performed By: **NDG** Date: **November 19, 2020** Checked By: **APW**

Test No: **IT-04**
Method: Double Ring Infiltrometer
Location: South East of Proposed Building TP-C3
Depth: 36" Below Grade

Time	Δ Time (min)	Δ Depth Inner Ring (in)	Rate (in/min)	Rate (in/hr)	Δ Depth Outer Ring (in)	Comments
						Pre-soak
1:05 PM		0			0	Topped Off
2:05 PM	60.00	3	0.05	3.00	3	
2:05 PM		0		0.00	0	Refilled
2:20 PM	15.00	3/4	0.05	3.00	3/4	
2:35 PM	15.00	1 1/2	0.05		1 1/2	
2:50 PM	15.00	2 1/4	0.05	3.00	2 1/4	
3:05 PM	15.00	3	0.05	3.00	3	End Test

Result **Avg. Infiltration Rate** **0.05** **3.00**

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **Proton International Northrop Road Facility**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Soil Infiltration Test**
Performed By: **NDG** Date: **November 20, 2020** Checked By: **APW**

Test No: **IT-05**
Method: Double Ring Infiltrometer
Location: South West of Proposed Building
Depth: 36" Below Grade

Time	Δ Time (min)	Δ Depth Inner Ring (in)	Rate (in/min)	Rate (in/hr)	Δ Depth Outer Ring (in)	Comments
						Pre-soak
10:30 AM		0			0	Topped Off
11:30 AM	60.00	3/4	0.01	0.75	3/4	
						Refilled
12:00 PM	30.00	1 1/8	0.01	0.75	1 1/8	
12:30 PM	30.00	1 1/2	0.01	0.75	1 1/2	
1:00 PM	30.00	1 7/8	0.01	0.75	1 7/8	
1:30 PM	30.00	2 1/4	0.01	0.75	2 1/4	End Test

Result **Avg. Infiltration Rate** **0.01** **0.75**

Wetland and Watercourse Survey Memorandum: 932 Northrop Road, Wallingford, Connecticut

TO: Peter A. Carbone - Proton International

FROM: Raina Volovski, PWS, CPSS and Rick Canavan, PhD - Tighe & Bond

DATE: September 20, 2019

Background

Tighe & Bond conduced a field investigation at 932 Northrop Road, located in Wallingford, Connecticut to identify the presence or absence of state and federal wetlands and watercourses. The field investigation was conducted on September 03, 2019 by a Certified Professional Soil Scientist and Professional Wetland Scientist. No wetlands or watercourses were identified on site or within fifty feet of the site boundary during the investigation.

Regulatory Information

Wetlands and watercourses are regulated by municipal, state, and Federal laws and regulations, each with different definitions and regulatory requirements. Accordingly, the State and municipalities may regulate wetlands and waters that fall outside of Federal jurisdiction; however, where Federal jurisdiction exists, concurrent State and municipal jurisdiction is almost always present.

Municipal Regulations

The Town of Wallingford Inland Wetland and Watercourses Regulations (effective date May 08, 2016) provide jurisdiction over activities within the boundaries of wetlands and watercourses and within a fifty (50) feet from the wetland or watercourse boundary.

State Regulations

State of Connecticut wetland determinations are based on the presence of poorly drained, very poorly drained, alluvial, or floodplain soils and submerged land. Watercourses are defined as "rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through or border upon the state or any portion thereof." Intermittent watercourse determinations are made based on the presence of a defined permanent channel and bank, and two of the following characteristics: (1) evidence of scour or deposits of recent alluvium or detritus, (2) the presence of standing or flowing water for a duration longer than a particular storm incident, and (3) the presence of hydrophytic vegetation. (See Inland Wetlands and Watercourses Act §22a-38 CGS.).

Federal Regulations

The Clean Water Act (33 CFR 328.8) is the basis of Federal regulation of "Waters of the United States" and associated wetlands. The review of the Site for the presence of Federally-regulated wetlands and waters was conducted in accordance with the Regional Supplement to the Corps of Engineers Wetland Delineation Manual Northcentral and Northeast Region (Version 2.0) (January 2012). This manual requires there to be dominant hydrophytic vegetation, hydric soils, and hydrological conditions present in determining wetland areas.

Field Investigation

In preparation of the site visit, a desktop study of available information was conducted. The Natural Resources Conservation Service Web Soil Survey (WSS)[1], National Wetland Inventory (NWI)[2], and historic and current aerial photographs were reviewed.

Wetlands were not identified by the NWI, and areas of saturation or inundation were not noted on historic or current aerials.

One man-made drainage swale was observed along the southwest portion of the property. The swale led to a cement pre-cast culvert located along the southwest property boundary. The drainage swale lacked evidence of scour or deposits of recent alluvium or detritus and the presence of standing or flowing water for a duration longer than a particular storm incident. A scattering of hydrophytic vegetation was present along the banks, meeting only one of the required characteristics. The site had been historically disturbed, as evident by the man-made swale, and observed throughout the site during the field investigation.

The east side of the site was dominated by mature red maple (*Acer rubrum*) tree cover with sparse understory. A field in the northwest of the site was vegetated with mugwort (*Artemisia vulgaris*) and common reed (*Phragmites australis*). The remaining western portion of the property was dominated by red maple trees with an understory consisting of silky dogwood (*Cornus amomum*), autumn olive (*Elaeagnus umbellate*), common red raspberry (*Rubus idaeus*), multiflora rose (*Rosa multiflora*), eastern poison ivy (*Toxicodendron radicans*), fox grape (*Vitis labrusca*), and oriental bittersweet (*Celastrus orbiculatus*). Mugwort, common reed, autumn olive, multiflora rose, and oriental bittersweet are non-native invasive species according to the Connecticut Invasive Plant Working Group[3].

Red maple and silky dogwood are considered hydrophytic vegetation by the U.S Army Corps of Engineers (Corps). Soil within the area dominated by hydrophytic vegetation lacked hydric characteristics and indicators and does not meet state or federal definitions of a wetland.

Soil

Soil was observed by obtaining samples by hand auger. Hydric soils were not observed on site during the field investigation. The soil observed corresponds to the WSS data with the exception of for a hill located in the center of the property comprised of human transported material, including building material, construction waste, trash, boulders and soil.

The WSS classifies the on-site soils as:

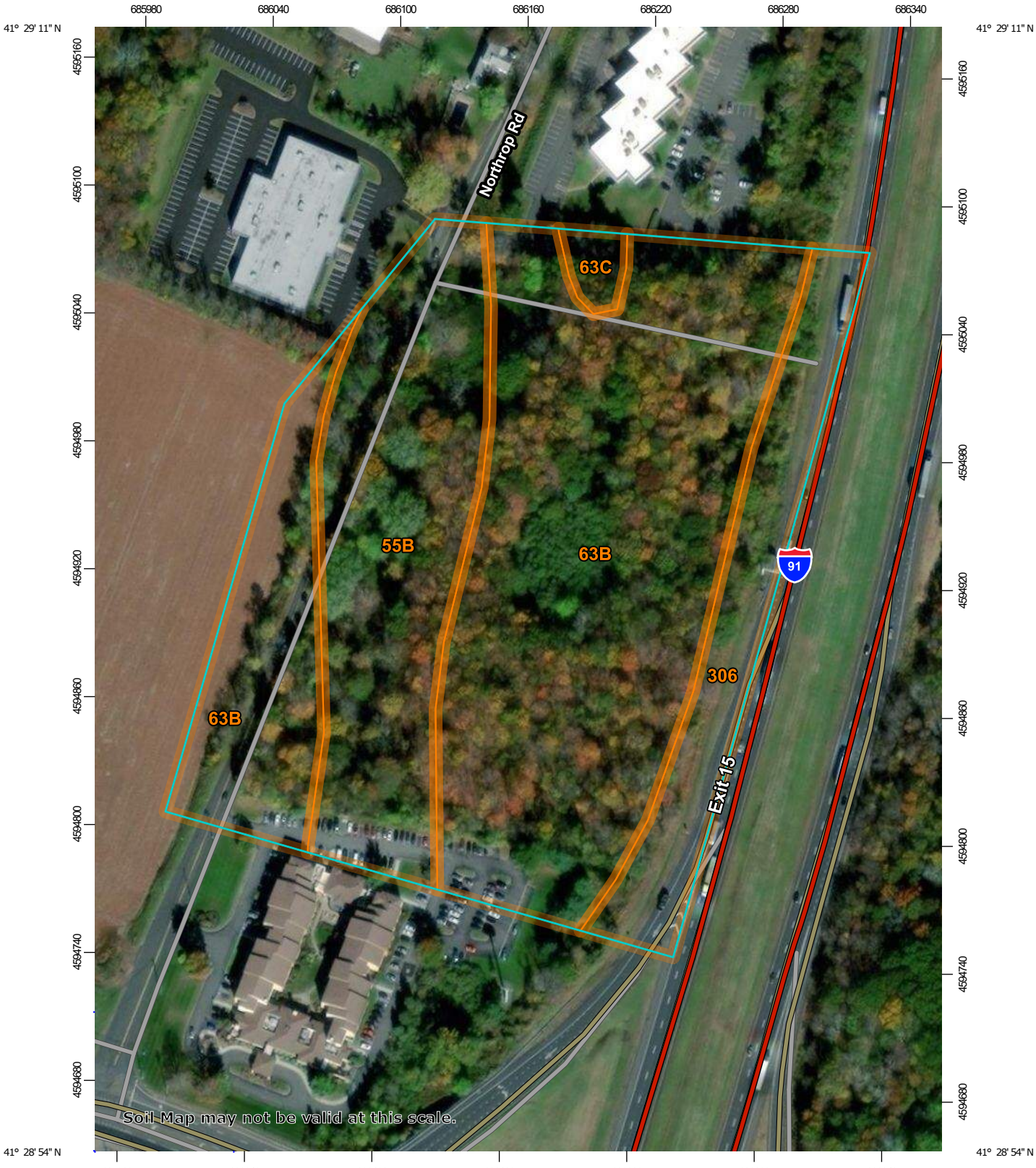
Watchaug fine sandy loam (Map Unit 55B)
Watchaug soils is common on hills on upland and till plains on uplands. The parent material consists of course-loamy melt-out till derived from basalt and/or sandstone and shale. The natural drainage class is moderately well drained and does not meet hydric criteria.

[1] https://websoilsurvey.nrcs.usda.gov/app/
[2] https://www.fws.gov/wetlands/Data/Mapper.html
[3] https://cipwg.uconn.edu/

Cheshire fine sandy loam (Map Unit 63C, B)
Cheshire soils are typically found on hills on uplands and till plains on upland. The parent material consists of coarse-loamy melt-out till derived from basalt and/or sandstone and shale. Natural drainage class is well drained and does not meet hydric criteria.

Summary

During the September 03, 2019 field investigation, no wetlands or watercourses were observed on or within 50-feet of the site. One drainage swale was observed; however, does not meet the State definition of an intermittent watercourse as it lacks defining characteristics. The southwest portion of the site was dominated by facultative and facultative wet vegetation; however, the soils observed were non-hydric and the area lacked wetland hydrologic indicators.



Map Scale: 1:2,570 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N 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 1:12,000.

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: State of Connecticut
Survey Area Data: Version 18, Dec 6, 2018

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

Date(s) aerial images were photographed: Dec 31, 2009—Oct 30, 2017

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
55B	Watchaug fine sandy loam, 3 to 8 percent slopes	4.7	24.7%
63B	Cheshire fine sandy loam, 3 to 8 percent slopes	11.6	61.4%
63C	Cheshire fine sandy loam, 8 to 15 percent slopes	0.2	1.3%
306	Udorthents-Urban land complex	2.4	12.7%
Totals for Area of Interest		**19.0**	**100.0%**

U.S. Fish and Wildlife Service
National Wetlands Inventory

Wetlands

August 27, 2019

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

APPENDIX C

EX WS 01
10.535 ac
CN 60
TC=56

DESIGN POINT A

EX WS 02
1.285 ac
CN 55
TC=33

DESIGN POINT B

LEGEND:

WATERSHED BOUNDRY

Tc FLOW PATH

SCALE: 1" = 80'

CONNECTICUT PROTON THERAPY CENTER WALLINGFORD, CT	
EXISTING WATERSHED MAP	
DATE: 10/15/2020	Tighe&Bond
SCALE: 1" = 80'	
FIGURE: WM-01	

Tighe&Bond

Project Name: **Connecticut Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Existing Conditions CN & Tc**
Prepared By: **PAR** Checked By: **APW**
Date: **October 15, 2020**

Designation: **EX-WS-01**
Location: Flow along the southwest portion of site discharging to Design Point A

Cover Type	Area, ac	CN	A x CN
Wooded, HSG B	7.228	55	398
Landscaped and Lawn, HSG B	0.021	61	1
Wooded, HSG C	3.263	70	228
Landscaped and Lawn, HSG C	0.023	74	2
	10.535		629

Weighted CN: 60

Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.8	300	0.087	49.2

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	unpaved	0.014	1.91	209	1.8
Segment C - D	unpaved	0.015	1.98	579	4.9

Total Tc = 56.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond

Project Name: **Connecticut Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Existing Conditions CN & Tc**
Prepared By: **PAR** Checked By: **APW**
Date: **October 15, 2020**

Designation: **EX-WS-02**
Location: Eastern edge of site discharge offsite

Cover Type	Area, ac	CN	A x CN
Wooded, HSG B	1.285	55	71
	1.285		71

Weighted CN: 55

Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.8	150	0.06	32.8

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment E - F	paved	1	20.33	0	0.0

Total Tc = 32.9 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Subcat Reach Pond Link

Routing Diagram for Existing HydroCAD
Prepared by Tighe & Bond, Printed 11/18/2020

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
458,905	60	(EX-WS-01)
55,975	55	(EX-WS-02)
514,879	**59**	**TOTAL AREA**

Summary for Subcatchment EX-WS-01: Design Point A

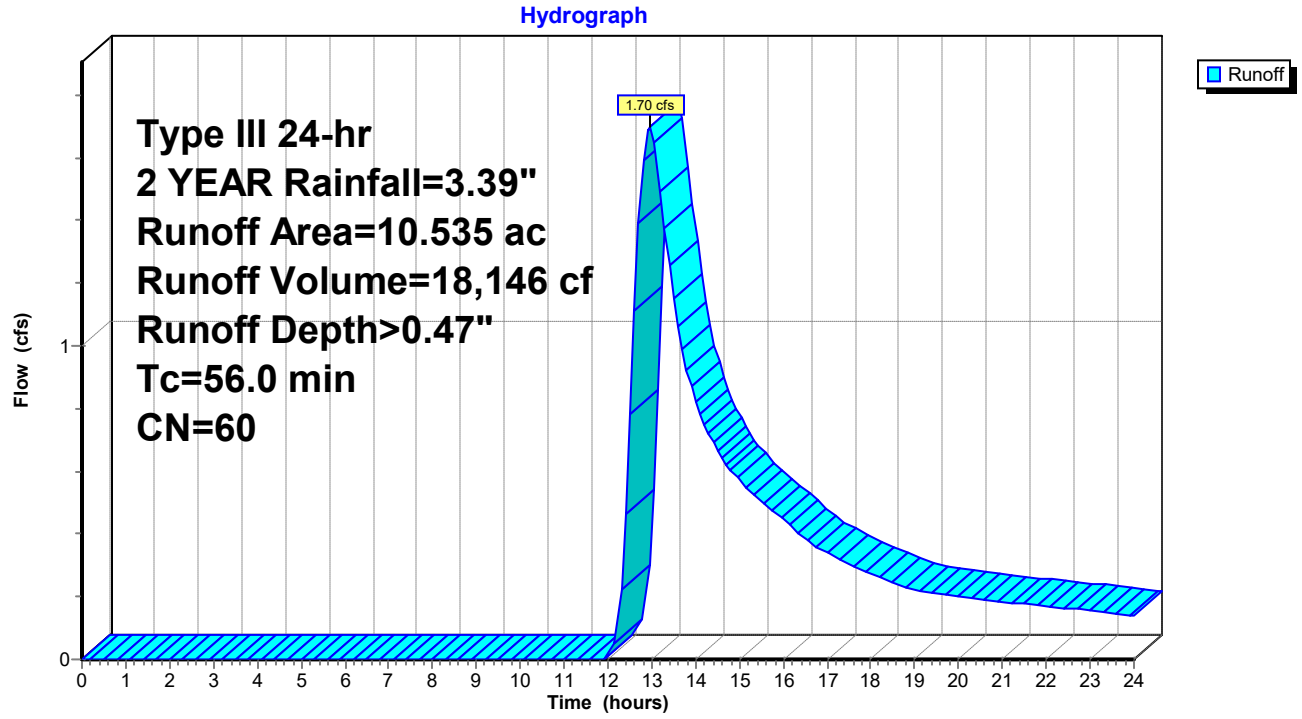
Runoff = 1.70 cfs @ 12.95 hrs, Volume= 18,146 cf, Depth> 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	10.535	60	
	10.535		100.00% Pervious Area

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

Subcatchment EX-WS-01: Design Point A



Summary for Subcatchment EX-WS-02: Design Point B

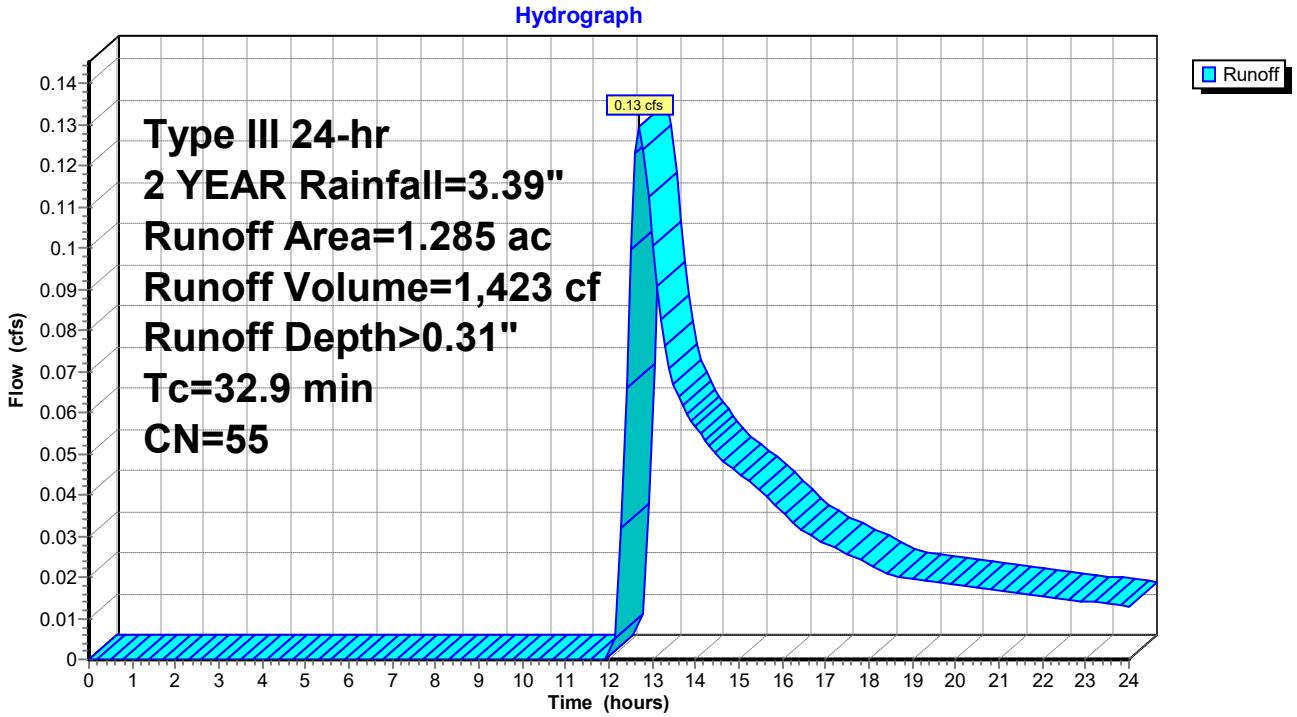
Runoff = 0.13 cfs @ 12.70 hrs, Volume= 1,423 cf, Depth> 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment EX-WS-02: Design Point B



Summary for Subcatchment EX-WS-01: Design Point A

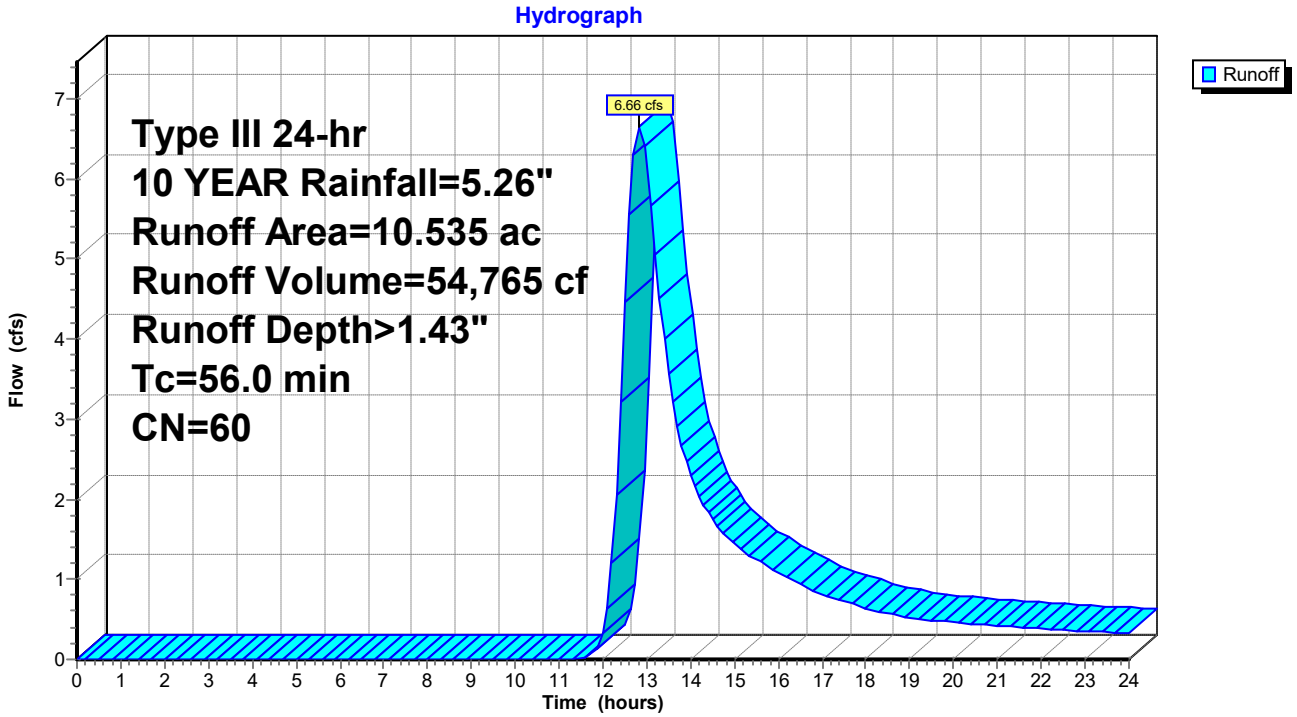
Runoff = 6.66 cfs @ 12.84 hrs, Volume= 54,765 cf, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	10.535	60	
	10.535		100.00% Pervious Area

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

Subcatchment EX-WS-01: Design Point A



Summary for Subcatchment EX-WS-02: Design Point B

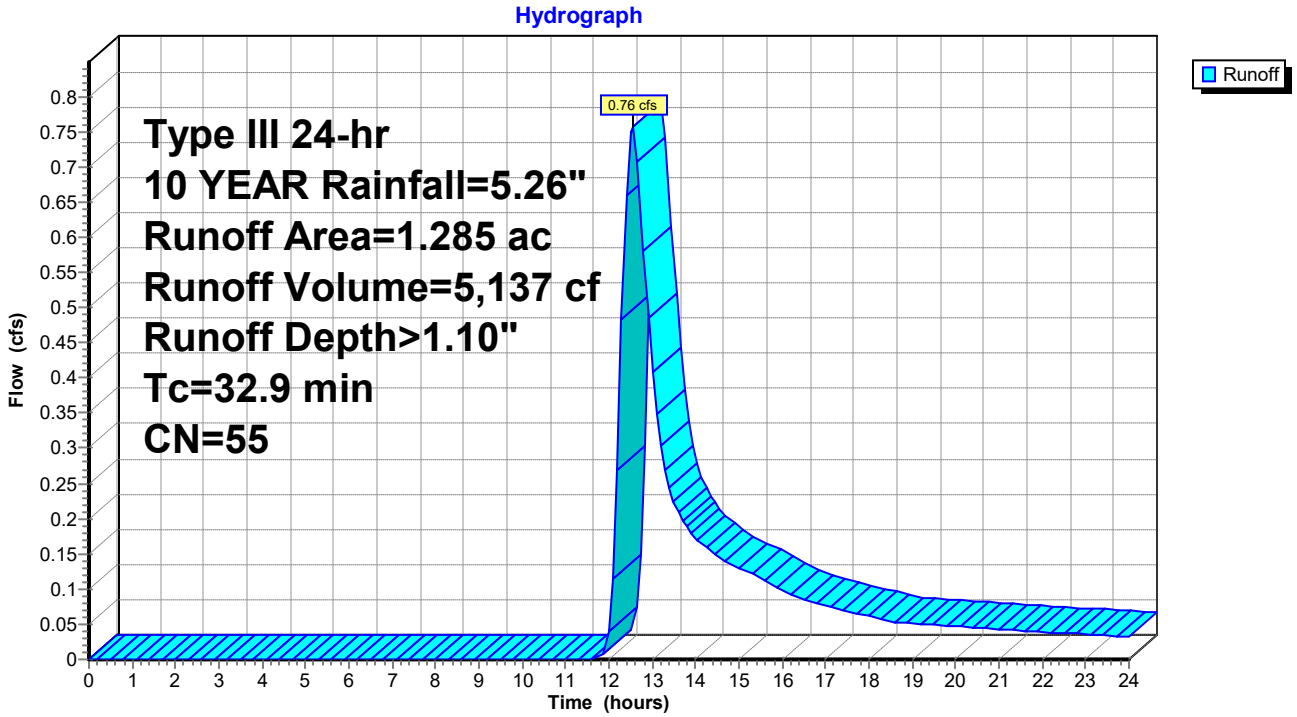
Runoff = 0.76 cfs @ 12.54 hrs, Volume= 5,137 cf, Depth> 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment EX-WS-02: Design Point B



Summary for Subcatchment EX-WS-01: Design Point A

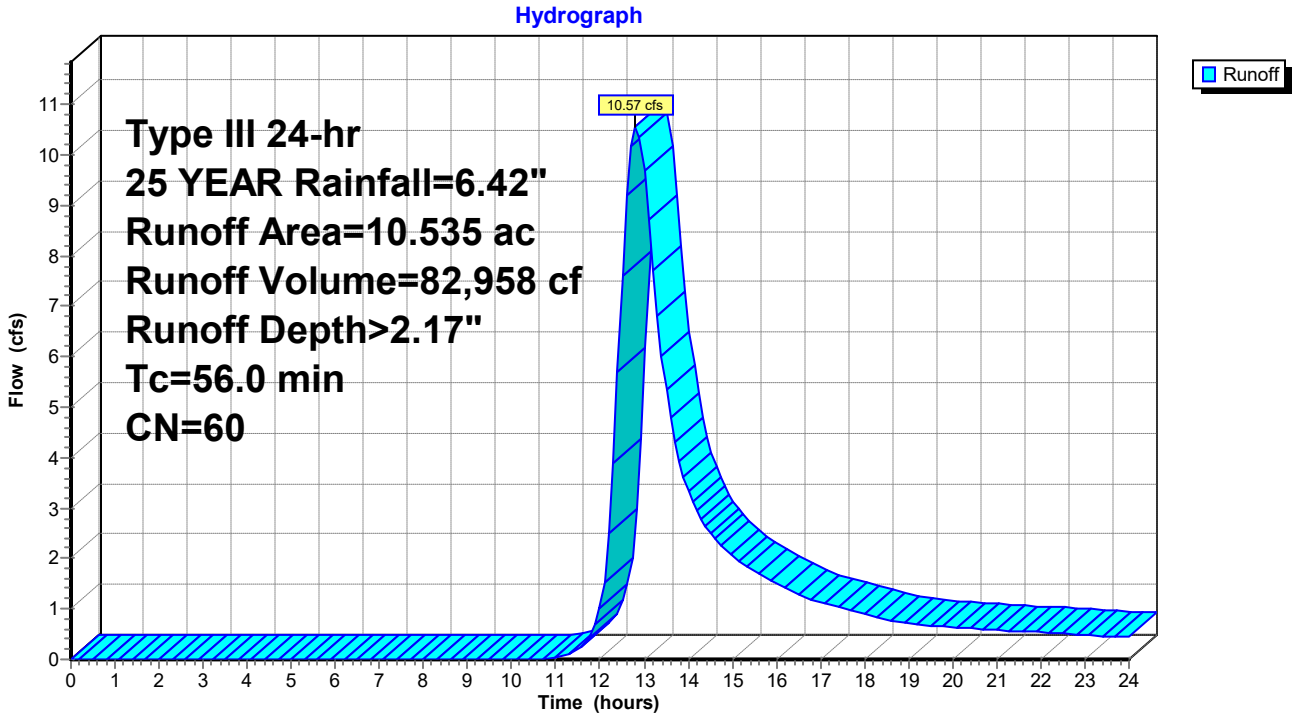
Runoff = 10.57 cfs @ 12.81 hrs, Volume= 82,958 cf, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	10.535	60	
	10.535		100.00% Pervious Area

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

Subcatchment EX-WS-01: Design Point A



Summary for Subcatchment EX-WS-02: Design Point B

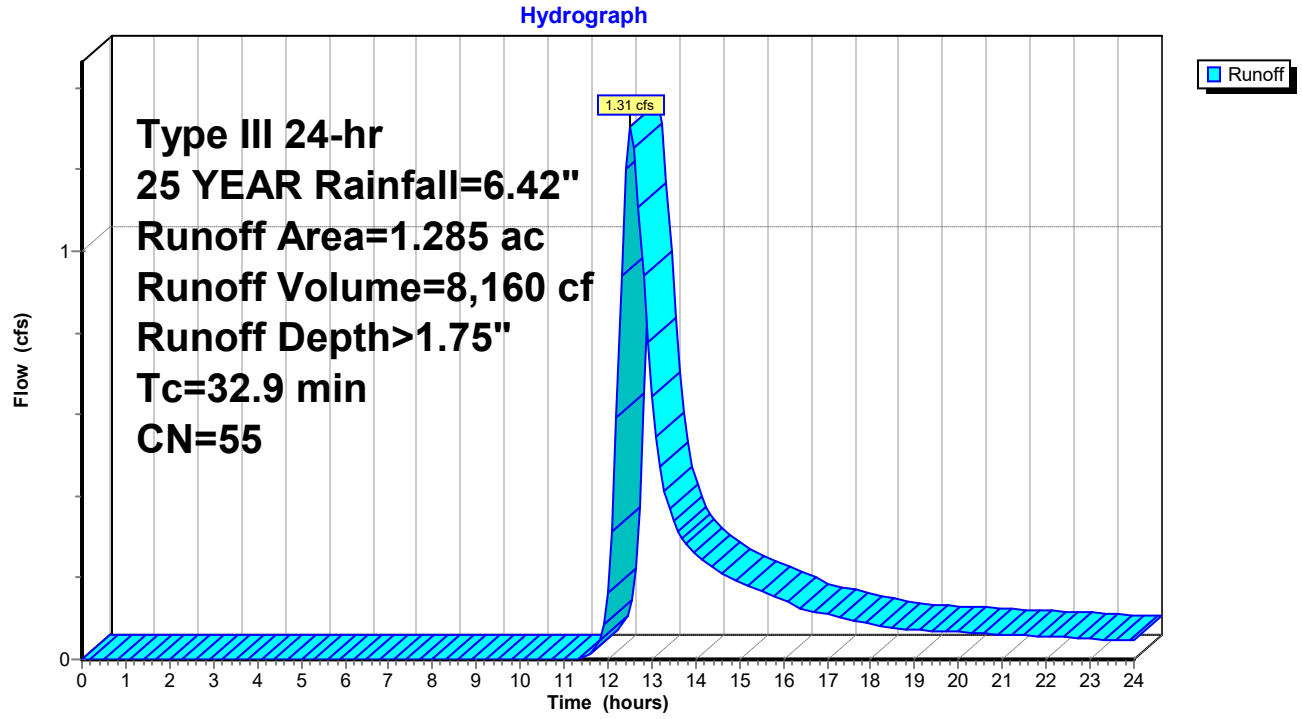
Runoff = 1.31 cfs @ 12.52 hrs, Volume= 8,160 cf, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment EX-WS-02: Design Point B



Summary for Subcatchment EX-WS-01: Design Point A

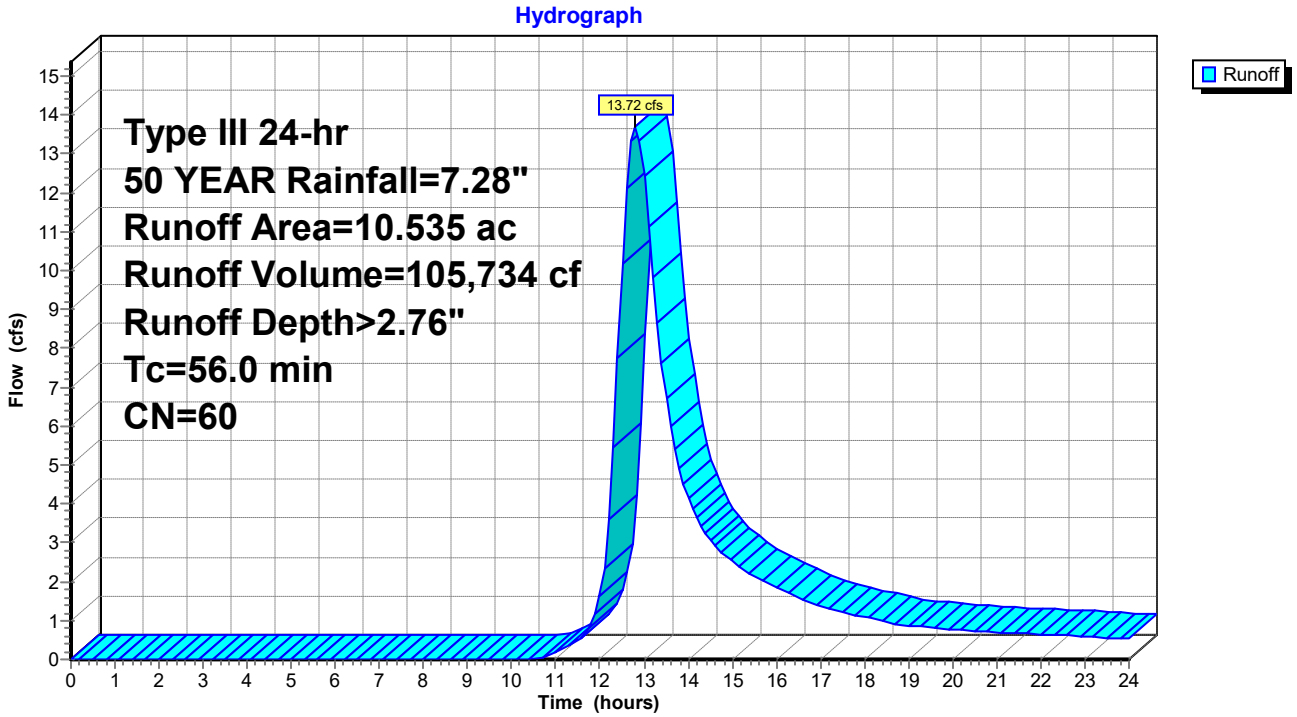
Runoff = 13.72 cfs @ 12.80 hrs, Volume= 105,734 cf, Depth> 2.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	10.535	60	
	10.535		100.00% Pervious Area

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

Subcatchment EX-WS-01: Design Point A



Summary for Subcatchment EX-WS-02: Design Point B

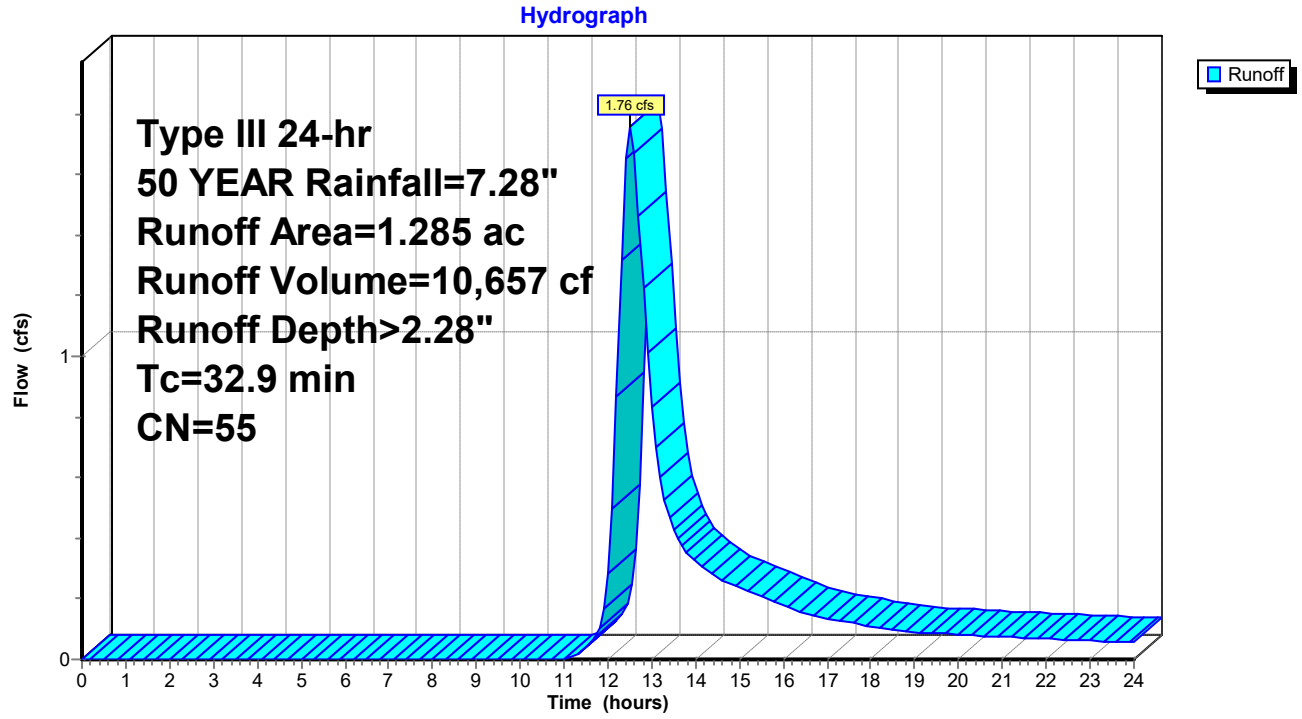
Runoff = 1.76 cfs @ 12.50 hrs, Volume= 10,657 cf, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment EX-WS-02: Design Point B



Summary for Subcatchment EX-WS-01: Design Point A

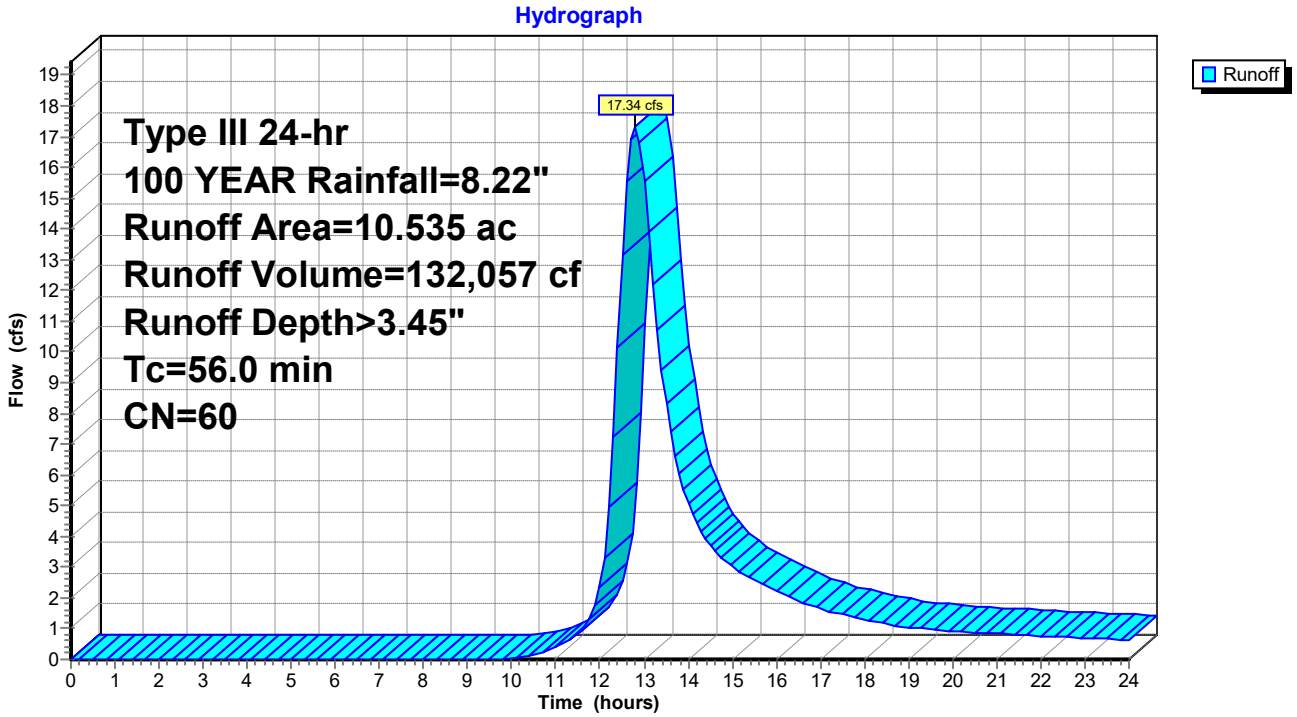
Runoff = 17.34 cfs @ 12.79 hrs, Volume= 132,057 cf, Depth> 3.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	10.535	60	
	10.535		100.00% Pervious Area

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

Subcatchment EX-WS-01: Design Point A



Summary for Subcatchment EX-WS-02: Design Point B

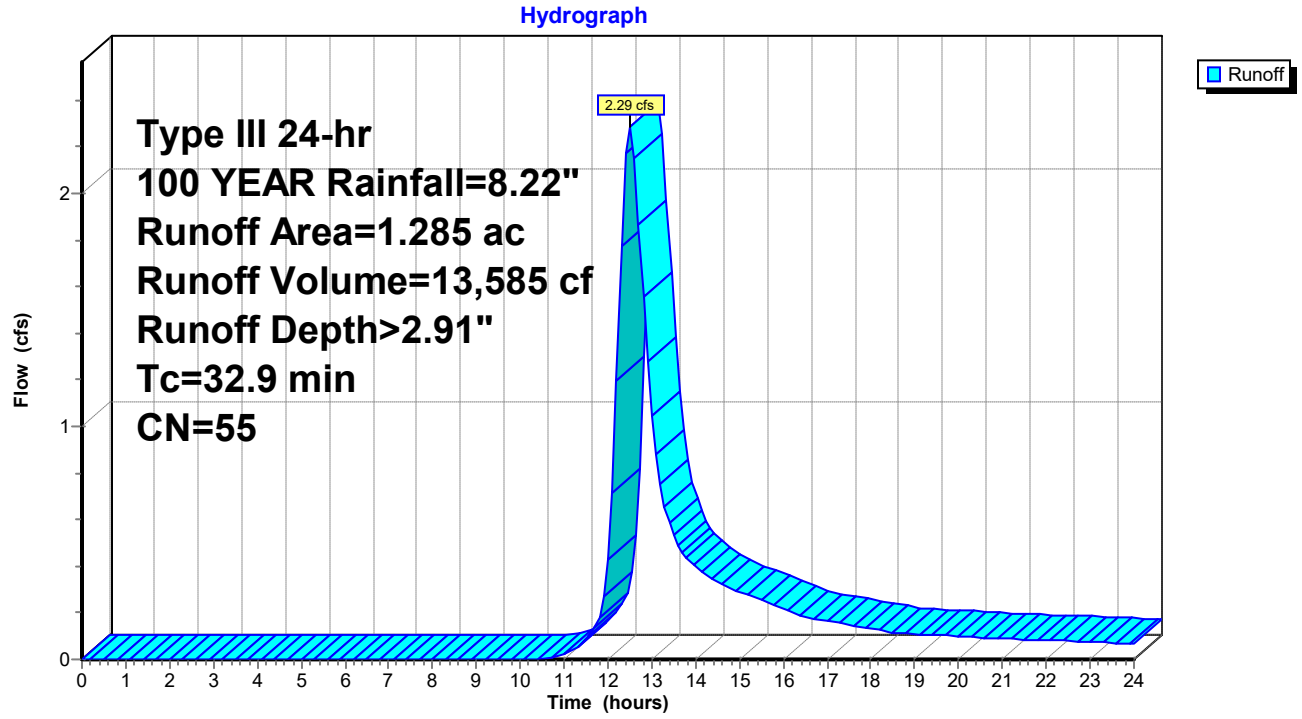
Runoff = 2.29 cfs @ 12.50 hrs, Volume= 13,585 cf, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment EX-WS-02: Design Point B



APPENDIX D

PR WS 01
8.454 ac
CN 61
TC=54

PR WS 02
0.449 ac
CN 94
TC=5

PR WS 03
1.210 ac
CN 88
TC=5

PR WS 04
0.422 ac
CN 98
TC=5

PR WS 05
1.285 ac
CN 55
TC=33

DESIGN POINT A

DESIGN POINT B

LEGEND:

WATERSHED BOUNDARY

Tc FLOW PATH

SCALE: 1" = 80'

CONNECTICUT PROTON THERAPY CENTER
WALLINGFORD, CT

PROPOSED WATERSHED MAP

DATE: 10/15/2020
SCALE: 1" = 80'
FIGURE: WM-02

Tighe&Bond

Nov 25, 2020-12:55pm Plotted By: PAReady
T:\Tighe & Bond, Inc. J:\P5050 Proton International\004 Northrop Road Facility - Civil\Design\Drainage\P5050-004-PR-WS.dwg

Tighe&Bond

Project Name: **Connecticut Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed Conditions CN & Tc**
Prepared By: **PAR** Checked By: **APW**
Date: **October 15, 2020**

Designation: **PR-WS-01**
Location: Northwest region of site

Cover Type	Area, ac	CN	A x CN
Wooded, HSG B	4.585	55	252
Landscaped and Lawn, HSG B	1.003	61	61
Wooded, HSG C	2.258	70	158
Landscaped and Lawn, HSG C	0.585	74	43
Impervious	0.024	74	2
	8.454		516

Weighted CN: 61

Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland			
Segment	Surface "n"	Flow Length (ft.)	Slope (ft/ft)	Time (min.)
Segment A - B	0.8	300	0.087	49.2

Shallow Concentrated Flow					
Segment		Slope (ft/ft)	V (ft/s)	Length (ft)	Time (min.)
Segment B - C	unpaved	0.014	1.91	209	1.8
Segment C - D	unpaved	0.022	2.39	213	1.5
Segment D - E	paved	0.02	3.08	170	0.9
Segment E - F	unpaved	0.03	2.79	97	0.6

Total Tc = 54.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond

Project Name: **Connecticut Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed Conditions CN & Tc**
Prepared By: **PAR** Checked By: **APW**
Date: **October 15, 2020**

Designation: **PR-WS-02**
Location: Southern region of site

Cover Type	Area, ac	CN	A x CN
Landscaped and Lawn, HSG B	0.025	61	2
Landscaped and Lawn, HSG C	0.042	74	3
Impervious	0.382	98	37
	0.449		42

Weighted CN: 94

Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.015	222	0.02	3.1

Total Tc = 3.1 Min.
Minimum Tc= 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond

Project Name: **Connecticut Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed Conditions CN & Tc**
Prepared By: **PAR** Checked By: **APW**
Date: **October 15, 2020**

Designation: **PR-WS-03**
Location: Proposed parking lot

Cover Type	Area, ac	CN	A x CN
Landscaped and Lawn, HSG B	0.311	61	19
Landscaped and Lawn, HSG C	0.015	74	1
Impervious	0.884	98	87
	1.210		107

Weighted CN: 88

Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.24	45	0.17	3.2

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	paved	0.007	1.70	155	1.5

Total Tc = 4.7 Min.
Minimum Tc= 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **PR-WS-04**
Location: Building

Cover Type	Area, ac	CN	A x CN
Impervious	0.422	98	41
	0.422		41

Weighted CN: 98

Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.011	86	0.05	0.8

Total Tc = 0.8 Min.
Minimum Tc= 5.0 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond

Project Name: **Connecticut Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed Conditions CN & Tc**
Prepared By: **PAR** Checked By: **APW**
Date: **October 15, 2020**

Designation: **PR-WS-05**
Location: Northeast portion of site discharge offsite

Cover Type	Area, ac	CN	A x CN
Wooded, HSG B	1.285	55	71
	1.285		71

Weighted CN: 55

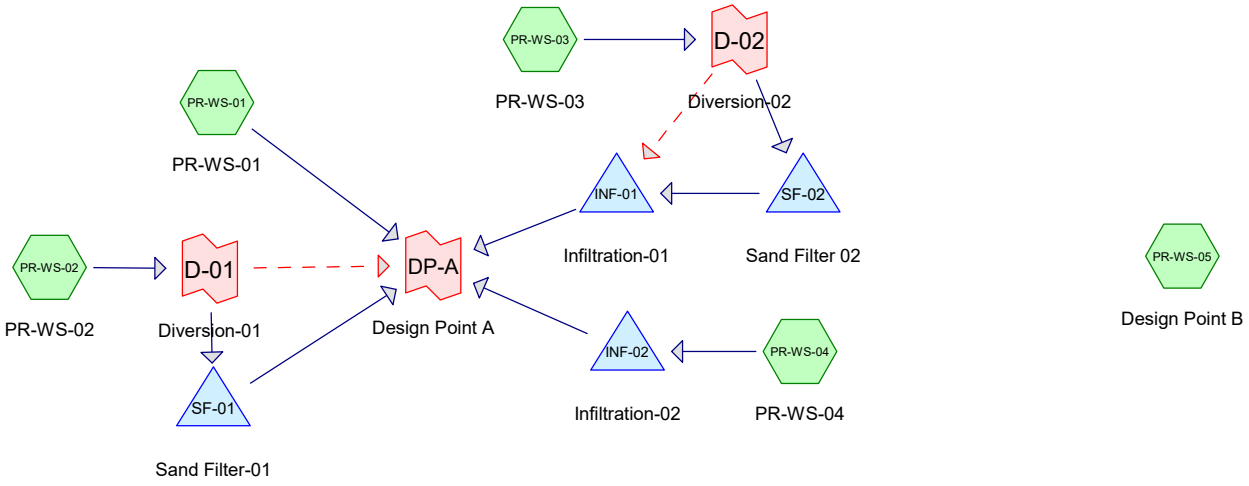
Time of Concentration
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland				
Segment	**Surface "n"**	**Flow Length (ft.)**	**Slope (ft/ft)**	**Time (min.)**
Segment A - B	0.8	150	0.06	32.8

Shallow Concentrated Flow					
Segment		**Slope (ft/ft)**	**V (ft/s)**	**Length (ft)**	**Time (min.)**
Segment B - C	unpaved	0.096	5.00	21	0.1

Total Tc = 32.9 Min.

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation



Subcat Reach Pond Link

Routing Diagram for Proposed HydroCAD
Prepared by Tighe & Bond, Printed 11/25/2020

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
368,256	61	(PR-WS-01)
19,558	94	(PR-WS-02)
52,708	88	(PR-WS-03)
18,382	98	(PR-WS-04)
55,975	55	(PR-WS-05)

Summary for Subcatchment PR-WS-01: PR-WS-01

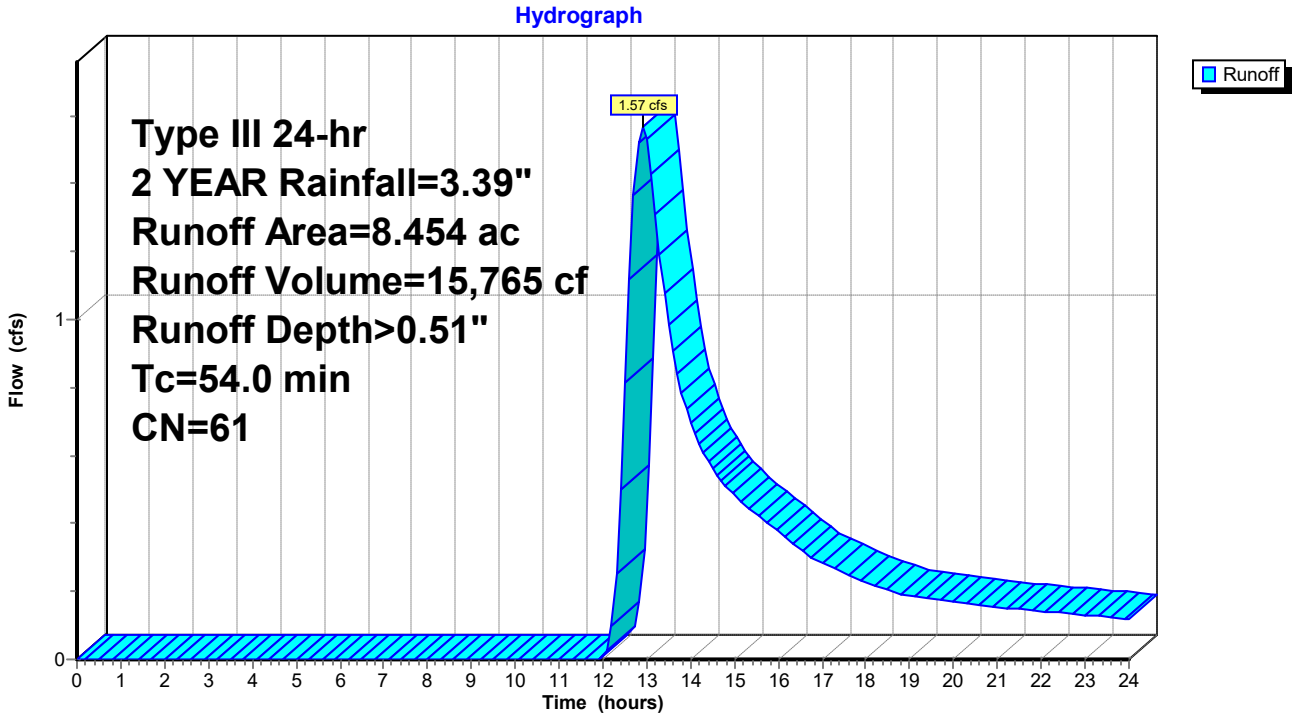
Runoff = 1.57 cfs @ 12.91 hrs, Volume= 15,765 cf, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	8.454	61	
	8.454		100.00% Pervious Area

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

Subcatchment PR-WS-01: PR-WS-01



Summary for Subcatchment PR-WS-02: PR-WS-02

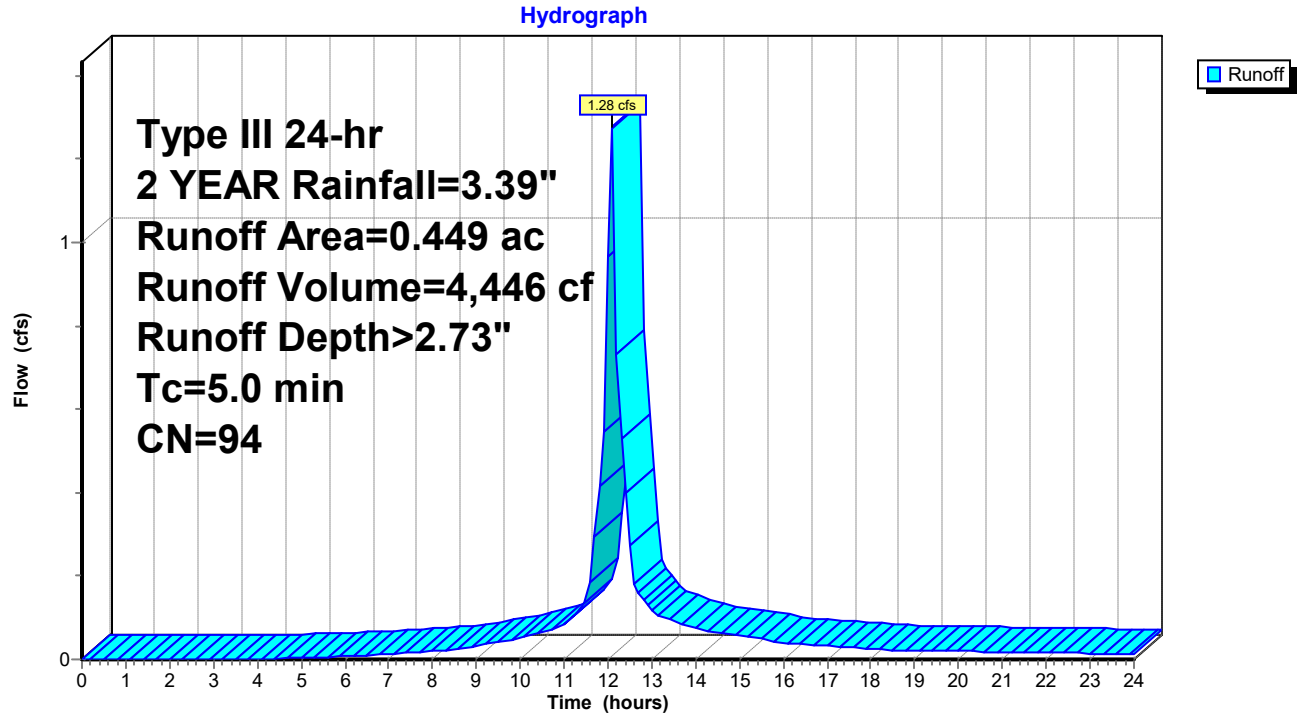
Runoff = 1.28 cfs @ 12.09 hrs, Volume= 4,446 cf, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	0.449	94	
	0.449		100.00% Pervious Area

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

Subcatchment PR-WS-02: PR-WS-02



Summary for Subcatchment PR-WS-03: PR-WS-03

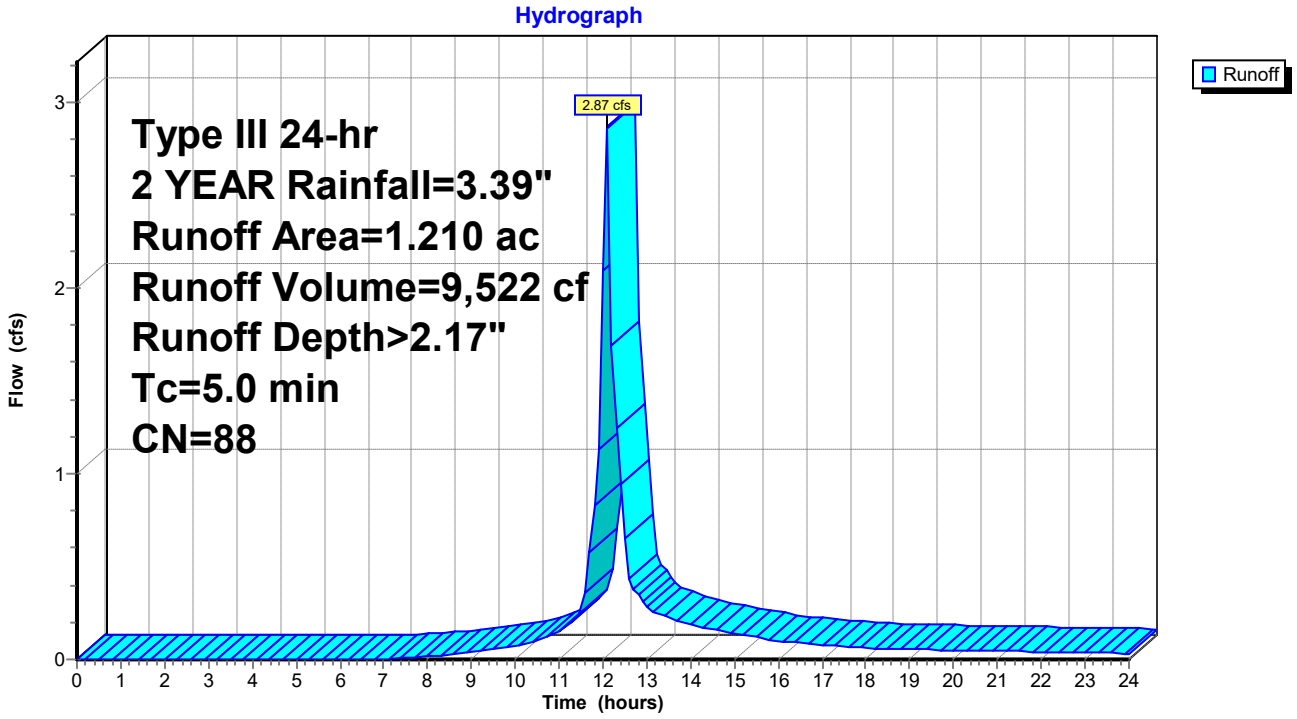
Runoff = 2.87 cfs @ 12.09 hrs, Volume= 9,522 cf, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	1.210	88	
	1.210		100.00% Pervious Area

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

Subcatchment PR-WS-03: PR-WS-03



Summary for Subcatchment PR-WS-04: PR-WS-04

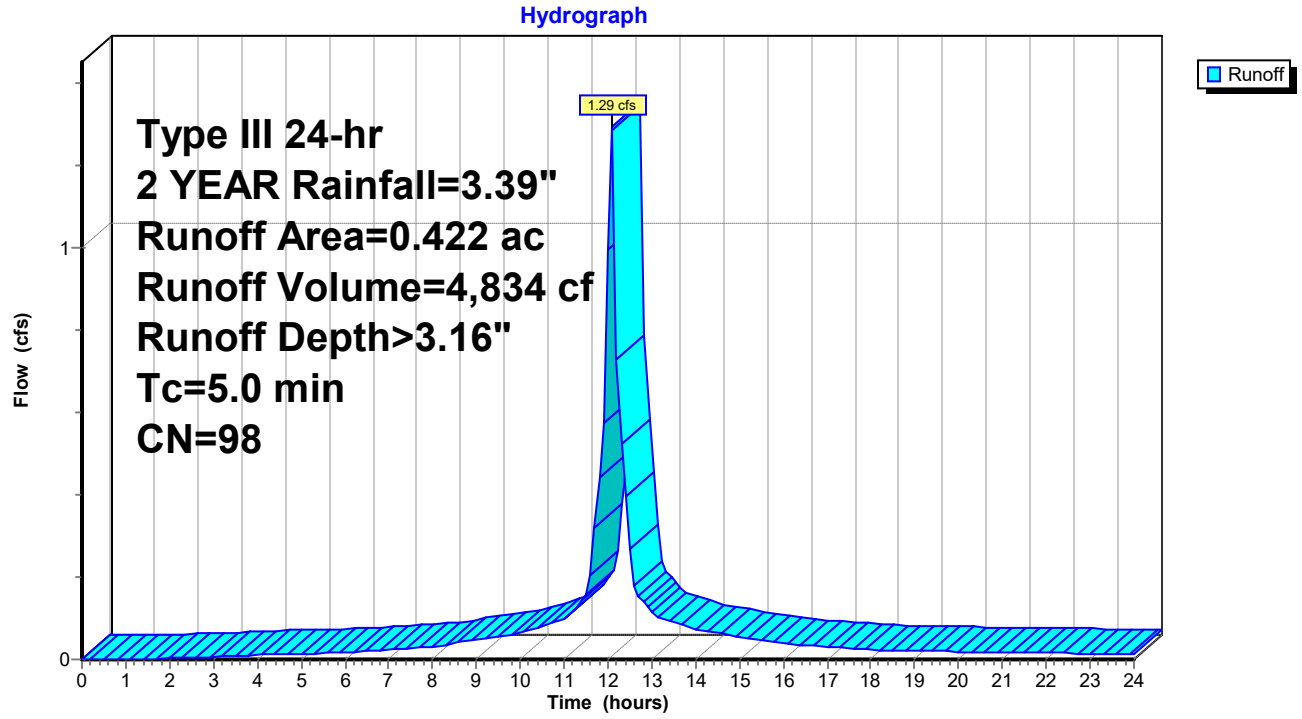
Runoff = 1.29 cfs @ 12.08 hrs, Volume= 4,834 cf, Depth> 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	0.422	98	
	0.422		100.00% Impervious Area

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

Subcatchment PR-WS-04: PR-WS-04



Summary for Subcatchment PR-WS-05: Design Point B

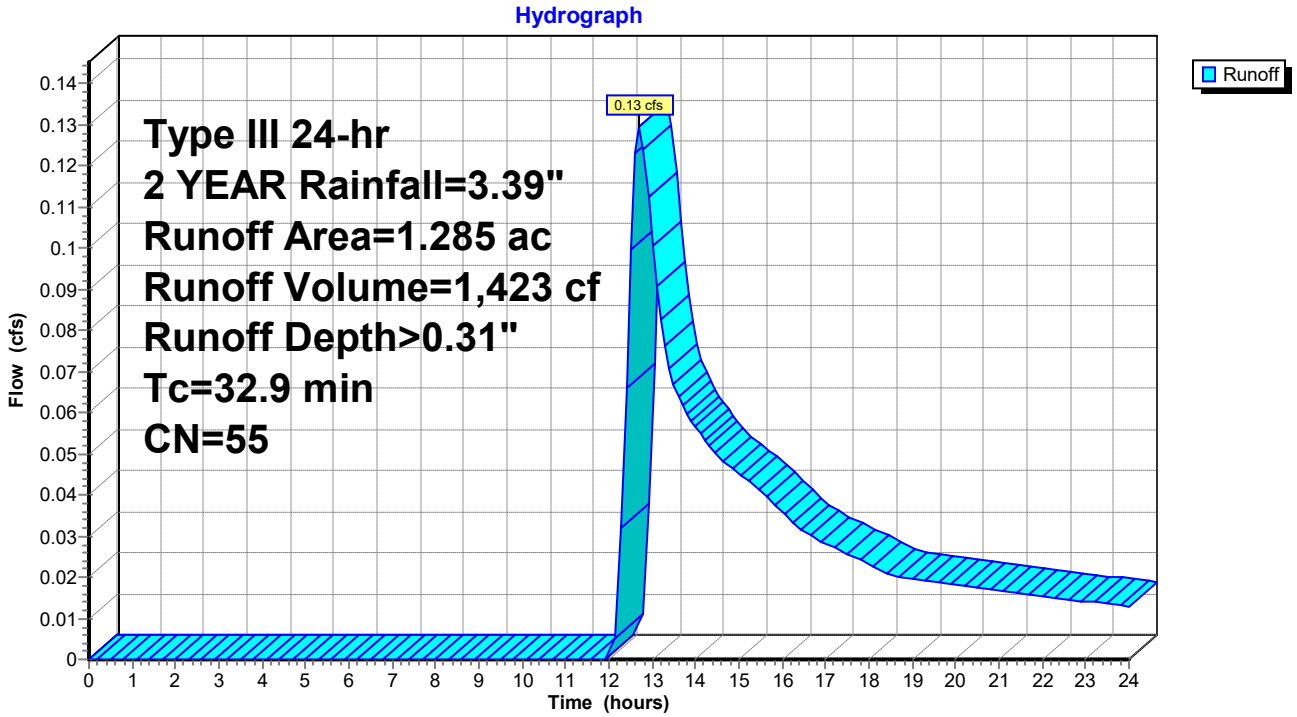
Runoff = 0.13 cfs @ 12.70 hrs, Volume= 1,423 cf, Depth> 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 2 YEAR Rainfall=3.39"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment PR-WS-05: Design Point B



Summary for Pond INF-01: Infiltration-01

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 1.83" for 2 YEAR event
Inflow = 1.60 cfs @ 12.23 hrs, Volume= 8,040 cf
Outflow = 0.07 cfs @ 16.51 hrs, Volume= 3,062 cf, Atten= 96%, Lag= 256.7 min
Discarded = 0.07 cfs @ 16.51 hrs, Volume= 3,062 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 342.94' @ 16.51 hrs Surf.Area= 2,064 sf Storage= 5,954 cf

Plug-Flow detention time= 341.3 min calculated for 3,049 cf (38% of inflow)
Center-of-Mass det. time= 251.0 min (1,051.0 - 799.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	339.00'	413 cf	**20.69'W x 99.77'L x 9.67'H Field A** 19,952 cf Overall - 18,920 cf Embedded = 1,032 cf x 40.0% Voids
#2A	339.50'	15,078 cf	**StormTrap ST1 DoubleTrap 8-0** x 21 Inside #1 Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf 3 Rows adjusted for 630.1 cf perimeter wall 20.69' x 98.44' Core + 0.00' x 0.67' Border = 20.69' x 99.77' System
#3	344.65'	126 cf	**4.00'D x 10.00'H Outlet Control Structure** -Impervious
		15,616 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	339.00'	**0.750 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	344.46'	**15.0" Round RCP_Round 15"** L= 32.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.46' / 344.30' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#3	Device 2	344.46'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	346.25'	**5.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.07 cfs @ 16.51 hrs HW=342.94' (Free Discharge)
└**1=Exfiltration** (Controls 0.07 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=339.00' (Free Discharge)
└**2=RCP_Round 15"** (Controls 0.00 cfs)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond INF-01: Infiltration-01 - Chamber Wizard Field A

Chamber Model = StormTrap ST1 DoubleTrap 8-0 (StormTrap ST1 DoubleTrap® Type I/III/VI)
Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf
Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf
3 Rows adjusted for 630.1 cf perimeter wall

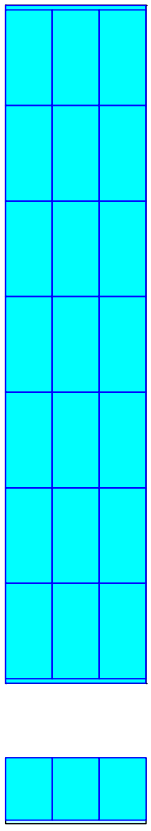
7 Chambers/Row x 14.06' Long = 98.44' Row Length +8.0" Border x 2 = 99.77' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
6.0" Base + 110.0" Chamber Height = 9.67' Field Height

24.0 cf Sidewall x 7 x 2 + 49.0 cf Endwall x 3 x 2 = 630.1 cf Perimeter Wall
21 Chambers x 718.0 cf - 630.1 cf Perimeter wall = 14,448.0 cf Chamber Storage
21 Chambers x 888.9 cf + 252.8 cf Border = 18,920.1 cf Displacement

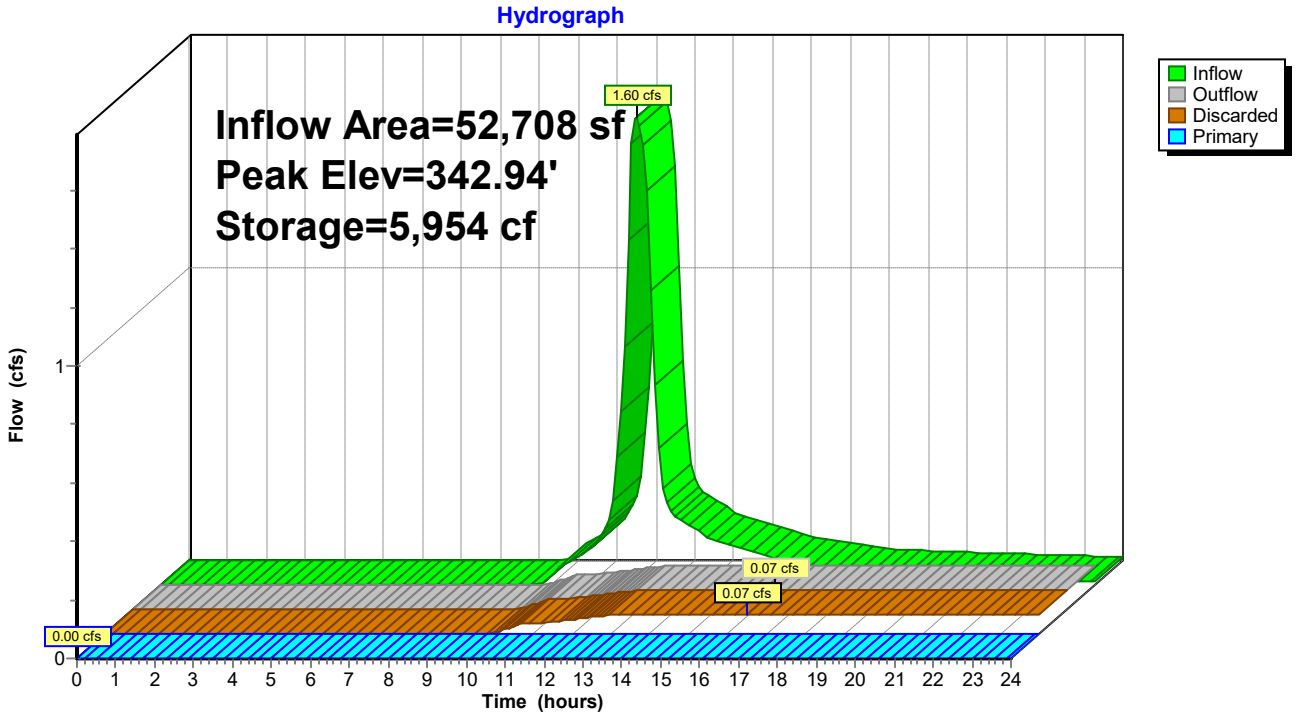
19,952.1 cf Field - 18,920.1 cf Chambers = 1,032.0 cf Stone x 40.0% Voids = 412.8 cf Stone Storage

Chamber Storage + Stone Storage = 14,860.8 cf = 0.341 af
Overall Storage Efficiency = 74.5%
Overall System Size = 99.77' x 20.69' x 9.67'

21 Chambers (plus border)
739.0 cy Field
38.2 cy Stone



Pond INF-01: Infiltration-01



Summary for Pond INF-02: Infiltration-02

Inflow Area = 18,382 sf,100.00% Impervious, Inflow Depth > 3.16" for 2 YEAR event
Inflow = 1.29 cfs @ 12.08 hrs, Volume= 4,834 cf
Outflow = 0.08 cfs @ 13.77 hrs, Volume= 4,588 cf, Atten= 94%, Lag= 101.1 min
Discarded = 0.08 cfs @ 13.77 hrs, Volume= 4,588 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 351.61' @ 13.77 hrs Surf.Area= 2,112 sf Storage= 2,097 cf

Plug-Flow detention time= 217.8 min calculated for 4,588 cf (95% of inflow)
Center-of-Mass det. time= 188.4 min (942.5 - 754.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	350.00'	2,132 cf	**39.50'W x 53.46'L x 3.75'H Field A** 7,918 cf Overall - 2,589 cf Embedded = 5,329 cf x 40.0% Voids
#2A	350.75'	2,589 cf	**ADS_StormTech DC-780 +Cap** x 56 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
		4,721 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	351.10'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 351.10' / 350.55' S= 0.0275 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	352.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	353.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	350.00'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.08 cfs @ 13.77 hrs HW=351.61' (Free Discharge)
└**4=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=350.00' (Free Discharge)
└**1=Culvert** (Controls 0.00 cfs)
  ├**2=Orifice/Grate** (Controls 0.00 cfs)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond INF-02: Infiltration-02 - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 +Cap (ADS StormTech® DC-780 with cap length)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

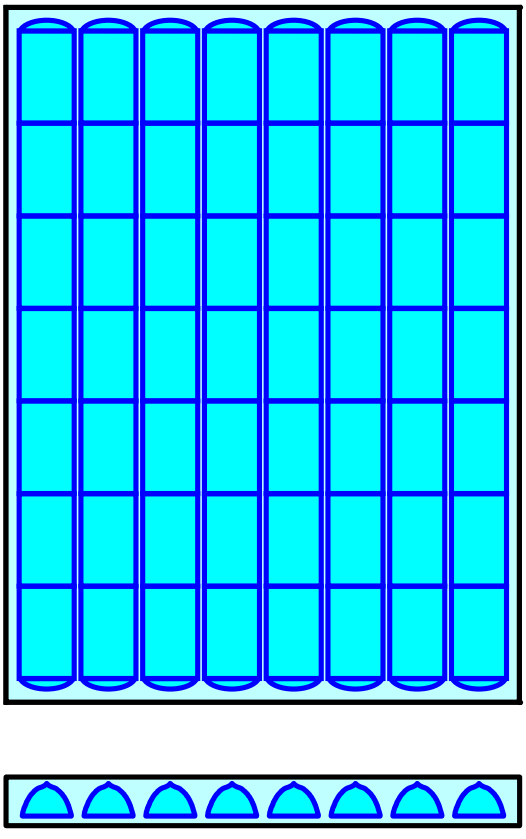
7 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 51.46' Row Length +12.0" End Stone x 2 = 53.46' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

56 Chambers x 46.2 cf = 2,589.4 cf Chamber Storage

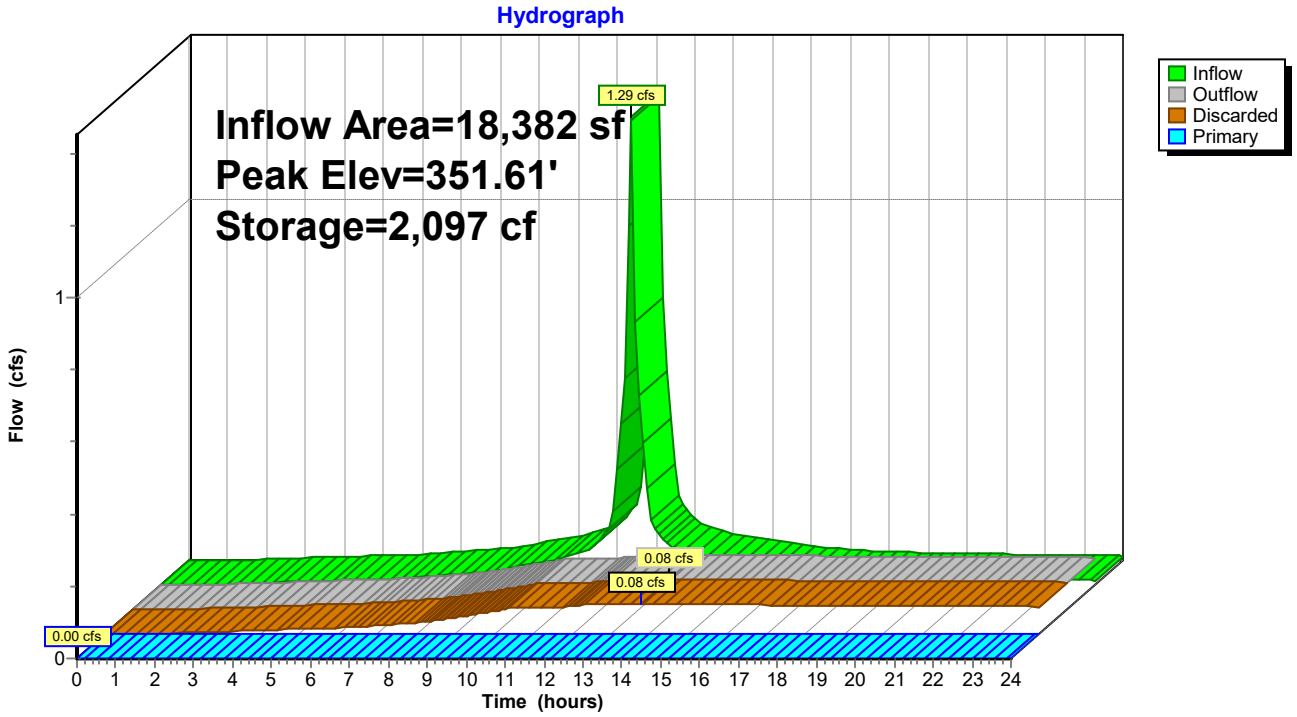
7,918.3 cf Field - 2,589.4 cf Chambers = 5,328.9 cf Stone x 40.0% Voids = 2,131.6 cf Stone Storage

Chamber Storage + Stone Storage = 4,720.9 cf = 0.108 af
Overall Storage Efficiency = 59.6%
Overall System Size = 53.46' x 39.50' x 3.75'

56 Chambers
293.3 cy Field
197.4 cy Stone



Pond INF-02: Infiltration-02



Summary for Pond SF-01: Sand Filter-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 2.73" for 2 YEAR event
Inflow = 1.28 cfs @ 12.09 hrs, Volume= 4,446 cf
Outflow = 1.10 cfs @ 12.12 hrs, Volume= 4,394 cf, Atten= 14%, Lag= 2.2 min
Discarded = 0.00 cfs @ 12.12 hrs, Volume= 286 cf
Primary = 1.09 cfs @ 12.12 hrs, Volume= 4,108 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 347.55' @ 12.12 hrs Surf.Area= 225 sf Storage= 214 cf

Plug-Flow detention time= 14.1 min calculated for 4,394 cf (99% of inflow)
Center-of-Mass det. time= 6.8 min (790.9 - 784.1)

Volume	Invert	Avail.Storage	Storage Description
#1	345.17'	300 cf	**Sand Filter (Conic)** Listed below (Recalc) 749 cf Overall x 40.0% Voids
#2	348.50'	2,112 cf	**Sand Filter (Conic)** Listed below (Recalc)
		2,412 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
345.17	225	0	0	225
348.50	225	749	749	402

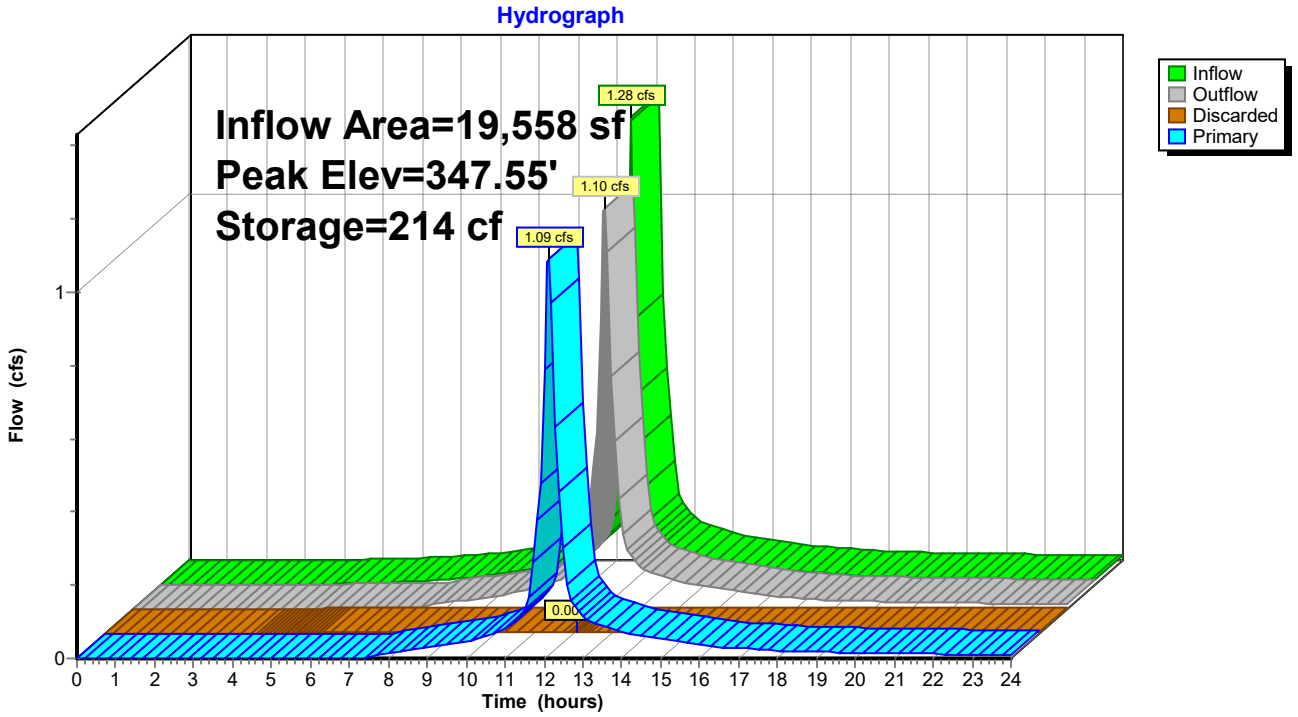
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
348.50	225	0	0	225
349.00	287	128	128	293
350.00	430	356	484	451
351.00	599	512	996	638
352.00	793	694	1,690	853
352.50	899	423	2,112	971

Device	Routing	Invert	Outlet Devices
#1	Discarded	345.17'	**0.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	345.67'	**6.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 345.67' / 345.57' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.00 cfs @ 12.12 hrs HW=347.47' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=1.06 cfs @ 12.12 hrs HW=347.47' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 1.06 cfs @ 5.40 fps)

Pond SF-01: Sand Filter-01



Summary for Pond SF-02: Sand Filter 02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 2.17" for 2 YEAR event
Inflow = 2.87 cfs @ 12.09 hrs, Volume= 9,522 cf
Outflow = 1.66 cfs @ 12.23 hrs, Volume= 9,383 cf, Atten= 42%, Lag= 8.4 min
Discarded = 0.06 cfs @ 12.23 hrs, Volume= 1,343 cf
Primary = 1.60 cfs @ 12.23 hrs, Volume= 8,040 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 348.16' @ 12.23 hrs Surf.Area= 1,350 sf Storage= 1,241 cf

Plug-Flow detention time= 18.3 min calculated for 9,344 cf (98% of inflow)
Center-of-Mass det. time= 9.7 min (821.3 - 811.5)

Volume	Invert	Avail.Storage	Storage Description
#1	344.17'	799 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 1,998 cf Overall x 40.0% Voids
#2	347.50'	7,308 cf	**Sand Filter (Prismatic)** Listed below (Recalc)
		8,107 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.17	600	0	0
347.50	600	1,998	1,998

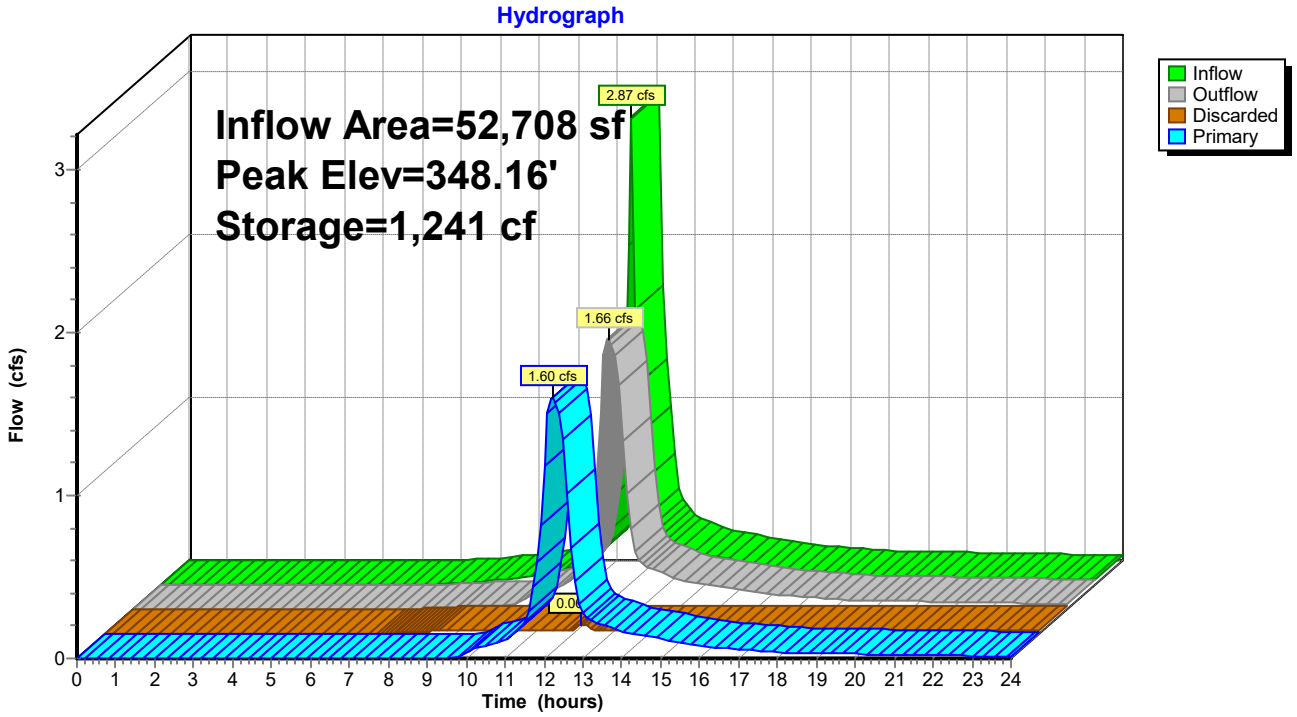
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.50	600	0	0
348.00	712	328	328
349.00	955	834	1,162
350.00	1,224	1,090	2,251
351.00	1,518	1,371	3,622
352.00	1,837	1,678	5,300
353.00	2,180	2,009	7,308

Device	Routing	Invert	Outlet Devices
#1	Primary	344.67'	**6.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 344.67' / 344.47' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Discarded	344.17'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.06 cfs @ 12.23 hrs HW=348.11' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=1.59 cfs @ 12.23 hrs HW=348.11' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 1.59 cfs @ 8.10 fps)

Pond SF-02: Sand Filter 02

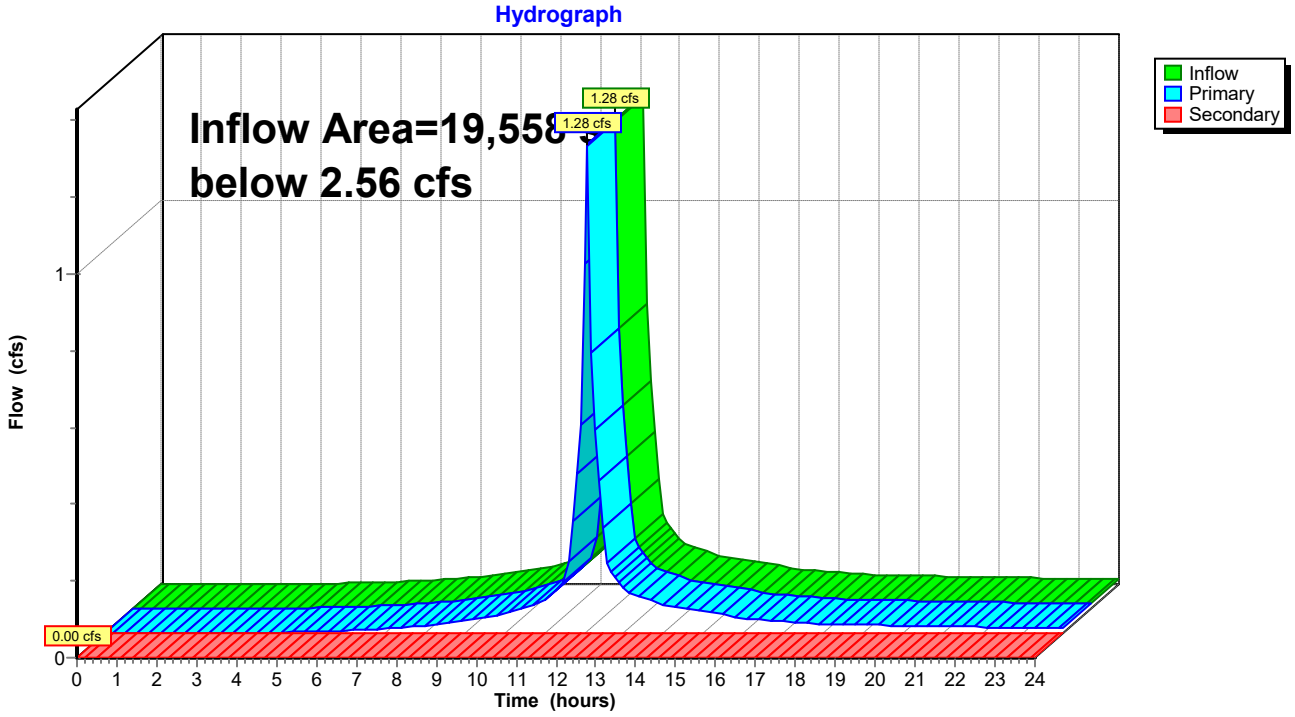


Summary for Link D-01: Diversion-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 2.73" for 2 YEAR event
Inflow = 1.28 cfs @ 12.09 hrs, Volume= 4,446 cf
Primary = 1.28 cfs @ 12.09 hrs, Volume= 4,446 cf, Atten= 0%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow below 2.56 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-01: Diversion-01

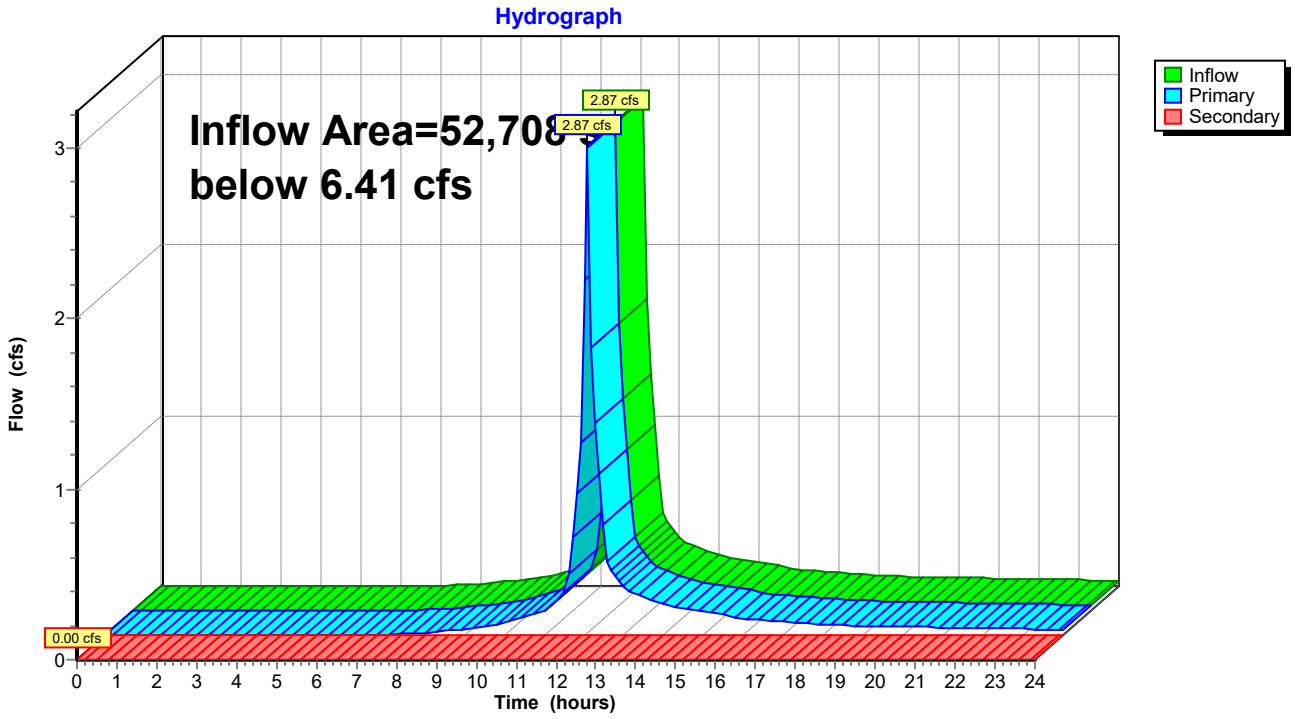


Summary for Link D-02: Diversion-02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 2.17" for 2 YEAR event
Inflow = 2.87 cfs @ 12.09 hrs, Volume= 9,522 cf
Primary = 2.87 cfs @ 12.09 hrs, Volume= 9,522 cf, Atten= 0%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow below 6.41 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-02: Diversion-02

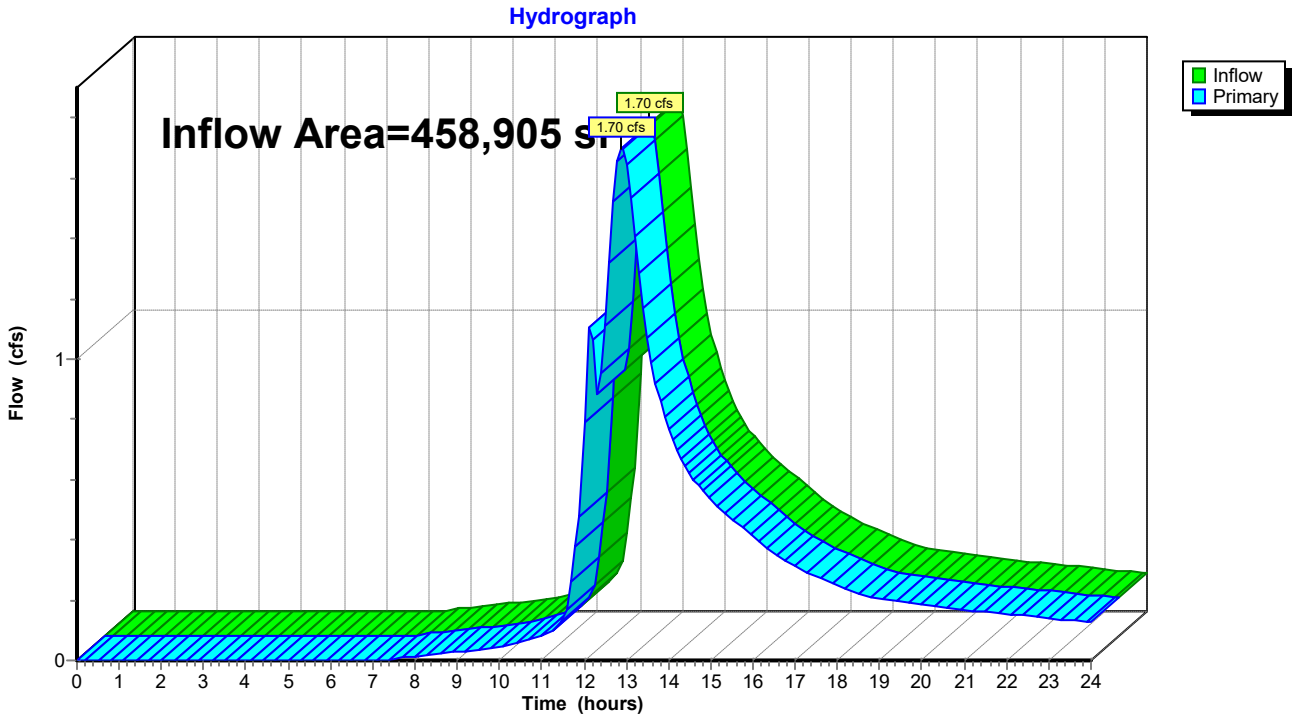


Summary for Link DP-A: Design Point A

Inflow Area = 458,905 sf, 4.01% Impervious, Inflow Depth > 0.52" for 2 YEAR event
Inflow = 1.70 cfs @ 12.89 hrs, Volume= 19,872 cf
Primary = 1.70 cfs @ 12.89 hrs, Volume= 19,872 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link DP-A: Design Point A



Summary for Subcatchment PR-WS-01: PR-WS-01

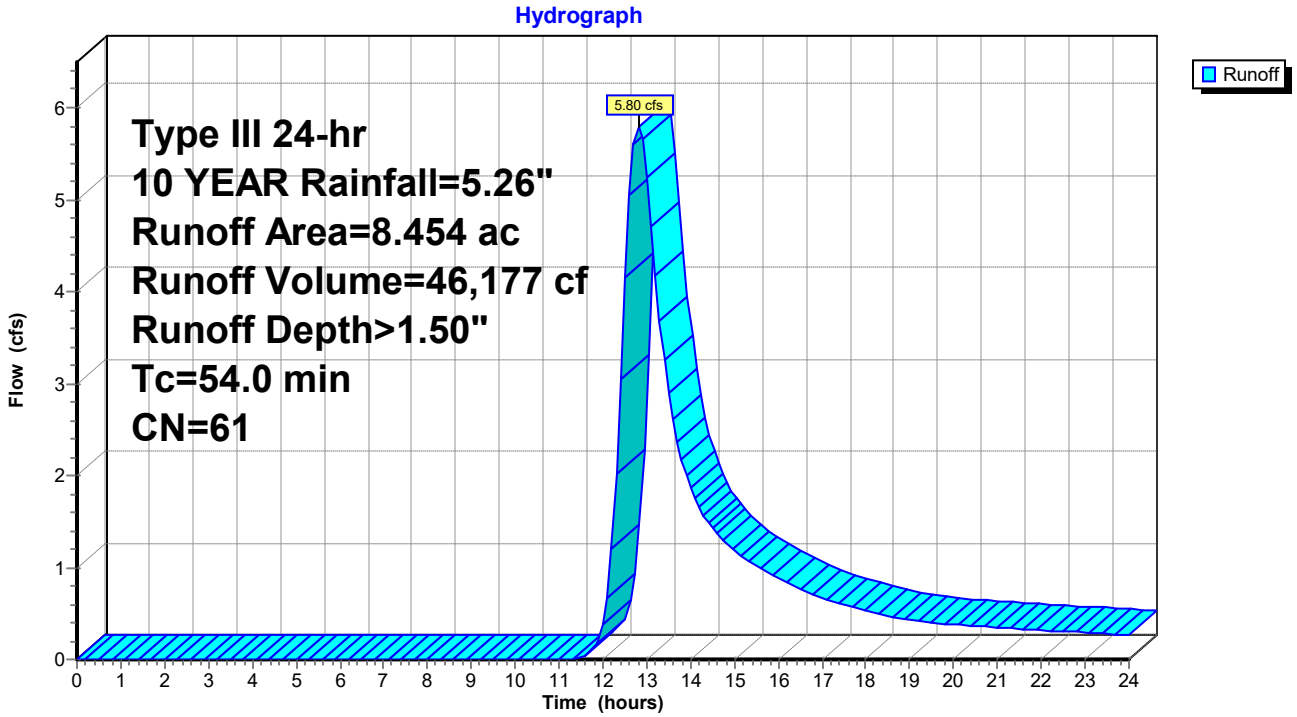
Runoff = 5.80 cfs @ 12.81 hrs, Volume= 46,177 cf, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	8.454	61	
	8.454		100.00% Pervious Area

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

Subcatchment PR-WS-01: PR-WS-01



Summary for Subcatchment PR-WS-02: PR-WS-02

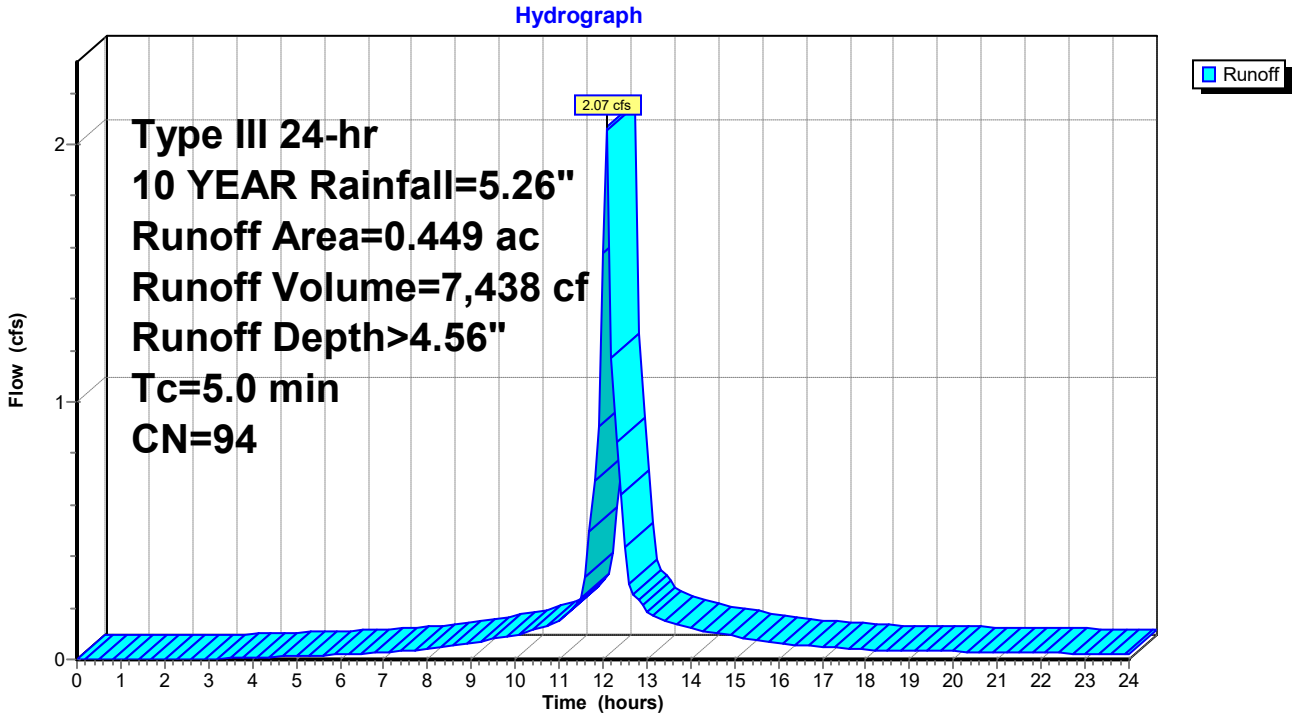
Runoff = 2.07 cfs @ 12.09 hrs, Volume= 7,438 cf, Depth> 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	0.449	94	
	0.449		100.00% Pervious Area

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

Subcatchment PR-WS-02: PR-WS-02



Summary for Subcatchment PR-WS-03: PR-WS-03

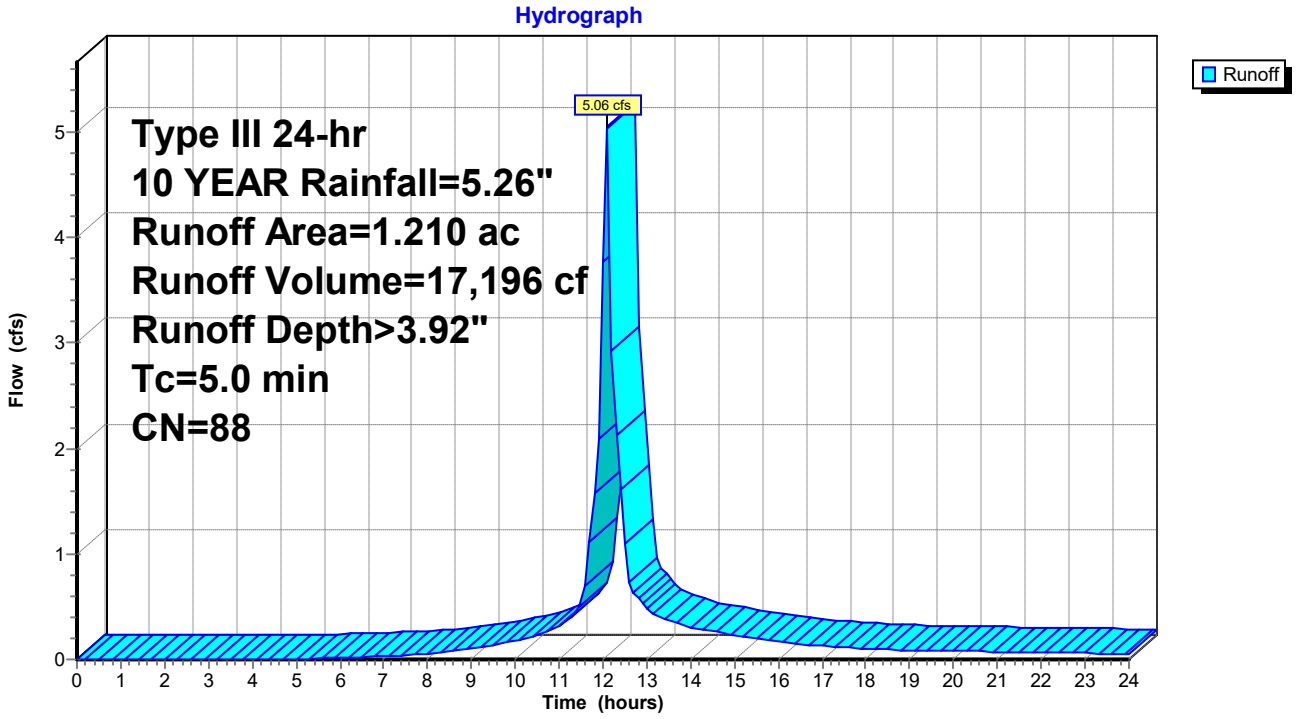
Runoff = 5.06 cfs @ 12.09 hrs, Volume= 17,196 cf, Depth> 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	1.210	88	
	1.210		100.00% Pervious Area

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

Subcatchment PR-WS-03: PR-WS-03



Summary for Subcatchment PR-WS-04: PR-WS-04

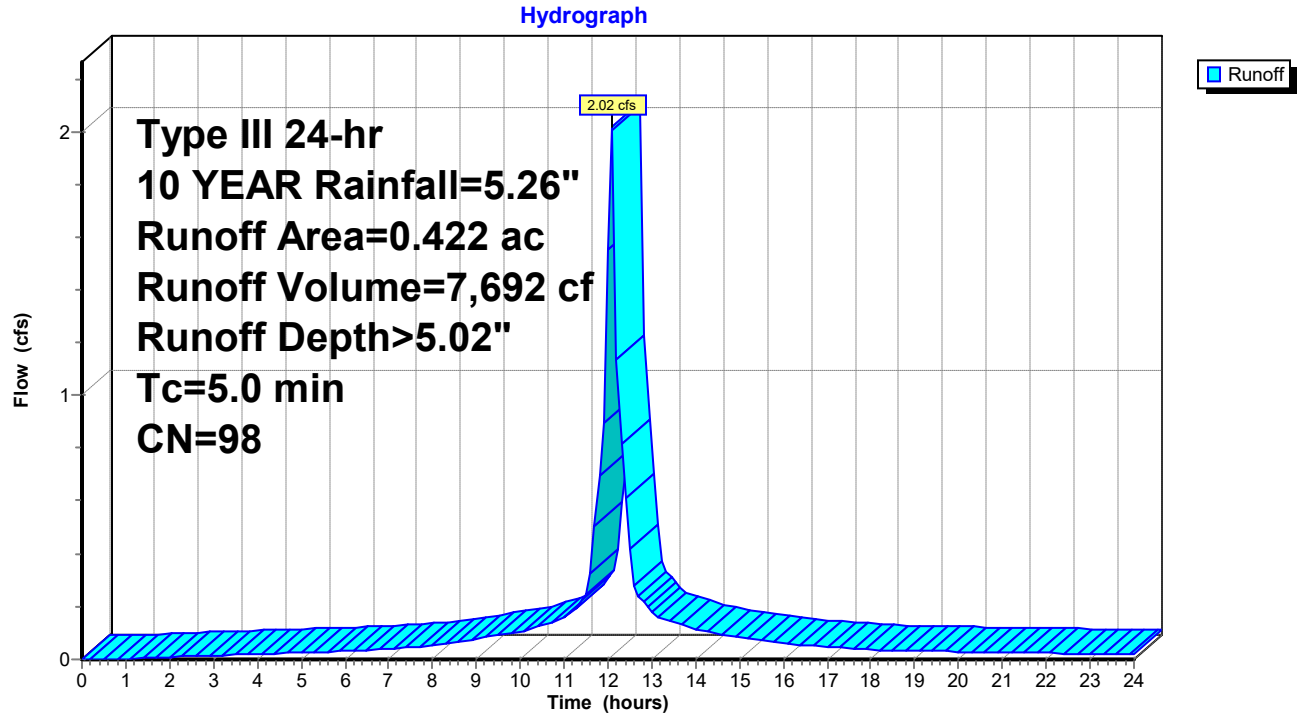
Runoff = 2.02 cfs @ 12.08 hrs, Volume= 7,692 cf, Depth> 5.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	0.422	98	
	0.422		100.00% Impervious Area

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

Subcatchment PR-WS-04: PR-WS-04



Summary for Subcatchment PR-WS-05: Design Point B

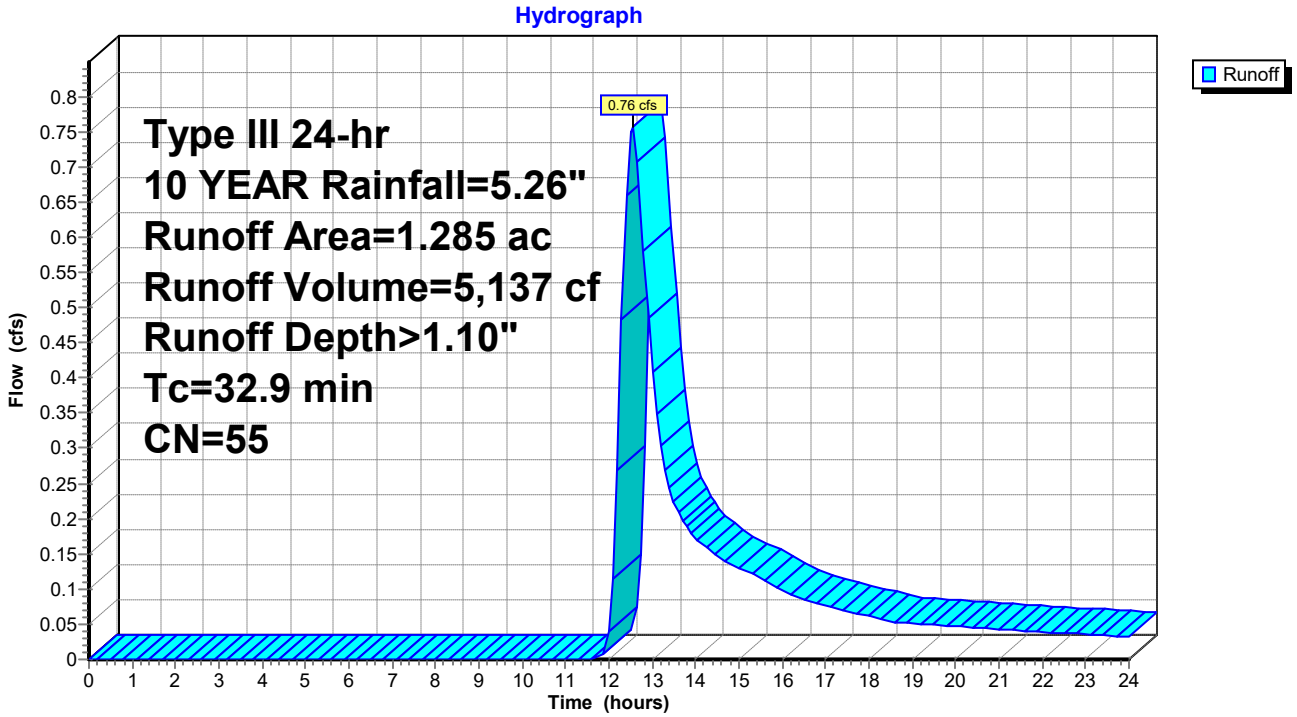
Runoff = 0.76 cfs @ 12.54 hrs, Volume= 5,137 cf, Depth> 1.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 10 YEAR Rainfall=5.26"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment PR-WS-05: Design Point B



Summary for Pond INF-01: Infiltration-01

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 3.51" for 10 YEAR event
Inflow = 2.01 cfs @ 12.32 hrs, Volume= 15,422 cf
Outflow = 0.36 cfs @ 13.51 hrs, Volume= 7,088 cf, Atten= 82%, Lag= 71.9 min
Discarded = 0.08 cfs @ 13.51 hrs, Volume= 3,957 cf
Primary = 0.28 cfs @ 13.51 hrs, Volume= 3,130 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 345.07' @ 13.51 hrs Surf.Area= 2,064 sf Storage= 9,976 cf

Plug-Flow detention time= 265.0 min calculated for 7,058 cf (46% of inflow)
Center-of-Mass det. time= 166.7 min (965.8 - 799.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	339.00'	413 cf	**20.69'W x 99.77'L x 9.67'H Field A** 19,952 cf Overall - 18,920 cf Embedded = 1,032 cf x 40.0% Voids
#2A	339.50'	15,078 cf	**StormTrap ST1 DoubleTrap 8-0** x 21 Inside #1 Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf 3 Rows adjusted for 630.1 cf perimeter wall 20.69' x 98.44' Core + 0.00' x 0.67' Border = 20.69' x 99.77' System
#3	344.65'	126 cf	**4.00'D x 10.00'H Outlet Control Structure** -Impervious
		15,616 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	339.00'	**0.750 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	344.46'	**15.0" Round RCP_Round 15"** L= 32.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.46' / 344.30' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#3	Device 2	344.46'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	346.25'	**5.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.08 cfs @ 13.51 hrs HW=345.07' (Free Discharge)
└**1=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.28 cfs @ 13.51 hrs HW=345.07' (Free Discharge)
└**2=RCP_Round 15"** (Passes 0.28 cfs of 1.16 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.28 cfs @ 3.21 fps)
  └**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond INF-01: Infiltration-01 - Chamber Wizard Field A

Chamber Model = StormTrap ST1 DoubleTrap 8-0 (StormTrap ST1 DoubleTrap® Type I/III/VI)
Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf
Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf
3 Rows adjusted for 630.1 cf perimeter wall

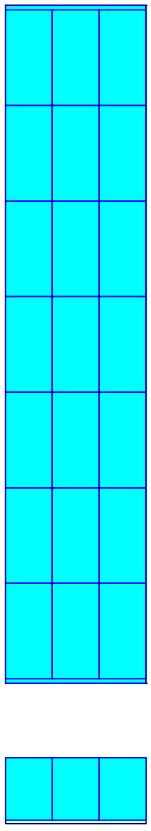
7 Chambers/Row x 14.06' Long = 98.44' Row Length +8.0" Border x 2 = 99.77' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
6.0" Base + 110.0" Chamber Height = 9.67' Field Height

24.0 cf Sidewall x 7 x 2 + 49.0 cf Endwall x 3 x 2 = 630.1 cf Perimeter Wall
21 Chambers x 718.0 cf - 630.1 cf Perimeter wall = 14,448.0 cf Chamber Storage
21 Chambers x 888.9 cf + 252.8 cf Border = 18,920.1 cf Displacement

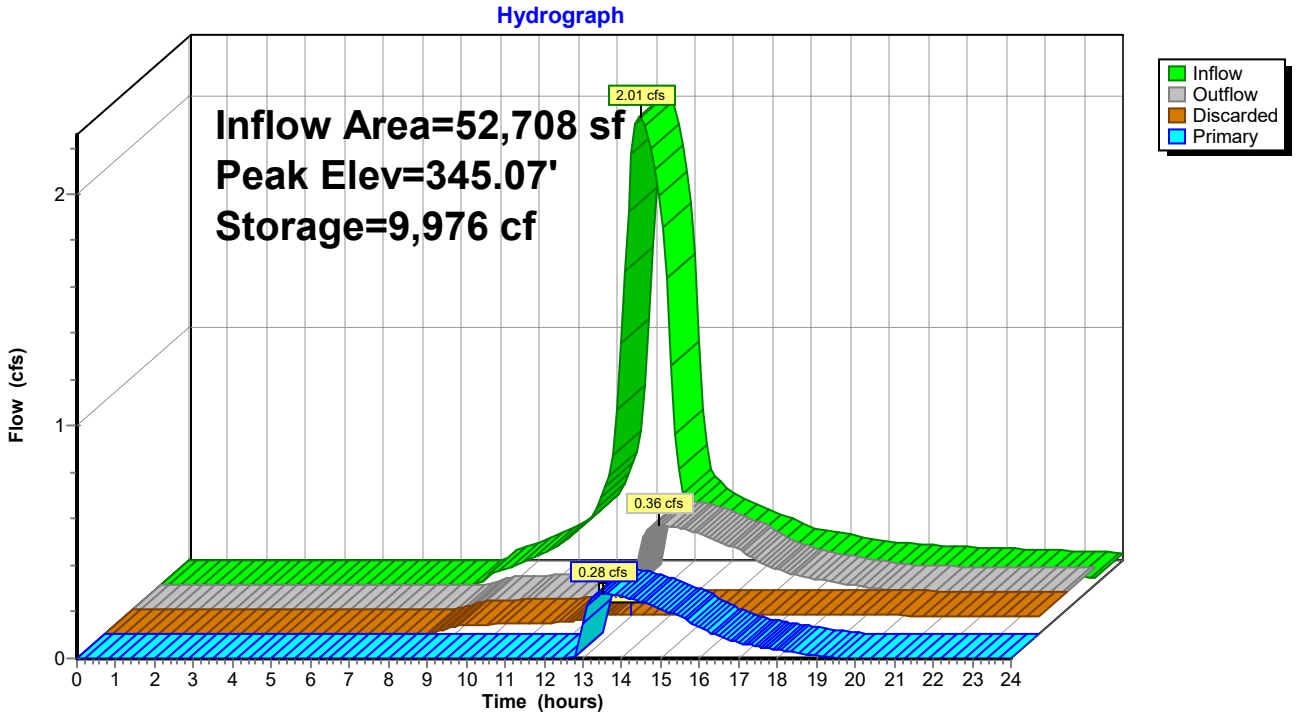
19,952.1 cf Field - 18,920.1 cf Chambers = 1,032.0 cf Stone x 40.0% Voids = 412.8 cf Stone Storage

Chamber Storage + Stone Storage = 14,860.8 cf = 0.341 af
Overall Storage Efficiency = 74.5%
Overall System Size = 99.77' x 20.69' x 9.67'

21 Chambers (plus border)
739.0 cy Field
38.2 cy Stone



Pond INF-01: Infiltration-01



Summary for Pond INF-02: Infiltration-02

Inflow Area = 18,382 sf,100.00% Impervious, Inflow Depth > 5.02" for 10 YEAR event
Inflow = 2.02 cfs @ 12.08 hrs, Volume= 7,692 cf
Outflow = 0.21 cfs @ 12.86 hrs, Volume= 6,170 cf, Atten= 90%, Lag= 46.4 min
Discarded = 0.09 cfs @ 12.86 hrs, Volume= 5,198 cf
Primary = 0.12 cfs @ 12.86 hrs, Volume= 972 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 352.50' @ 12.86 hrs Surf.Area= 2,112 sf Storage= 3,443 cf

Plug-Flow detention time= 216.1 min calculated for 6,144 cf (80% of inflow)
Center-of-Mass det. time= 141.0 min (887.1 - 746.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	350.00'	2,132 cf	**39.50'W x 53.46'L x 3.75'H Field A** 7,918 cf Overall - 2,589 cf Embedded = 5,329 cf x 40.0% Voids
#2A	350.75'	2,589 cf	**ADS_StormTech DC-780 +Cap** x 56 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
		4,721 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	351.10'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 351.10' / 350.55' S= 0.0275 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	352.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	353.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	350.00'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.09 cfs @ 12.86 hrs HW=352.50' (Free Discharge)
└**4=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.12 cfs @ 12.86 hrs HW=352.50' (Free Discharge)
└**1=Culvert** (Passes 0.12 cfs of 3.58 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 2.50 fps)
  └**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond INF-02: Infiltration-02 - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 +Cap (ADS StormTech® DC-780 with cap length)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

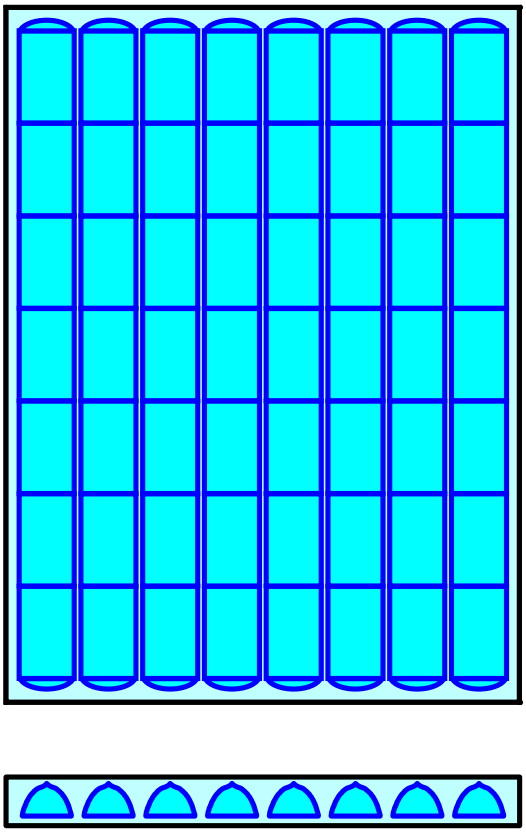
7 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 51.46' Row Length +12.0" End Stone x 2 = 53.46' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

56 Chambers x 46.2 cf = 2,589.4 cf Chamber Storage

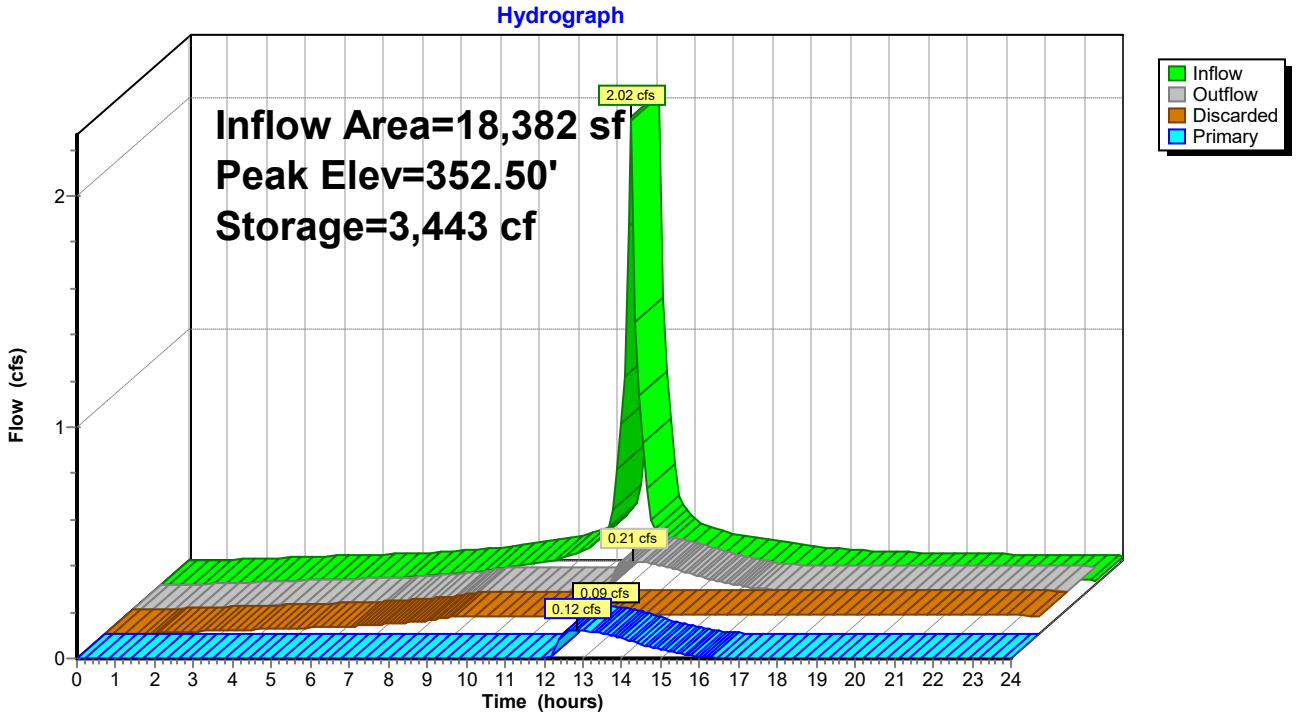
7,918.3 cf Field - 2,589.4 cf Chambers = 5,328.9 cf Stone x 40.0% Voids = 2,131.6 cf Stone Storage

Chamber Storage + Stone Storage = 4,720.9 cf = 0.108 af
Overall Storage Efficiency = 59.6%
Overall System Size = 53.46' x 39.50' x 3.75'

56 Chambers
293.3 cy Field
197.4 cy Stone



Pond INF-02: Infiltration-02



Summary for Pond SF-01: Sand Filter-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 4.56" for 10 YEAR event
Inflow = 2.07 cfs @ 12.09 hrs, Volume= 7,438 cf
Outflow = 1.56 cfs @ 12.16 hrs, Volume= 7,381 cf, Atten= 25%, Lag= 4.4 min
Discarded = 0.01 cfs @ 12.15 hrs, Volume= 315 cf
Primary = 1.55 cfs @ 12.16 hrs, Volume= 7,066 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 349.06' @ 12.16 hrs Surf.Area= 519 sf Storage= 443 cf

Plug-Flow detention time= 10.5 min calculated for 7,350 cf (99% of inflow)
Center-of-Mass det. time= 5.7 min (776.6 - 770.9)

Volume	Invert	Avail.Storage	Storage Description
#1	345.17'	300 cf	**Sand Filter (Conic)** Listed below (Recalc) 749 cf Overall x 40.0% Voids
#2	348.50'	2,112 cf	**Sand Filter (Conic)** Listed below (Recalc)
		2,412 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
345.17	225	0	0	225
348.50	225	749	749	402

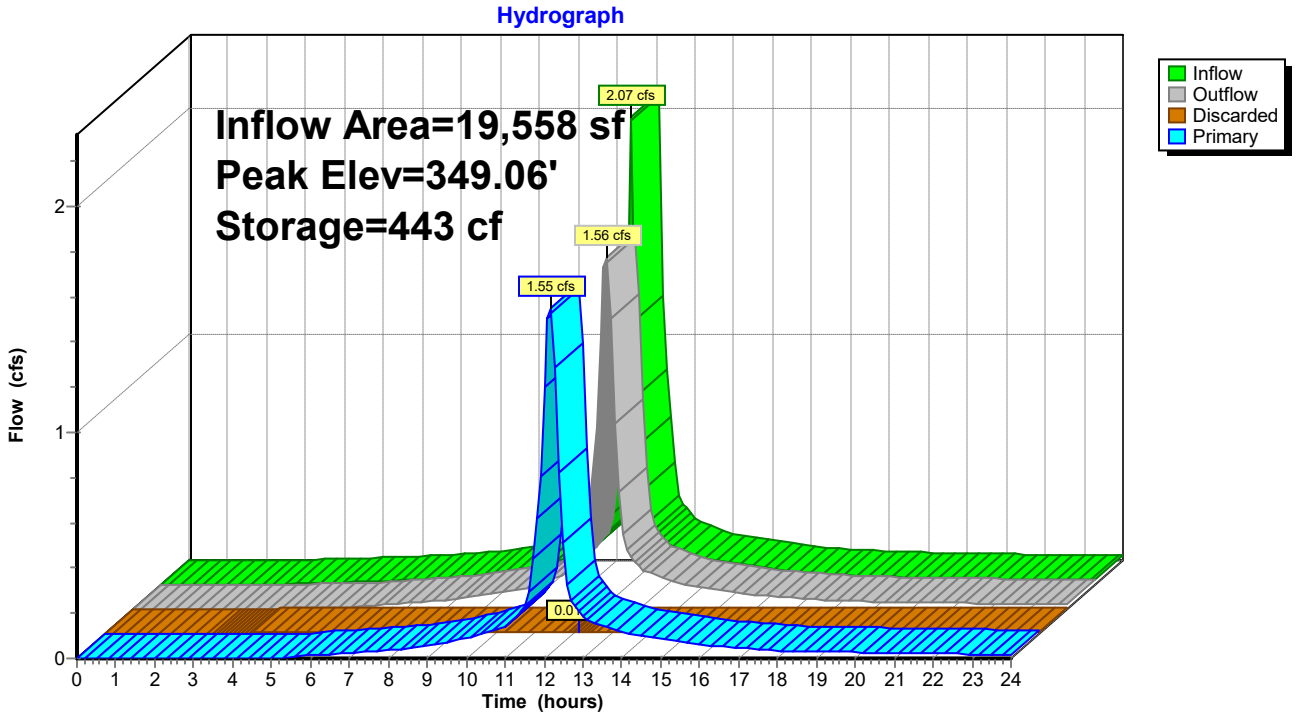
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
348.50	225	0	0	225
349.00	287	128	128	293
350.00	430	356	484	451
351.00	599	512	996	638
352.00	793	694	1,690	853
352.50	899	423	2,112	971

Device	Routing	Invert	Outlet Devices
#1	Discarded	345.17'	**0.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	345.67'	**6.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 345.67' / 345.57' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.15 hrs HW=348.94' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=1.52 cfs @ 12.16 hrs HW=348.94' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 1.52 cfs @ 7.75 fps)

Pond SF-01: Sand Filter-01



Summary for Pond SF-02: Sand Filter 02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 3.92" for 10 YEAR event
Inflow = 5.06 cfs @ 12.09 hrs, Volume= 17,196 cf
Outflow = 2.09 cfs @ 12.32 hrs, Volume= 17,049 cf, Atten= 59%, Lag= 13.7 min
Discarded = 0.08 cfs @ 12.32 hrs, Volume= 1,627 cf
Primary = 2.01 cfs @ 12.32 hrs, Volume= 15,422 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 350.00' @ 12.32 hrs Surf.Area= 1,824 sf Storage= 3,052 cf

Plug-Flow detention time= 17.6 min calculated for 16,978 cf (99% of inflow)
Center-of-Mass det. time= 12.3 min (807.2 - 794.9)

Volume	Invert	Avail.Storage	Storage Description
#1	344.17'	799 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 1,998 cf Overall x 40.0% Voids
#2	347.50'	7,308 cf	**Sand Filter (Prismatic)** Listed below (Recalc)
		8,107 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.17	600	0	0
347.50	600	1,998	1,998

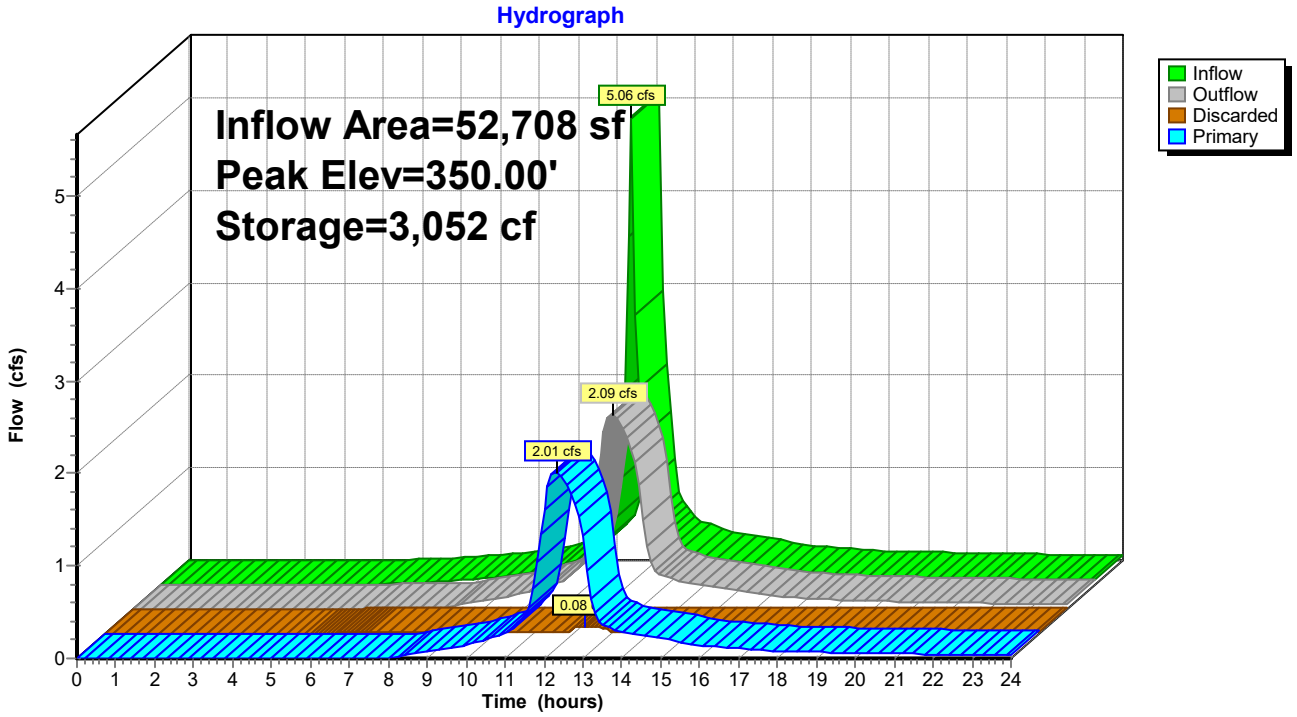
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.50	600	0	0
348.00	712	328	328
349.00	955	834	1,162
350.00	1,224	1,090	2,251
351.00	1,518	1,371	3,622
352.00	1,837	1,678	5,300
353.00	2,180	2,009	7,308

Device	Routing	Invert	Outlet Devices
#1	Primary	344.67'	**6.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 344.67' / 344.47' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Discarded	344.17'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.08 cfs @ 12.32 hrs HW=349.99' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=2.01 cfs @ 12.32 hrs HW=349.99' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 2.01 cfs @ 10.24 fps)

Pond SF-02: Sand Filter 02

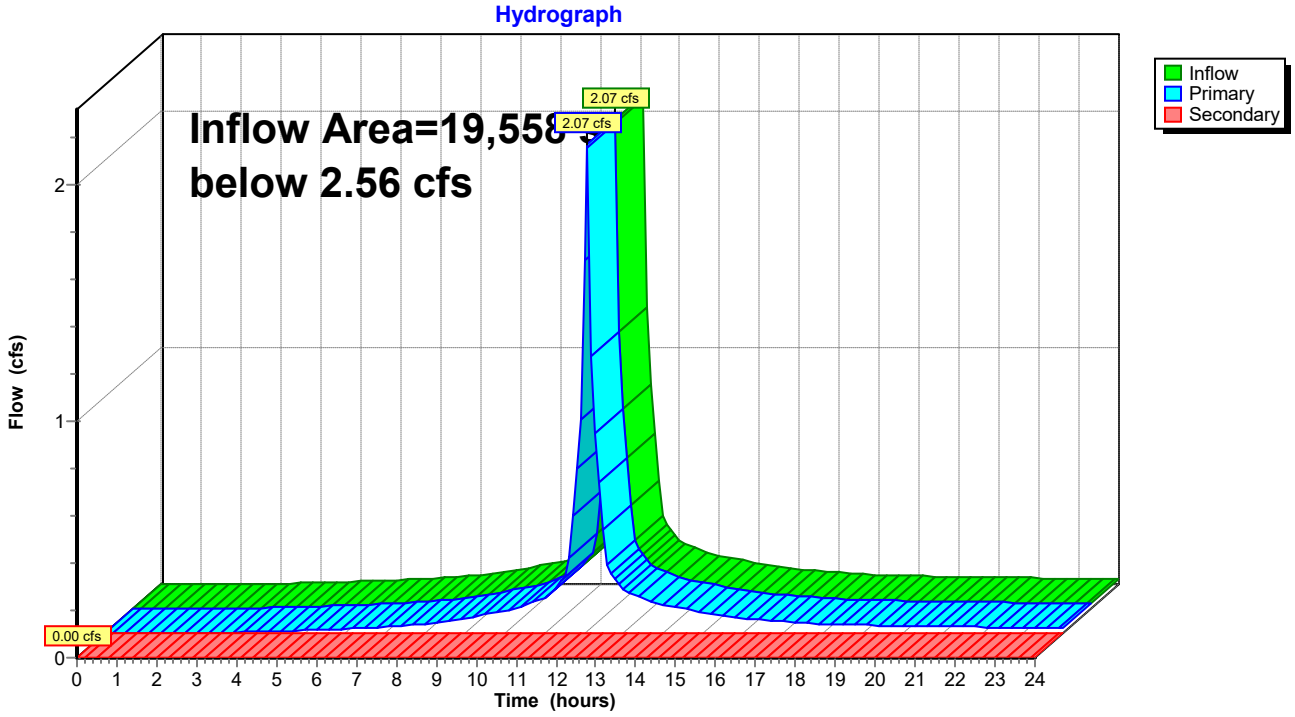


Summary for Link D-01: Diversion-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 4.56" for 10 YEAR event
Inflow = 2.07 cfs @ 12.09 hrs, Volume= 7,438 cf
Primary = 2.07 cfs @ 12.09 hrs, Volume= 7,438 cf, Atten= 0%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow below 2.56 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-01: Diversion-01

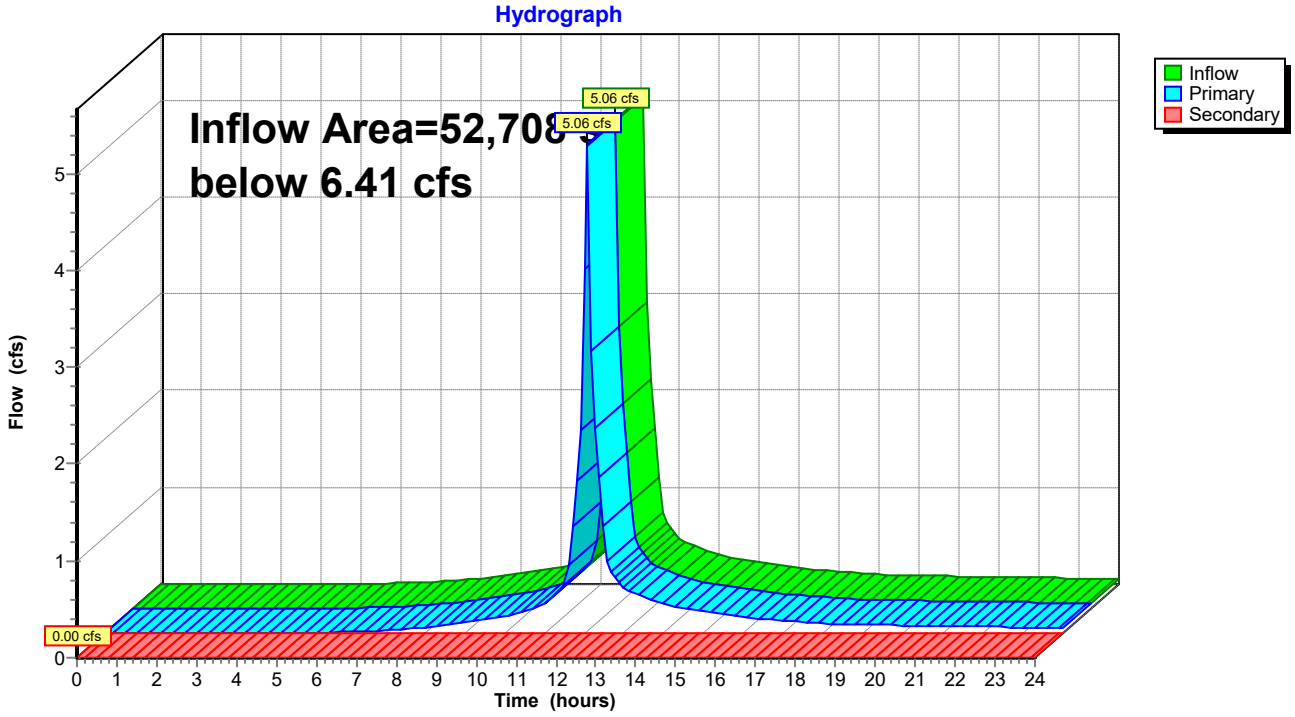


Summary for Link D-02: Diversion-02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 3.92" for 10 YEAR event
Inflow = 5.06 cfs @ 12.09 hrs, Volume= 17,196 cf
Primary = 5.06 cfs @ 12.09 hrs, Volume= 17,196 cf, Atten= 0%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow below 6.41 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-02: Diversion-02

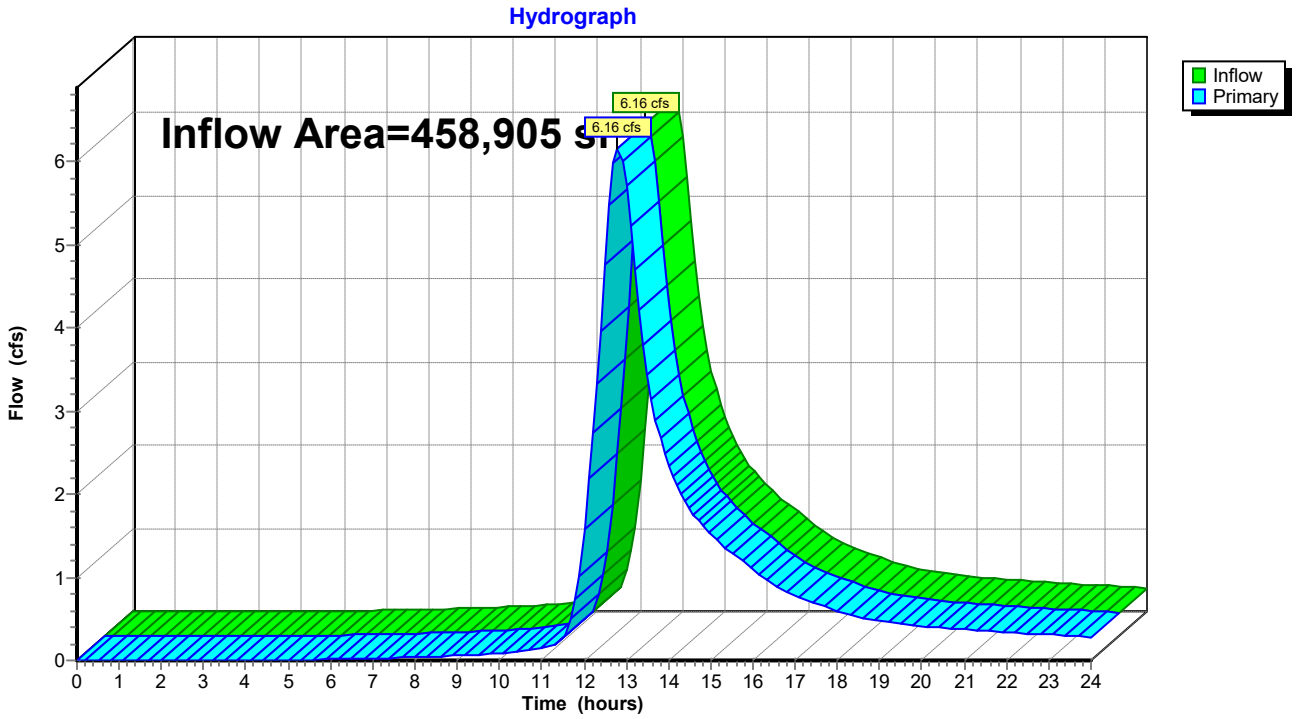


Summary for Link DP-A: Design Point A

Inflow Area = 458,905 sf, 4.01% Impervious, Inflow Depth > 1.50" for 10 YEAR event
Inflow = 6.16 cfs @ 12.80 hrs, Volume= 57,345 cf
Primary = 6.16 cfs @ 12.80 hrs, Volume= 57,345 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link DP-A: Design Point A



Summary for Subcatchment PR-WS-01: PR-WS-01

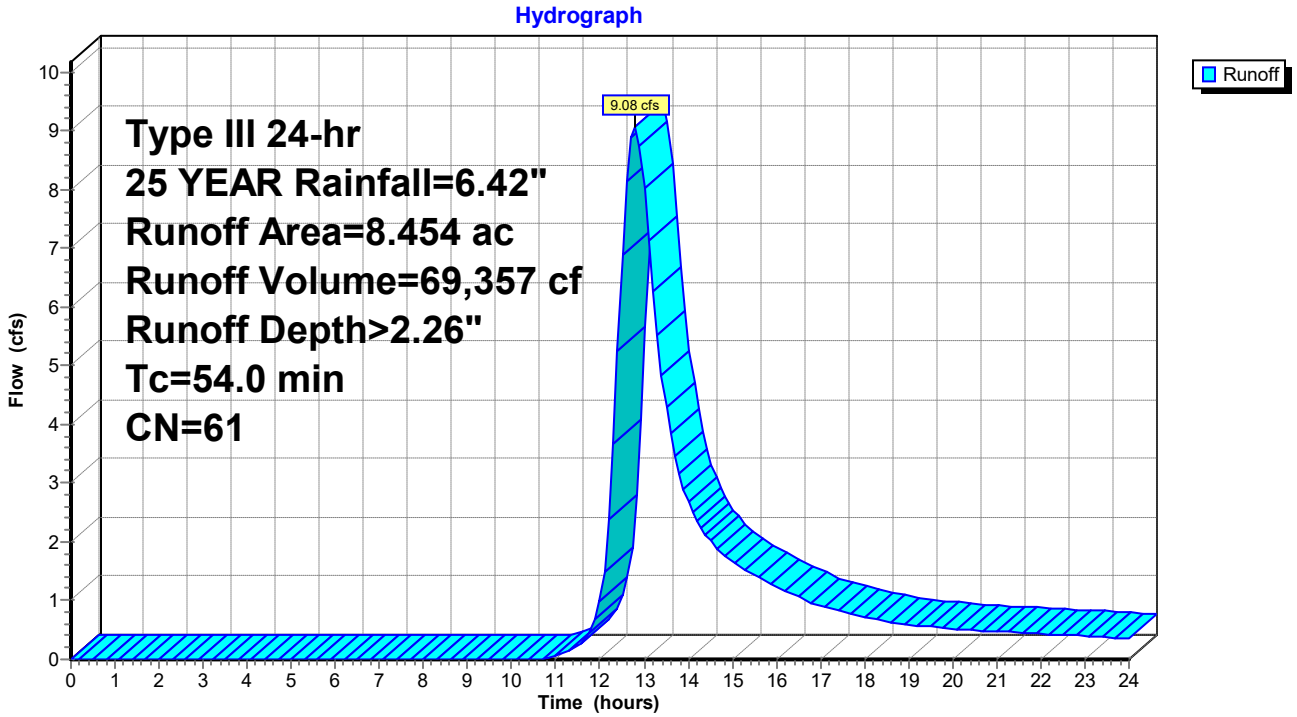
Runoff = 9.08 cfs @ 12.78 hrs, Volume= 69,357 cf, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	8.454	61	
	8.454		100.00% Pervious Area

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

Subcatchment PR-WS-01: PR-WS-01



Summary for Subcatchment PR-WS-02: PR-WS-02

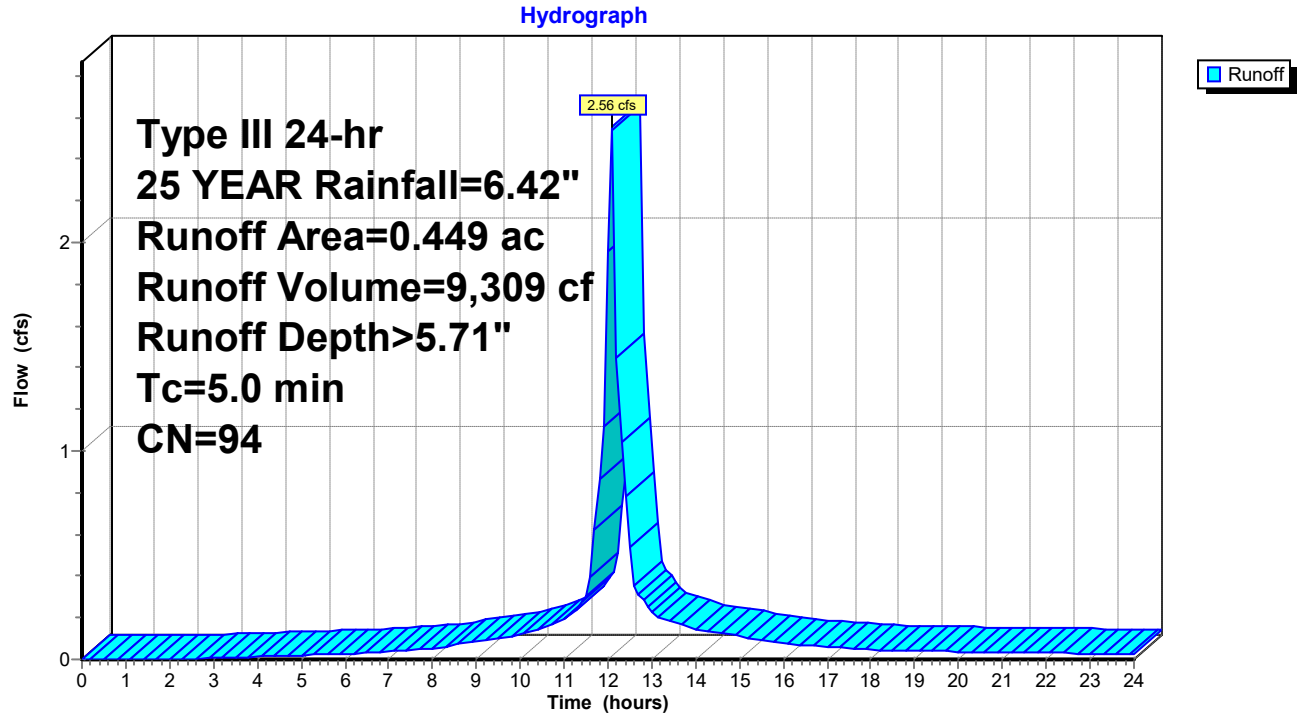
Runoff = 2.56 cfs @ 12.08 hrs, Volume= 9,309 cf, Depth> 5.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	0.449	94	
	0.449		100.00% Pervious Area

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

Subcatchment PR-WS-02: PR-WS-02



Summary for Subcatchment PR-WS-03: PR-WS-03

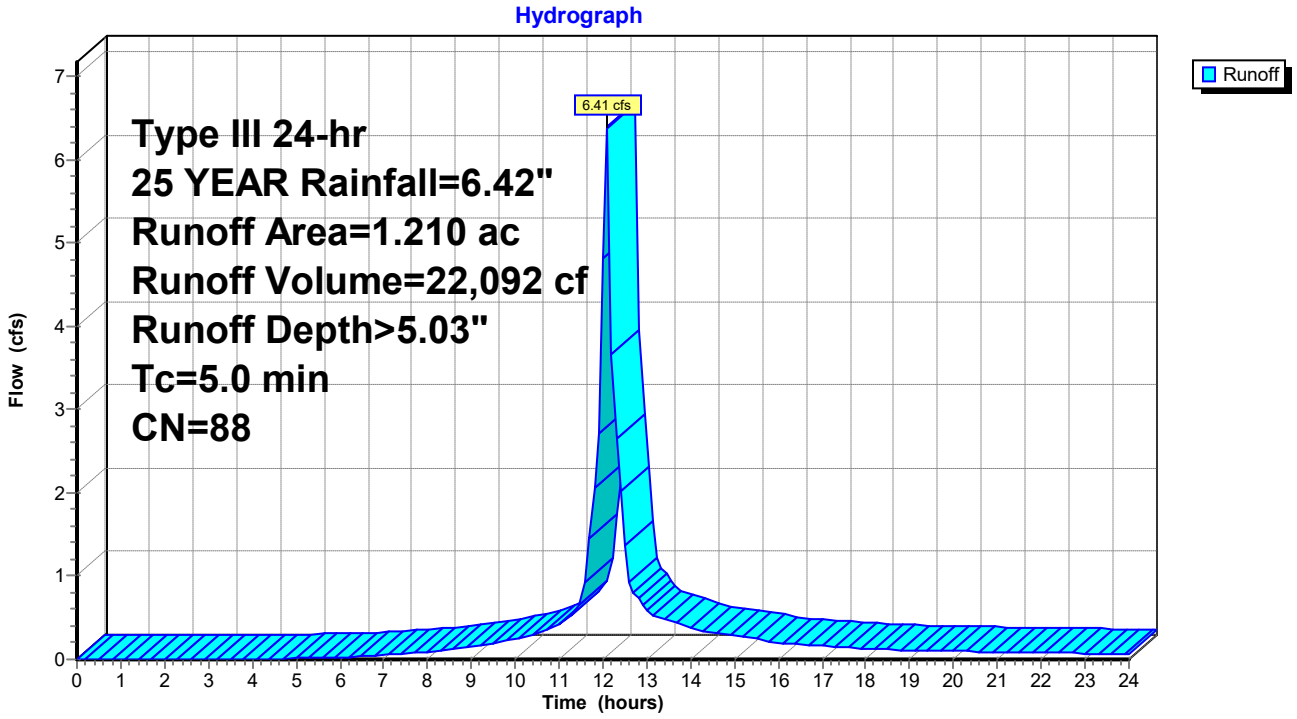
Runoff = 6.41 cfs @ 12.09 hrs, Volume= 22,092 cf, Depth> 5.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	1.210	88	
	1.210		100.00% Pervious Area

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

Subcatchment PR-WS-03: PR-WS-03



Summary for Subcatchment PR-WS-04: PR-WS-04

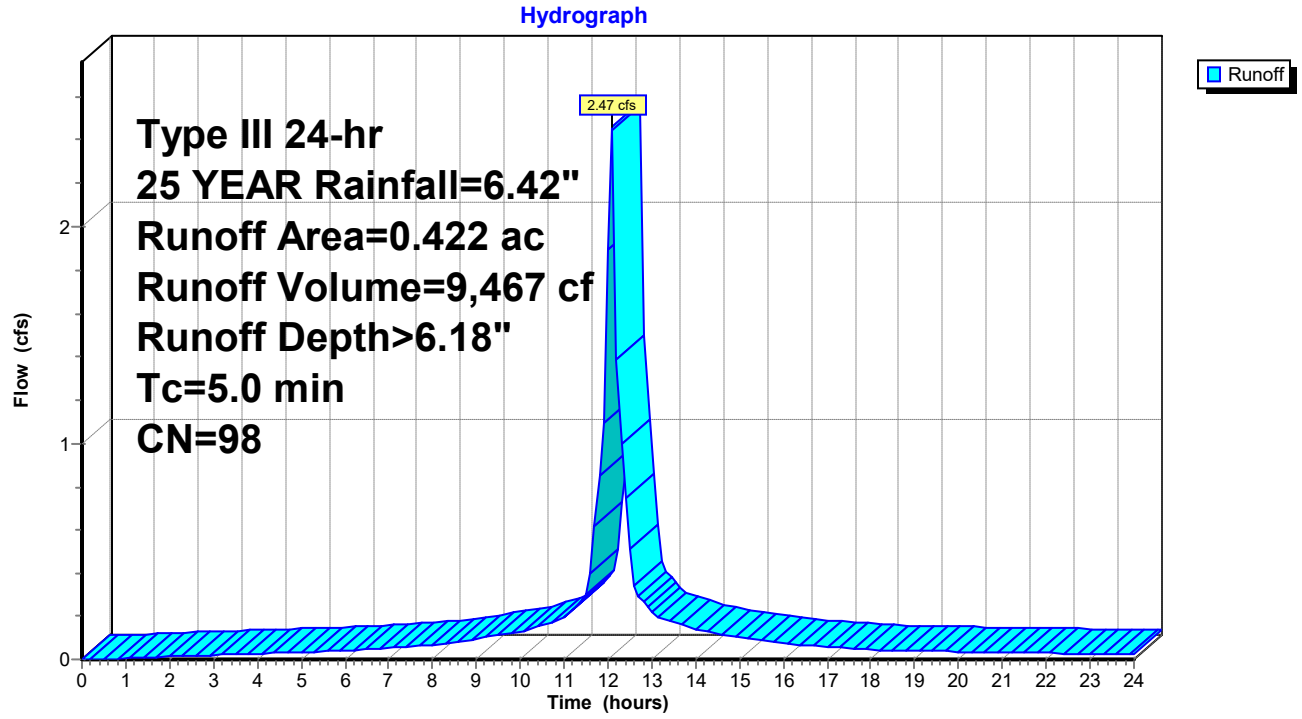
Runoff = 2.47 cfs @ 12.08 hrs, Volume= 9,467 cf, Depth> 6.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	0.422	98	
	0.422		100.00% Impervious Area

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

Subcatchment PR-WS-04: PR-WS-04



Summary for Subcatchment PR-WS-05: Design Point B

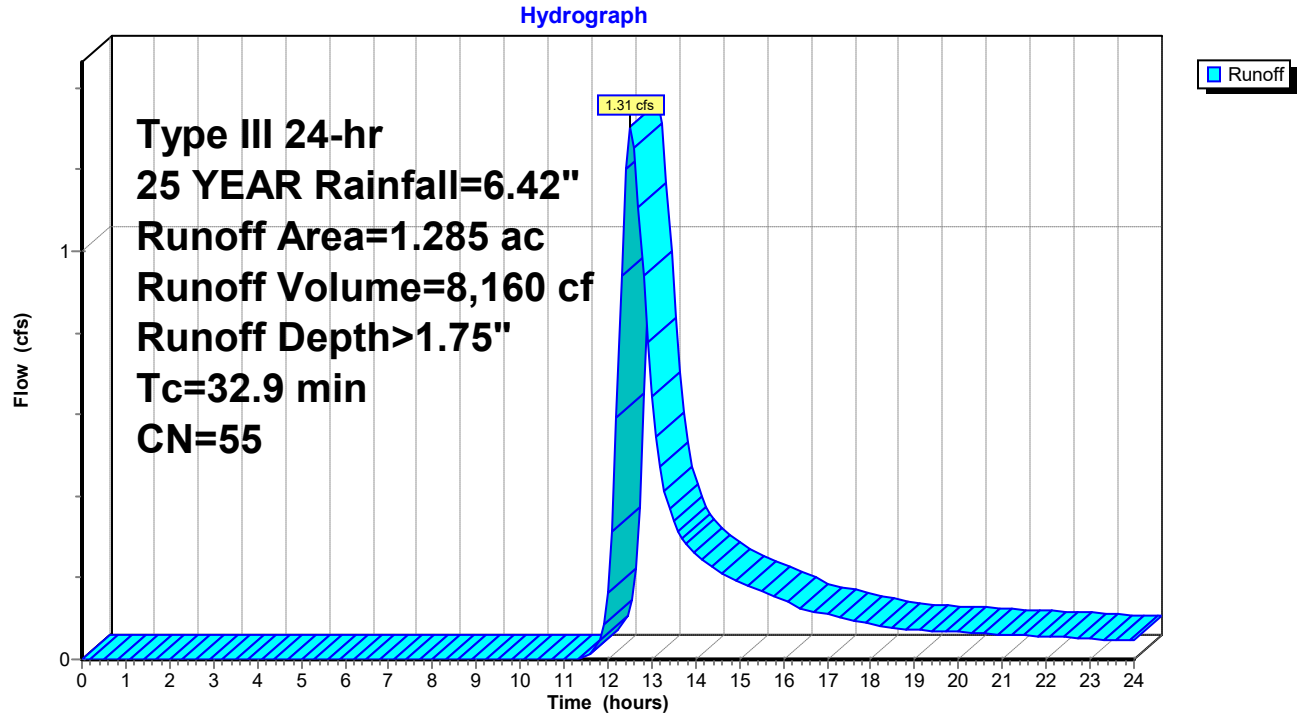
Runoff = 1.31 cfs @ 12.52 hrs, Volume= 8,160 cf, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 25 YEAR Rainfall=6.42"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment PR-WS-05: Design Point B



Summary for Pond INF-01: Infiltration-01

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 4.58" for 25 YEAR event
Inflow = 2.21 cfs @ 12.36 hrs, Volume= 20,125 cf
Outflow = 0.88 cfs @ 13.44 hrs, Volume= 11,509 cf, Atten= 60%, Lag= 65.0 min
Discarded = 0.09 cfs @ 13.44 hrs, Volume= 4,234 cf
Primary = 0.79 cfs @ 13.44 hrs, Volume= 7,275 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 346.31' @ 13.44 hrs Surf.Area= 2,064 sf Storage= 12,324 cf

Plug-Flow detention time= 230.2 min calculated for 11,461 cf (57% of inflow)
Center-of-Mass det. time= 139.7 min (937.7 - 798.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	339.00'	413 cf	**20.69'W x 99.77'L x 9.67'H Field A** 19,952 cf Overall - 18,920 cf Embedded = 1,032 cf x 40.0% Voids
#2A	339.50'	15,078 cf	**StormTrap ST1 DoubleTrap 8-0** x 21 Inside #1 Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf 3 Rows adjusted for 630.1 cf perimeter wall 20.69' x 98.44' Core + 0.00' x 0.67' Border = 20.69' x 99.77' System
#3	344.65'	126 cf	**4.00'D x 10.00'H Outlet Control Structure** -Impervious
		15,616 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	339.00'	**0.750 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	344.46'	**15.0" Round RCP_Round 15"** L= 32.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.46' / 344.30' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#3	Device 2	344.46'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	346.25'	**5.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.09 cfs @ 13.44 hrs HW=346.30' (Free Discharge)
└**1=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.69 cfs @ 13.44 hrs HW=346.30' (Free Discharge)
└**2=RCP_Round 15"** (Passes 0.69 cfs of 5.14 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.54 cfs @ 6.23 fps)
  └**4=Broad-Crested Rectangular Weir** (Weir Controls 0.15 cfs @ 0.60 fps)

Pond INF-01: Infiltration-01 - Chamber Wizard Field A

Chamber Model = StormTrap ST1 DoubleTrap 8-0 (StormTrap ST1 DoubleTrap® Type I/III/VI)
Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf
Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf
3 Rows adjusted for 630.1 cf perimeter wall

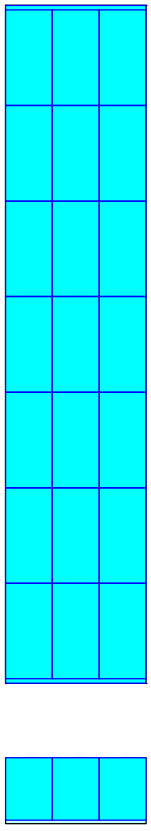
7 Chambers/Row x 14.06' Long = 98.44' Row Length +8.0" Border x 2 = 99.77' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
6.0" Base + 110.0" Chamber Height = 9.67' Field Height

24.0 cf Sidewall x 7 x 2 + 49.0 cf Endwall x 3 x 2 = 630.1 cf Perimeter Wall
21 Chambers x 718.0 cf - 630.1 cf Perimeter wall = 14,448.0 cf Chamber Storage
21 Chambers x 888.9 cf + 252.8 cf Border = 18,920.1 cf Displacement

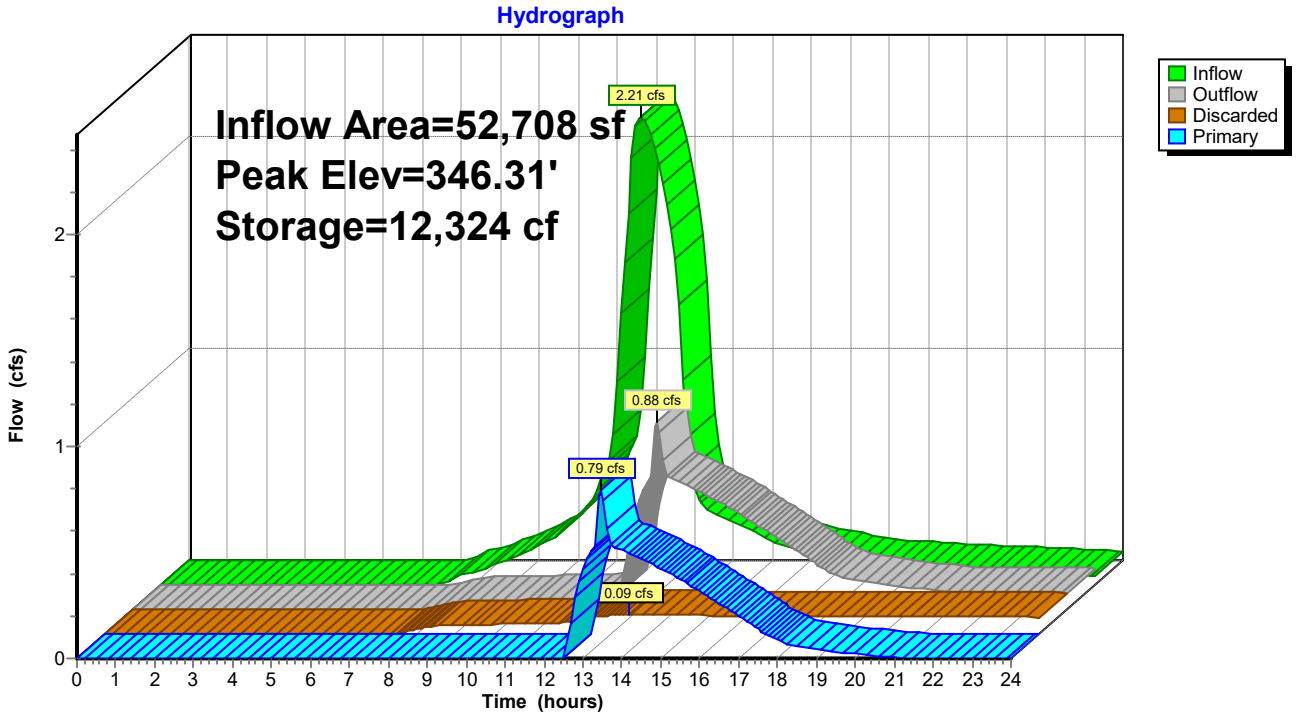
19,952.1 cf Field - 18,920.1 cf Chambers = 1,032.0 cf Stone x 40.0% Voids = 412.8 cf Stone Storage

Chamber Storage + Stone Storage = 14,860.8 cf = 0.341 af
Overall Storage Efficiency = 74.5%
Overall System Size = 99.77' x 20.69' x 9.67'

21 Chambers (plus border)
739.0 cy Field
38.2 cy Stone



Pond INF-01: Infiltration-01



Summary for Pond INF-02: Infiltration-02

Inflow Area = 18,382 sf,100.00% Impervious, Inflow Depth > 6.18" for 25 YEAR event
Inflow = 2.47 cfs @ 12.08 hrs, Volume= 9,467 cf
Outflow = 0.55 cfs @ 12.52 hrs, Volume= 7,682 cf, Atten= 78%, Lag= 25.9 min
Discarded = 0.09 cfs @ 12.52 hrs, Volume= 5,459 cf
Primary = 0.46 cfs @ 12.52 hrs, Volume= 2,223 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 353.06' @ 12.52 hrs Surf.Area= 2,112 sf Storage= 4,129 cf

Plug-Flow detention time= 194.1 min calculated for 7,682 cf (81% of inflow)
Center-of-Mass det. time= 119.1 min (862.2 - 743.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	350.00'	2,132 cf	**39.50'W x 53.46'L x 3.75'H Field A** 7,918 cf Overall - 2,589 cf Embedded = 5,329 cf x 40.0% Voids
#2A	350.75'	2,589 cf	**ADS_StormTech DC-780 +Cap** x 56 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
		4,721 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	351.10'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 351.10' / 350.55' S= 0.0275 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	352.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	353.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	350.00'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.09 cfs @ 12.52 hrs HW=353.05' (Free Discharge)
└**4=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.43 cfs @ 12.52 hrs HW=353.05' (Free Discharge)
└**1=Culvert** (Passes 0.43 cfs of 4.56 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 4.39 fps)
  └**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.21 cfs @ 0.77 fps)

Pond INF-02: Infiltration-02 - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 +Cap (ADS StormTech® DC-780 with cap length)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

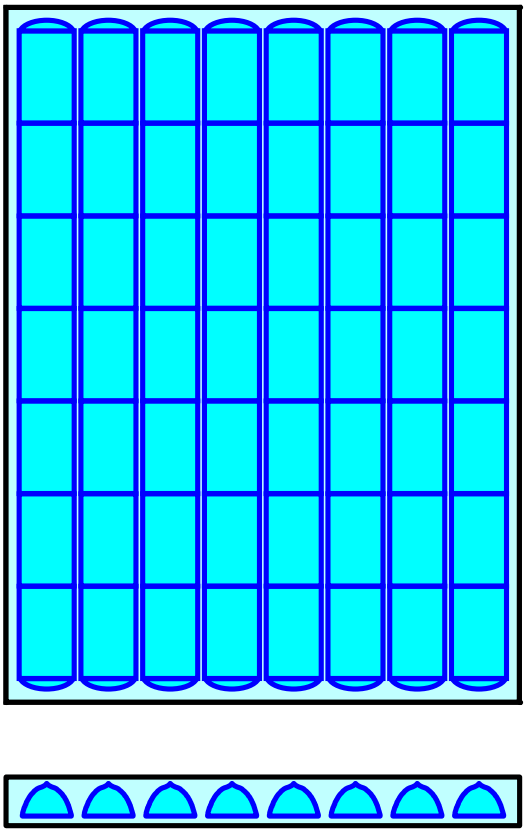
7 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 51.46' Row Length +12.0" End Stone x 2 = 53.46' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

56 Chambers x 46.2 cf = 2,589.4 cf Chamber Storage

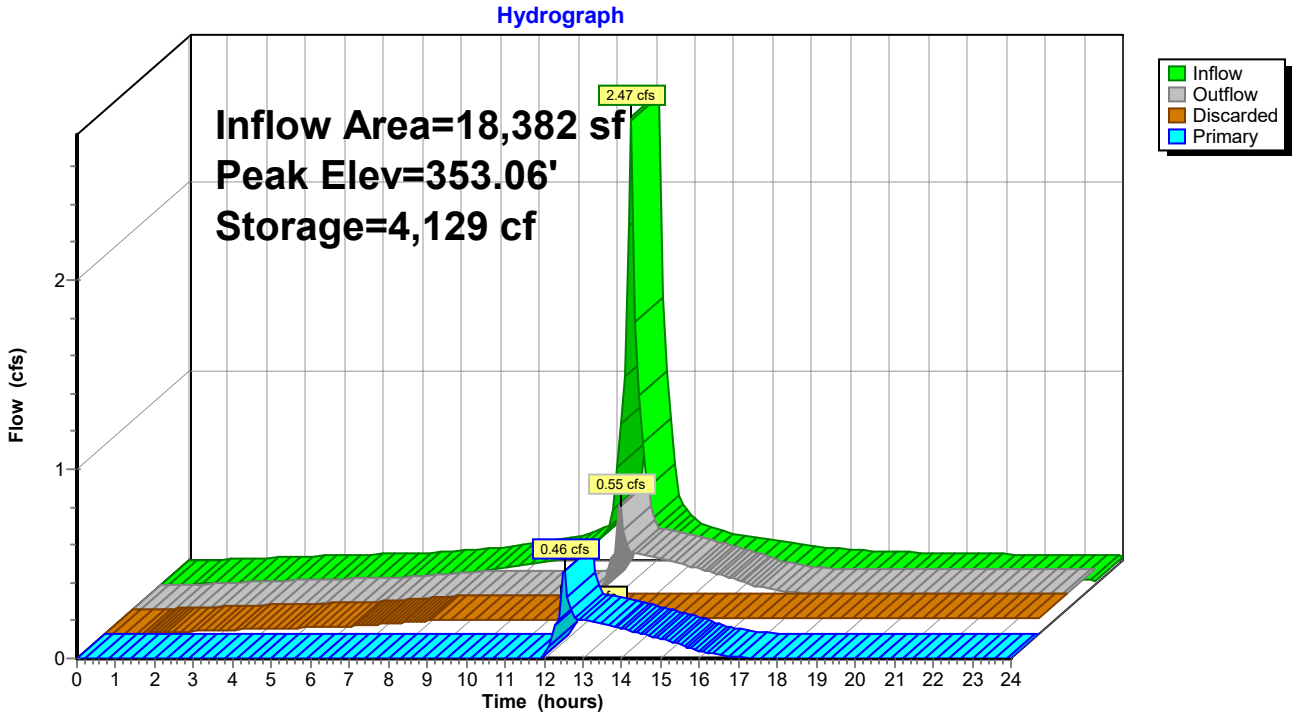
7,918.3 cf Field - 2,589.4 cf Chambers = 5,328.9 cf Stone x 40.0% Voids = 2,131.6 cf Stone Storage

Chamber Storage + Stone Storage = 4,720.9 cf = 0.108 af
Overall Storage Efficiency = 59.6%
Overall System Size = 53.46' x 39.50' x 3.75'

56 Chambers
293.3 cy Field
197.4 cy Stone



Pond INF-02: Infiltration-02



Summary for Pond SF-01: Sand Filter-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 5.71" for 25 YEAR event
Inflow = 2.56 cfs @ 12.08 hrs, Volume= 9,309 cf
Outflow = 1.73 cfs @ 12.19 hrs, Volume= 9,270 cf, Atten= 32%, Lag= 6.2 min
Discarded = 0.01 cfs @ 12.19 hrs, Volume= 329 cf
Primary = 1.72 cfs @ 12.19 hrs, Volume= 8,941 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 349.73' @ 12.19 hrs Surf.Area= 613 sf Storage= 672 cf

Plug-Flow detention time= 8.2 min calculated for 9,231 cf (99% of inflow)
Center-of-Mass det. time= 5.6 min (771.2 - 765.6)

Volume	Invert	Avail.Storage	Storage Description
#1	345.17'	300 cf	**Sand Filter (Conic)** Listed below (Recalc) 749 cf Overall x 40.0% Voids
#2	348.50'	2,112 cf	**Sand Filter (Conic)** Listed below (Recalc)
		2,412 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
345.17	225	0	0	225
348.50	225	749	749	402

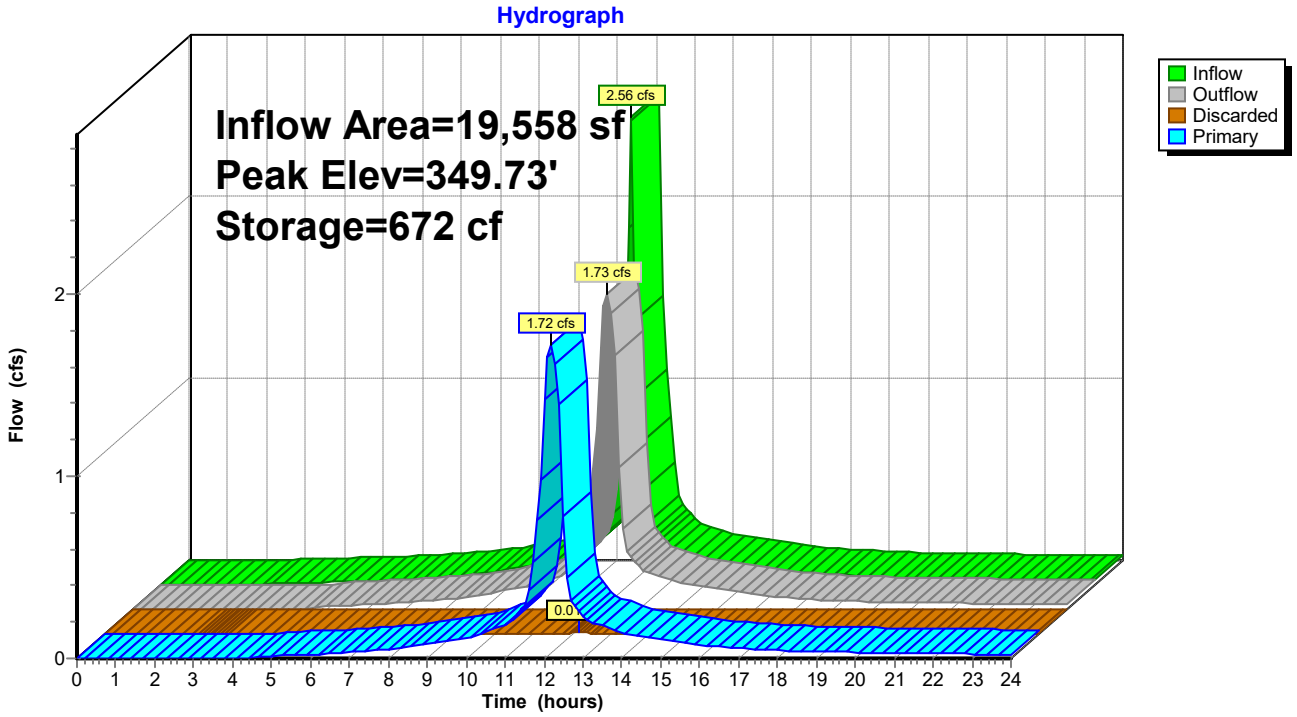
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
348.50	225	0	0	225
349.00	287	128	128	293
350.00	430	356	484	451
351.00	599	512	996	638
352.00	793	694	1,690	853
352.50	899	423	2,112	971

Device	Routing	Invert	Outlet Devices
#1	Discarded	345.17'	**0.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	345.67'	**6.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 345.67' / 345.57' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.19 hrs HW=349.69' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=1.71 cfs @ 12.19 hrs HW=349.69' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 1.71 cfs @ 8.70 fps)

Pond SF-01: Sand Filter-01



Summary for Pond SF-02: Sand Filter 02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 5.03" for 25 YEAR event
Inflow = 6.41 cfs @ 12.09 hrs, Volume= 22,092 cf
Outflow = 2.30 cfs @ 12.36 hrs, Volume= 21,934 cf, Atten= 64%, Lag= 16.1 min
Discarded = 0.10 cfs @ 12.36 hrs, Volume= 1,809 cf
Primary = 2.21 cfs @ 12.36 hrs, Volume= 20,125 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 351.01' @ 12.36 hrs Surf.Area= 2,122 sf Storage= 4,440 cf

Plug-Flow detention time= 19.2 min calculated for 21,843 cf (99% of inflow)
Center-of-Mass det. time= 14.7 min (802.8 - 788.1)

Volume	Invert	Avail.Storage	Storage Description
#1	344.17'	799 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 1,998 cf Overall x 40.0% Voids
#2	347.50'	7,308 cf	**Sand Filter (Prismatic)** Listed below (Recalc)
		8,107 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.17	600	0	0
347.50	600	1,998	1,998

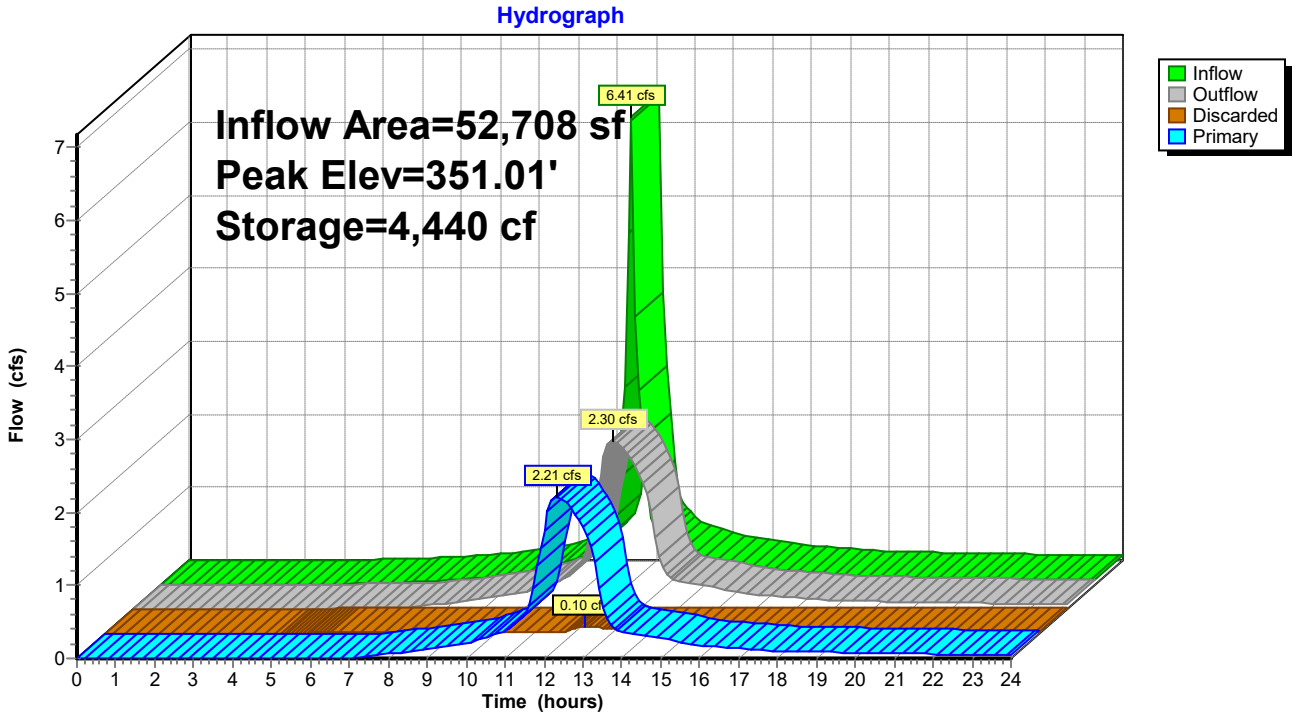
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.50	600	0	0
348.00	712	328	328
349.00	955	834	1,162
350.00	1,224	1,090	2,251
351.00	1,518	1,371	3,622
352.00	1,837	1,678	5,300
353.00	2,180	2,009	7,308

Device	Routing	Invert	Outlet Devices
#1	Primary	344.67'	**6.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 344.67' / 344.47' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Discarded	344.17'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.10 cfs @ 12.36 hrs HW=350.99' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=2.20 cfs @ 12.36 hrs HW=350.99' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 2.20 cfs @ 11.22 fps)

Pond SF-02: Sand Filter 02

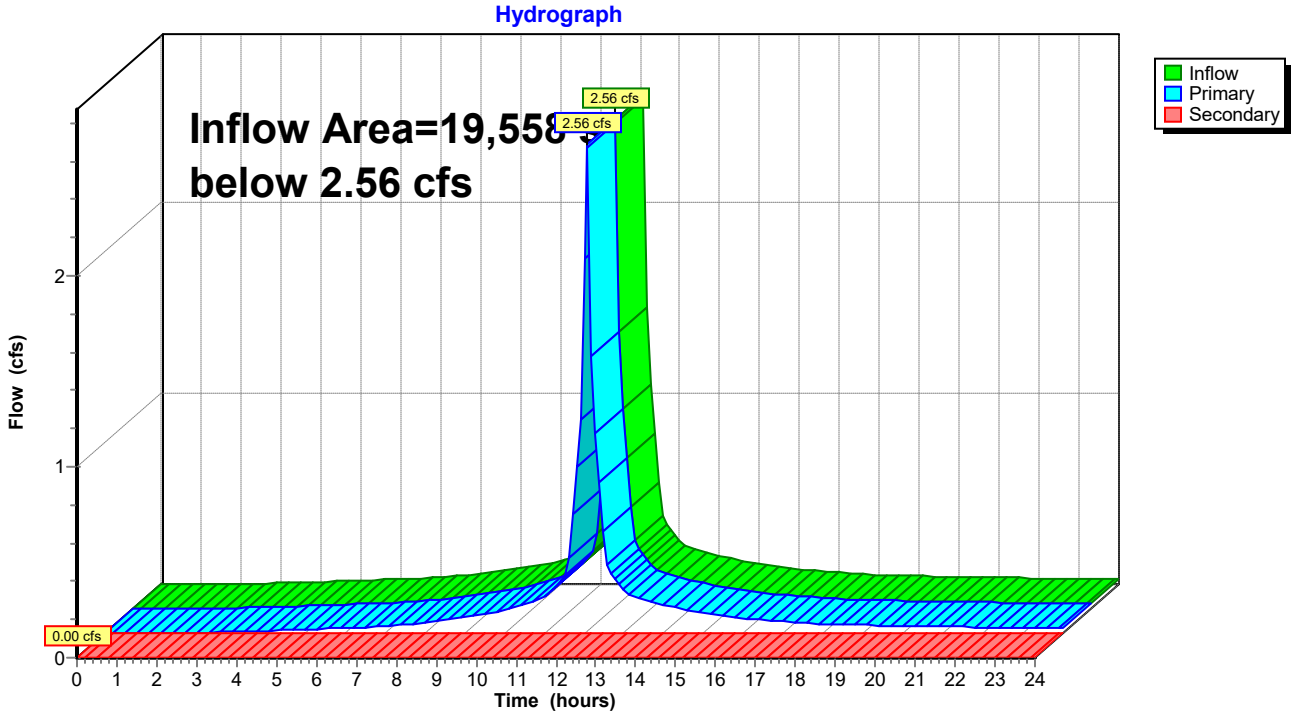


Summary for Link D-01: Diversion-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 5.71" for 25 YEAR event
Inflow = 2.56 cfs @ 12.08 hrs, Volume= 9,309 cf
Primary = 2.56 cfs @ 12.08 hrs, Volume= 9,309 cf, Atten= 0%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow below 2.56 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-01: Diversion-01

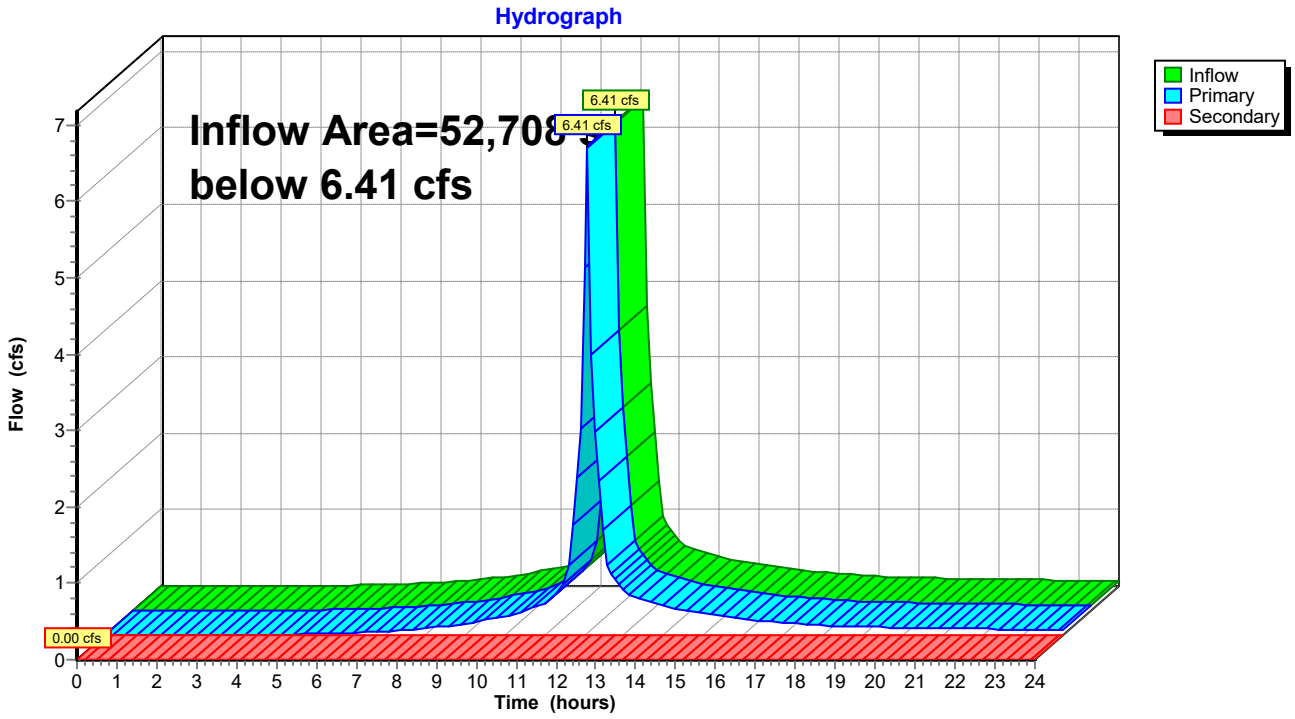


Summary for Link D-02: Diversion-02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 5.03" for 25 YEAR event
Inflow = 6.41 cfs @ 12.09 hrs, Volume= 22,092 cf
Primary = 6.41 cfs @ 12.09 hrs, Volume= 22,092 cf, Atten= 0%, Lag= 0.0 min
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Primary outflow = Inflow below 6.41 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-02: Diversion-02

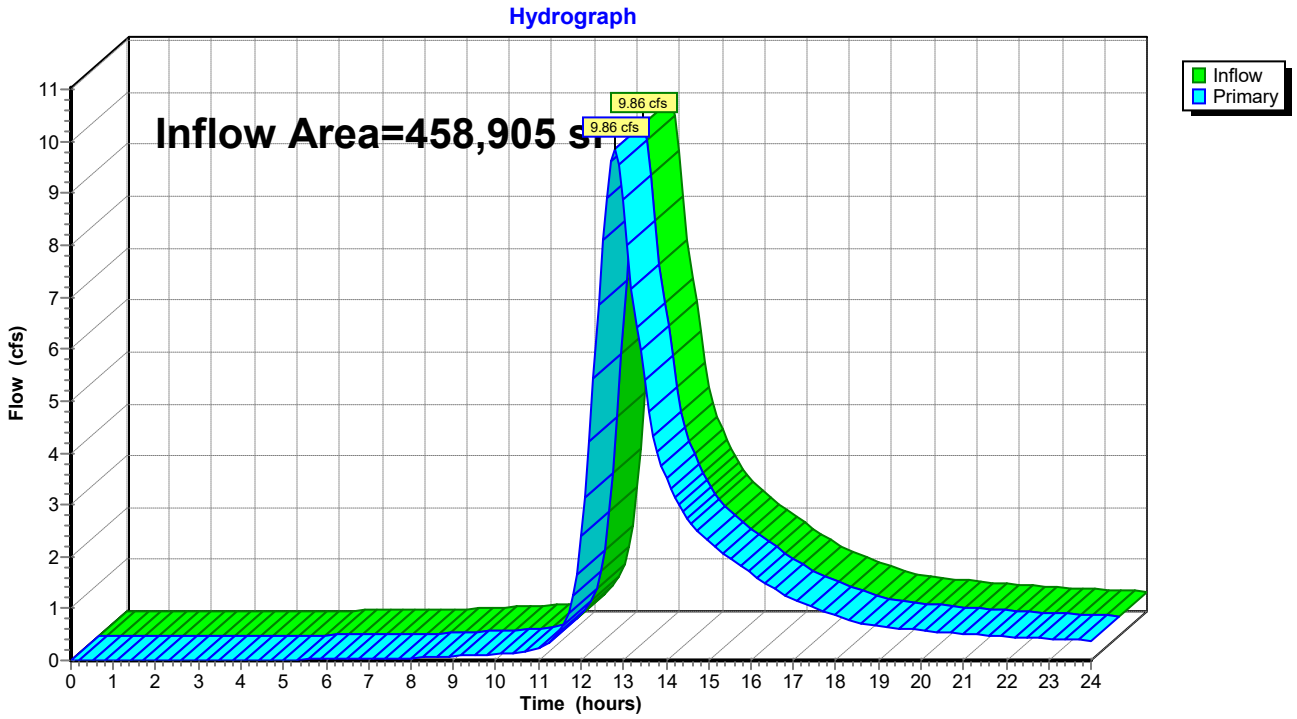


Summary for Link DP-A: Design Point A

Inflow Area = 458,905 sf, 4.01% Impervious, Inflow Depth > 2.30" for 25 YEAR event
Inflow = 9.86 cfs @ 12.79 hrs, Volume= 87,796 cf
Primary = 9.86 cfs @ 12.79 hrs, Volume= 87,796 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link DP-A: Design Point A



Summary for Subcatchment PR-WS-01: PR-WS-01

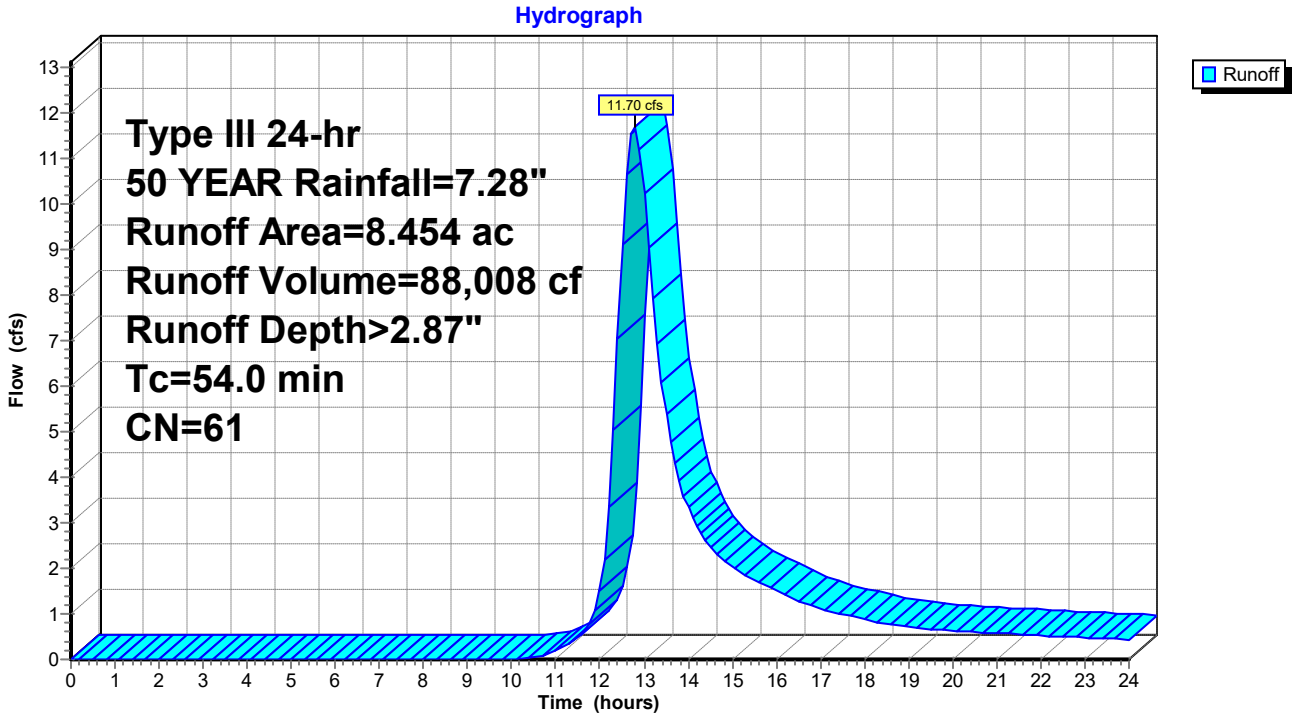
Runoff = 11.70 cfs @ 12.77 hrs, Volume= 88,008 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	8.454	61	
	8.454		100.00% Pervious Area

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

Subcatchment PR-WS-01: PR-WS-01



Summary for Subcatchment PR-WS-02: PR-WS-02

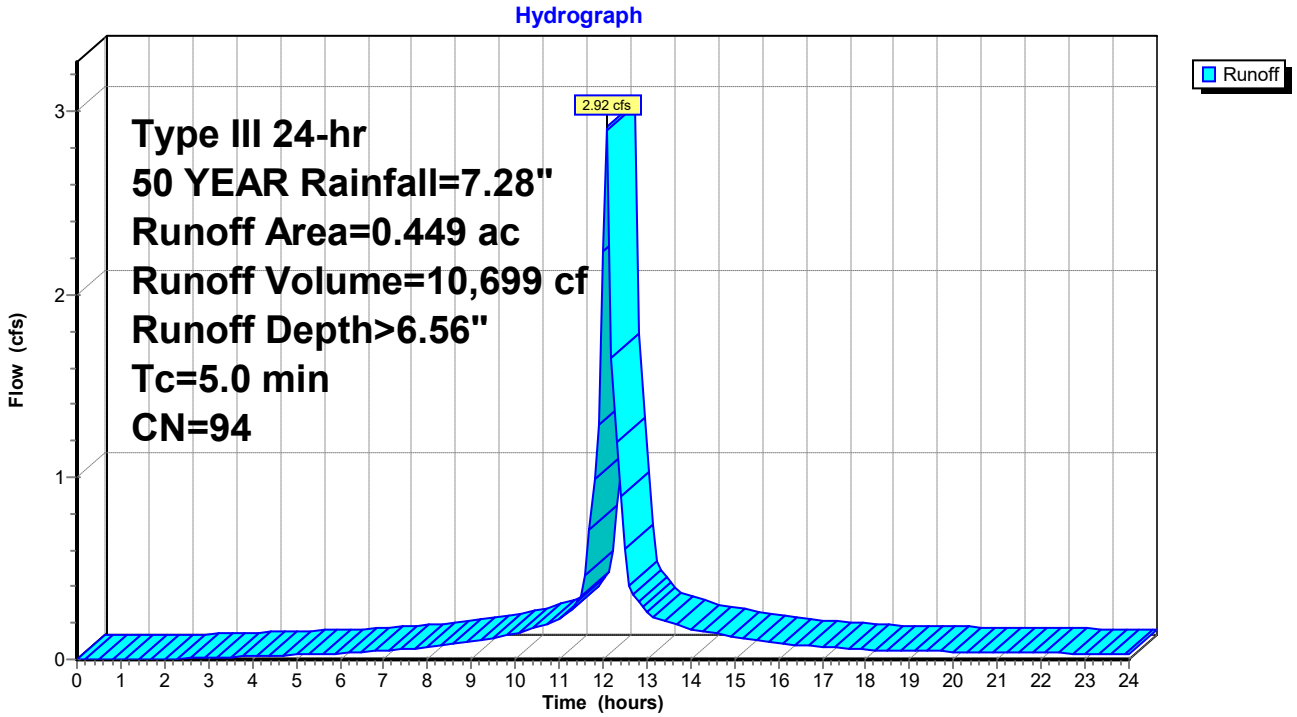
Runoff = 2.92 cfs @ 12.08 hrs, Volume= 10,699 cf, Depth> 6.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	0.449	94	
	0.449		100.00% Pervious Area

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

Subcatchment PR-WS-02: PR-WS-02



Summary for Subcatchment PR-WS-03: PR-WS-03

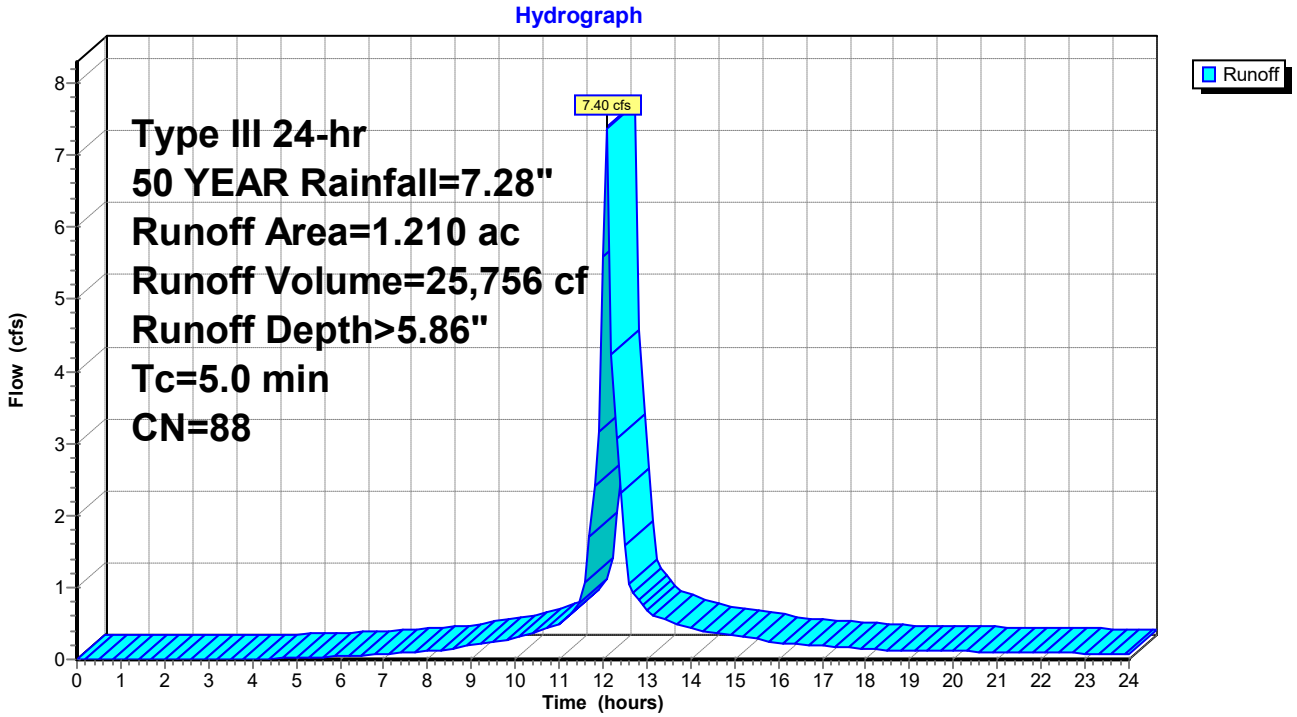
Runoff = 7.40 cfs @ 12.09 hrs, Volume= 25,756 cf, Depth> 5.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	1.210	88	
	1.210		100.00% Pervious Area

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

Subcatchment PR-WS-03: PR-WS-03



Summary for Subcatchment PR-WS-04: PR-WS-04

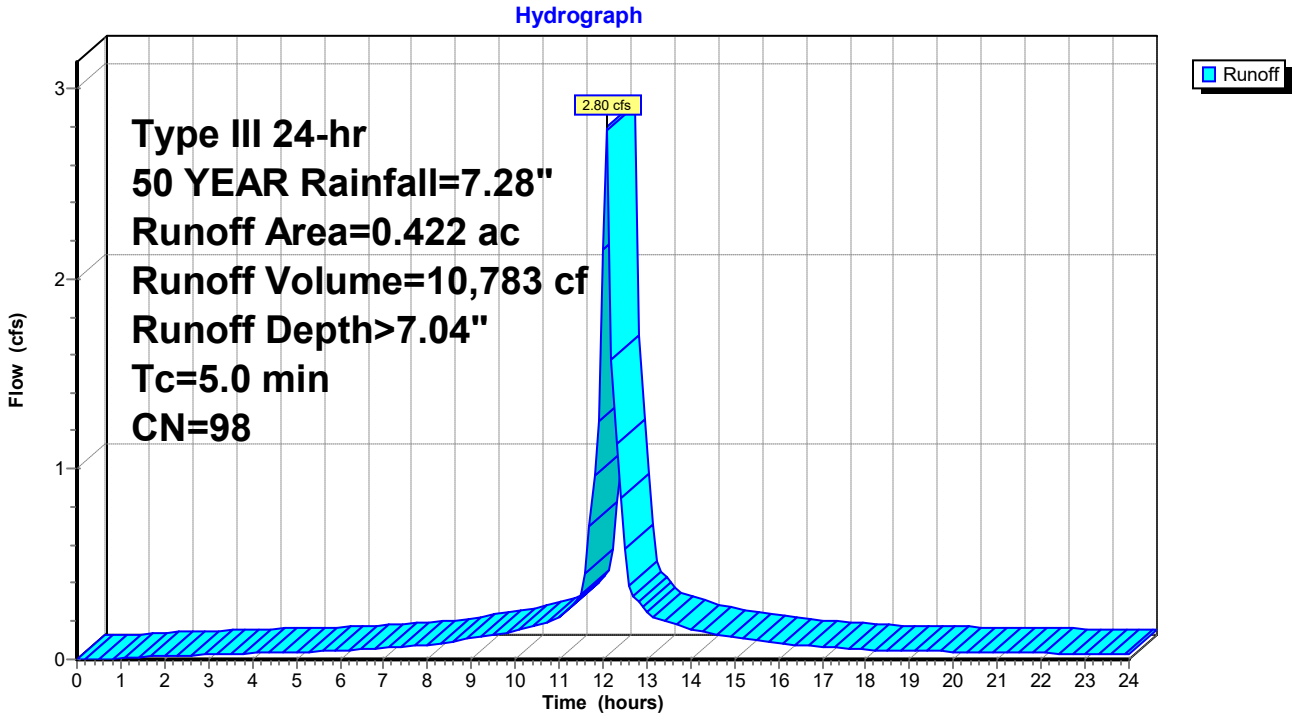
Runoff = 2.80 cfs @ 12.08 hrs, Volume= 10,783 cf, Depth> 7.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	0.422	98	
	0.422		100.00% Impervious Area

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

Subcatchment PR-WS-04: PR-WS-04



Summary for Subcatchment PR-WS-05: Design Point B

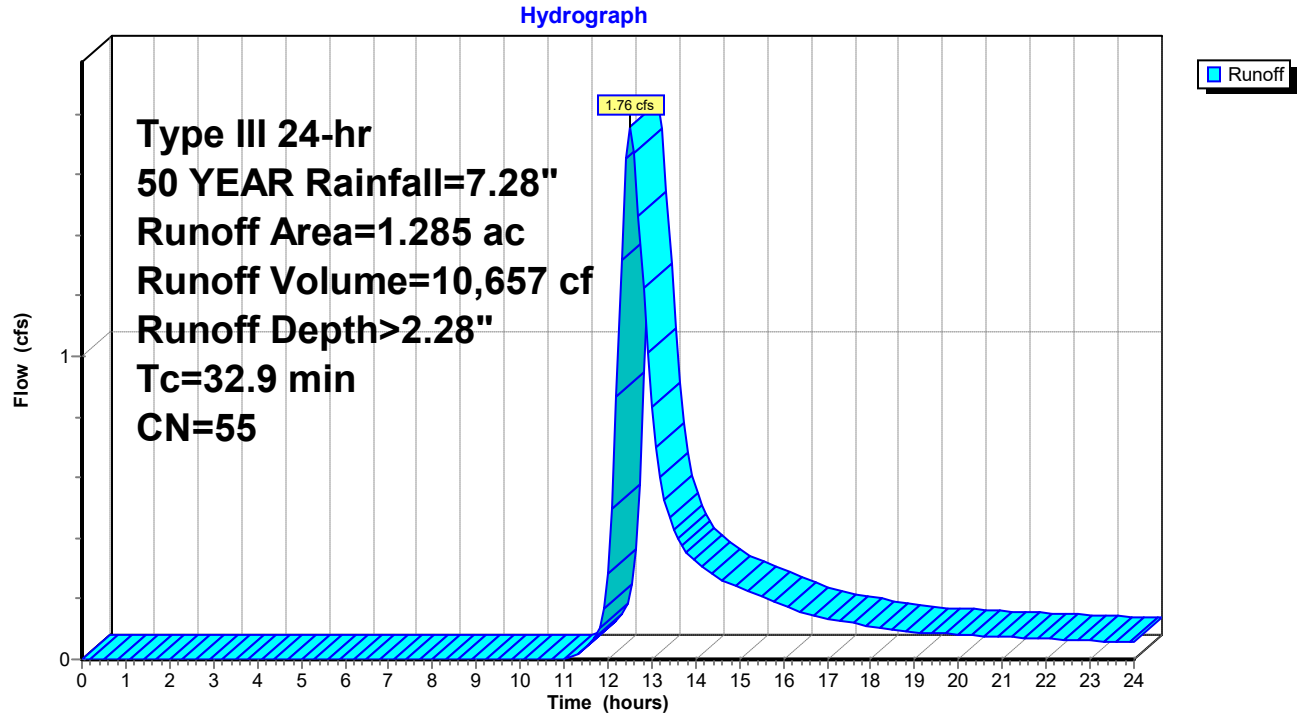
Runoff = 1.76 cfs @ 12.50 hrs, Volume= 10,657 cf, Depth> 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 50 YEAR Rainfall=7.28"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment PR-WS-05: Design Point B



Summary for Pond INF-01: Infiltration-01

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 5.39" for 50 YEAR event
Inflow = 3.05 cfs @ 12.11 hrs, Volume= 23,674 cf
Outflow = 1.79 cfs @ 13.21 hrs, Volume= 14,928 cf, Atten= 41%, Lag= 66.1 min
Discarded = 0.10 cfs @ 13.21 hrs, Volume= 4,388 cf
Primary = 1.69 cfs @ 13.21 hrs, Volume= 10,539 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 346.43' @ 13.21 hrs Surf.Area= 2,064 sf Storage= 12,559 cf

Plug-Flow detention time= 205.6 min calculated for 14,866 cf (63% of inflow)
Center-of-Mass det. time= 119.8 min (916.3 - 796.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	339.00'	413 cf	**20.69'W x 99.77'L x 9.67'H Field A** 19,952 cf Overall - 18,920 cf Embedded = 1,032 cf x 40.0% Voids
#2A	339.50'	15,078 cf	**StormTrap ST1 DoubleTrap 8-0** x 21 Inside #1 Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf 3 Rows adjusted for 630.1 cf perimeter wall 20.69' x 98.44' Core + 0.00' x 0.67' Border = 20.69' x 99.77' System
#3	344.65'	126 cf	**4.00'D x 10.00'H Outlet Control Structure** -Impervious
		15,616 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	339.00'	**0.750 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	344.46'	**15.0" Round RCP_Round 15"** L= 32.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.46' / 344.30' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#3	Device 2	344.46'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	346.25'	**5.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.10 cfs @ 13.21 hrs HW=346.43' (Free Discharge)
└**1=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=1.61 cfs @ 13.21 hrs HW=346.43' (Free Discharge)
└**2=RCP_Round 15"** (Passes 1.61 cfs of 5.41 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.56 cfs @ 6.47 fps)
  └**4=Broad-Crested Rectangular Weir** (Weir Controls 1.04 cfs @ 1.15 fps)

Pond INF-01: Infiltration-01 - Chamber Wizard Field A

Chamber Model = StormTrap ST1 DoubleTrap 8-0 (StormTrap ST1 DoubleTrap® Type I/III/VI)
Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf
Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf
3 Rows adjusted for 630.1 cf perimeter wall

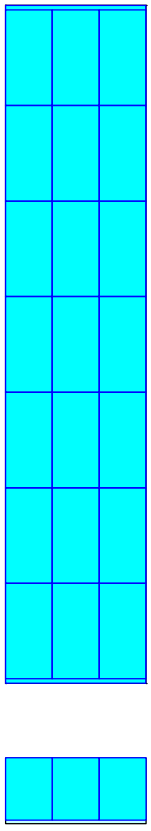
7 Chambers/Row x 14.06' Long = 98.44' Row Length +8.0" Border x 2 = 99.77' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
6.0" Base + 110.0" Chamber Height = 9.67' Field Height

24.0 cf Sidewall x 7 x 2 + 49.0 cf Endwall x 3 x 2 = 630.1 cf Perimeter Wall
21 Chambers x 718.0 cf - 630.1 cf Perimeter wall = 14,448.0 cf Chamber Storage
21 Chambers x 888.9 cf + 252.8 cf Border = 18,920.1 cf Displacement

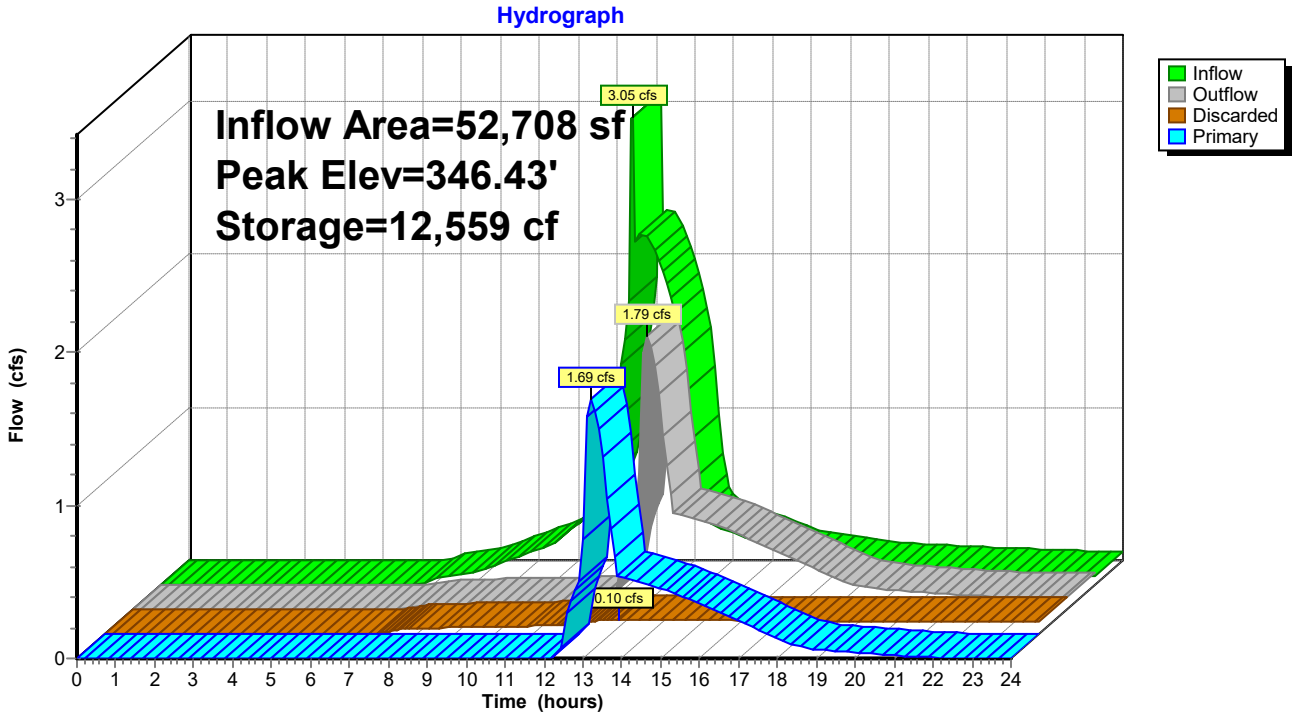
19,952.1 cf Field - 18,920.1 cf Chambers = 1,032.0 cf Stone x 40.0% Voids = 412.8 cf Stone Storage

Chamber Storage + Stone Storage = 14,860.8 cf = 0.341 af
Overall Storage Efficiency = 74.5%
Overall System Size = 99.77' x 20.69' x 9.67'

21 Chambers (plus border)
739.0 cy Field
38.2 cy Stone



Pond INF-01: Infiltration-01



Summary for Pond INF-02: Infiltration-02

Inflow Area = 18,382 sf,100.00% Impervious, Inflow Depth > 7.04" for 50 YEAR event
Inflow = 2.80 cfs @ 12.08 hrs, Volume= 10,783 cf
Outflow = 1.28 cfs @ 12.32 hrs, Volume= 8,812 cf, Atten= 54%, Lag= 14.4 min
Discarded = 0.09 cfs @ 12.33 hrs, Volume= 5,622 cf
Primary = 1.19 cfs @ 12.32 hrs, Volume= 3,190 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 353.16' @ 12.33 hrs Surf.Area= 2,112 sf Storage= 4,216 cf

Plug-Flow detention time= 175.2 min calculated for 8,776 cf (81% of inflow)
Center-of-Mass det. time= 103.1 min (844.5 - 741.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	350.00'	2,132 cf	**39.50'W x 53.46'L x 3.75'H Field A** 7,918 cf Overall - 2,589 cf Embedded = 5,329 cf x 40.0% Voids
#2A	350.75'	2,589 cf	**ADS_StormTech DC-780 +Cap** x 56 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
		4,721 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	351.10'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 351.10' / 350.55' S= 0.0275 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	352.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	353.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	350.00'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.09 cfs @ 12.33 hrs HW=353.14' (Free Discharge)
└**4=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=1.07 cfs @ 12.32 hrs HW=353.14' (Free Discharge)
└**1=Culvert** (Passes 1.07 cfs of 4.69 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.23 cfs @ 4.60 fps)
  └**3=Sharp-Crested Rectangular Weir** (Weir Controls 0.85 cfs @ 1.22 fps)

Pond INF-02: Infiltration-02 - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 +Cap (ADS StormTech® DC-780 with cap length)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

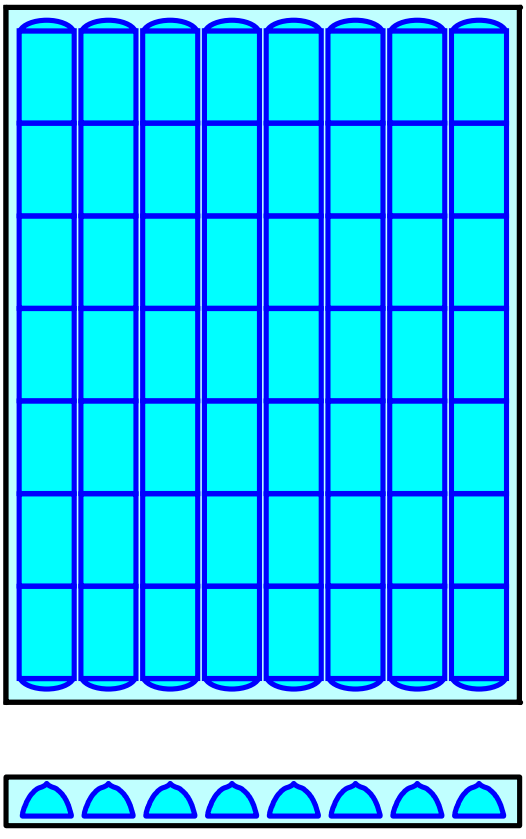
7 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 51.46' Row Length +12.0" End Stone x 2 = 53.46' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

56 Chambers x 46.2 cf = 2,589.4 cf Chamber Storage

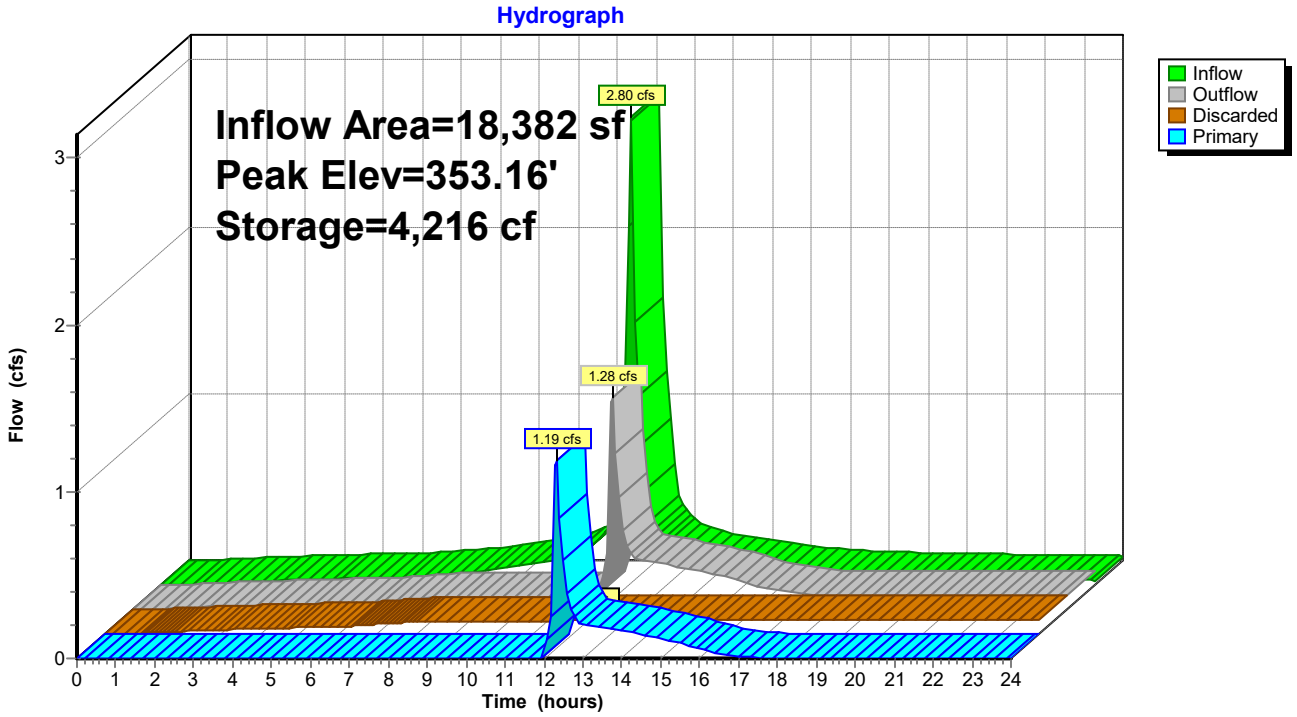
7,918.3 cf Field - 2,589.4 cf Chambers = 5,328.9 cf Stone x 40.0% Voids = 2,131.6 cf Stone Storage

Chamber Storage + Stone Storage = 4,720.9 cf = 0.108 af
Overall Storage Efficiency = 59.6%
Overall System Size = 53.46' x 39.50' x 3.75'

56 Chambers
293.3 cy Field
197.4 cy Stone



Pond INF-02: Infiltration-02



Summary for Pond SF-01: Sand Filter-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 6.49" for 50 YEAR event
Inflow = 2.59 cfs @ 12.08 hrs, Volume= 10,577 cf
Outflow = 1.79 cfs @ 12.20 hrs, Volume= 10,513 cf, Atten= 31%, Lag= 7.4 min
Discarded = 0.01 cfs @ 12.20 hrs, Volume= 338 cf
Primary = 1.78 cfs @ 12.20 hrs, Volume= 10,175 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 349.99' @ 12.20 hrs Surf.Area= 654 sf Storage= 781 cf

Plug-Flow detention time= 9.6 min calculated for 10,513 cf (99% of inflow)
Center-of-Mass det. time= 5.6 min (768.5 - 762.9)

Volume	Invert	Avail.Storage	Storage Description
#1	345.17'	300 cf	**Sand Filter (Conic)** Listed below (Recalc) 749 cf Overall x 40.0% Voids
#2	348.50'	2,112 cf	**Sand Filter (Conic)** Listed below (Recalc)
		2,412 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
345.17	225	0	0	225
348.50	225	749	749	402

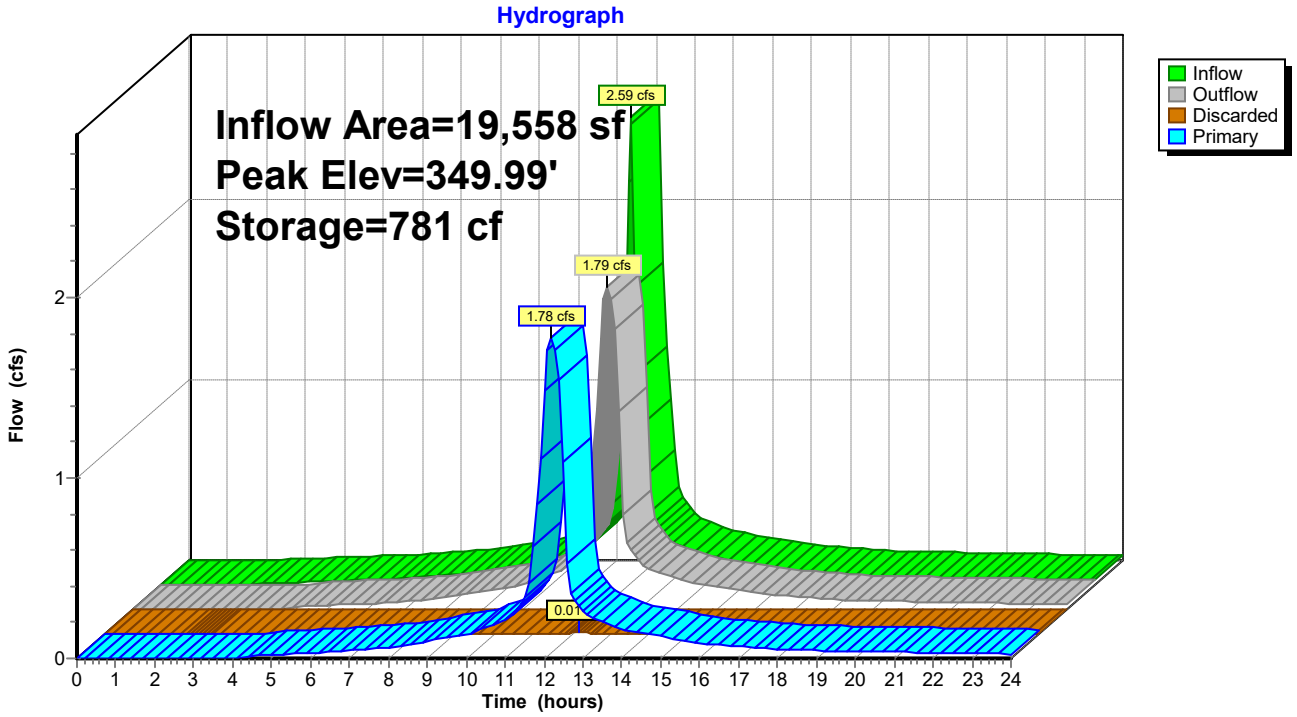
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
348.50	225	0	0	225
349.00	287	128	128	293
350.00	430	356	484	451
351.00	599	512	996	638
352.00	793	694	1,690	853
352.50	899	423	2,112	971

Device	Routing	Invert	Outlet Devices
#1	Discarded	345.17'	**0.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	345.67'	**6.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 345.67' / 345.57' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.20 hrs HW=349.99' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=1.78 cfs @ 12.20 hrs HW=349.99' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 1.78 cfs @ 9.05 fps)

Pond SF-01: Sand Filter-01



Summary for Pond SF-02: Sand Filter 02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 5.79" for 50 YEAR event
Inflow = 6.49 cfs @ 12.08 hrs, Volume= 25,415 cf
Outflow = 2.40 cfs @ 12.39 hrs, Volume= 25,264 cf, Atten= 63%, Lag= 18.7 min
Discarded = 0.11 cfs @ 12.39 hrs, Volume= 1,931 cf
Primary = 2.30 cfs @ 12.39 hrs, Volume= 23,333 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 351.53' @ 12.39 hrs Surf.Area= 2,286 sf Storage= 5,263 cf

Plug-Flow detention time= 19.8 min calculated for 25,159 cf (99% of inflow)
Center-of-Mass det. time= 16.1 min (800.8 - 784.7)

Volume	Invert	Avail.Storage	Storage Description
#1	344.17'	799 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 1,998 cf Overall x 40.0% Voids
#2	347.50'	7,308 cf	**Sand Filter (Prismatic)** Listed below (Recalc)
		8,107 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.17	600	0	0
347.50	600	1,998	1,998

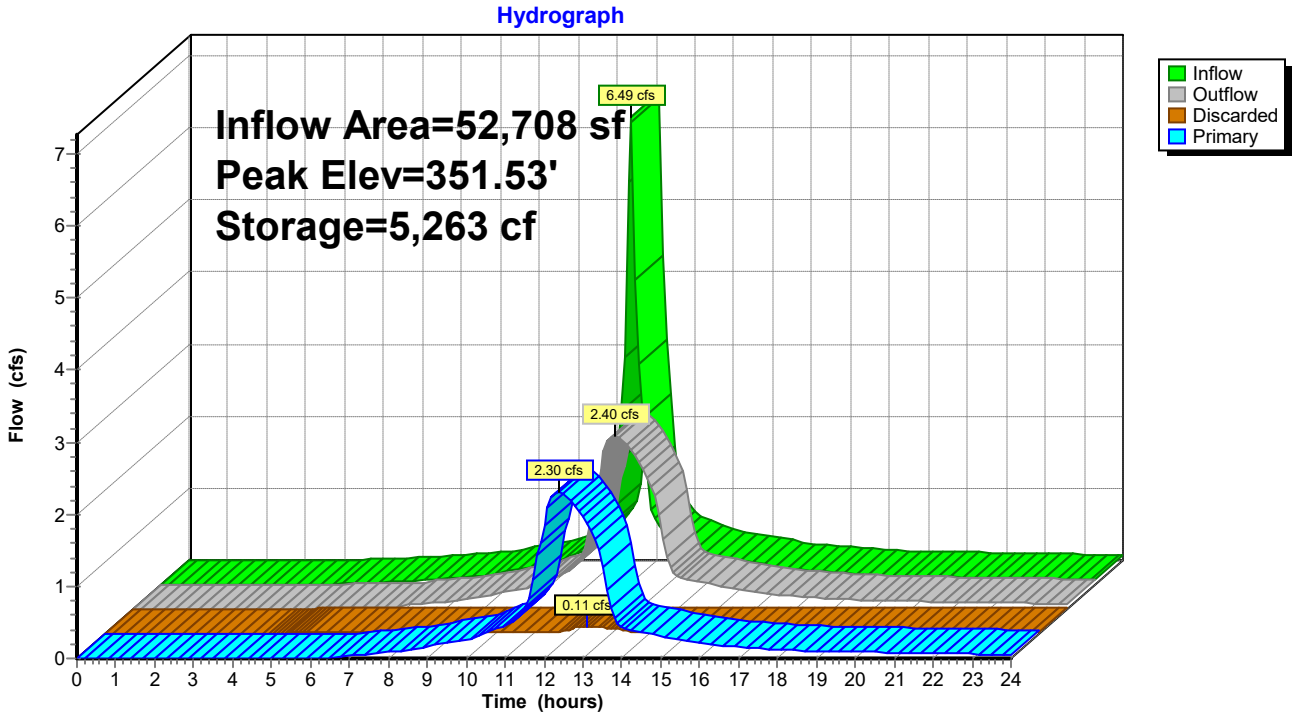
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.50	600	0	0
348.00	712	328	328
349.00	955	834	1,162
350.00	1,224	1,090	2,251
351.00	1,518	1,371	3,622
352.00	1,837	1,678	5,300
353.00	2,180	2,009	7,308

Device	Routing	Invert	Outlet Devices
#1	Primary	344.67'	**6.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 344.67' / 344.47' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Discarded	344.17'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.11 cfs @ 12.39 hrs HW=351.52' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.11 cfs)

Primary OutFlow Max=2.30 cfs @ 12.39 hrs HW=351.52' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 2.30 cfs @ 11.70 fps)

Pond SF-02: Sand Filter 02

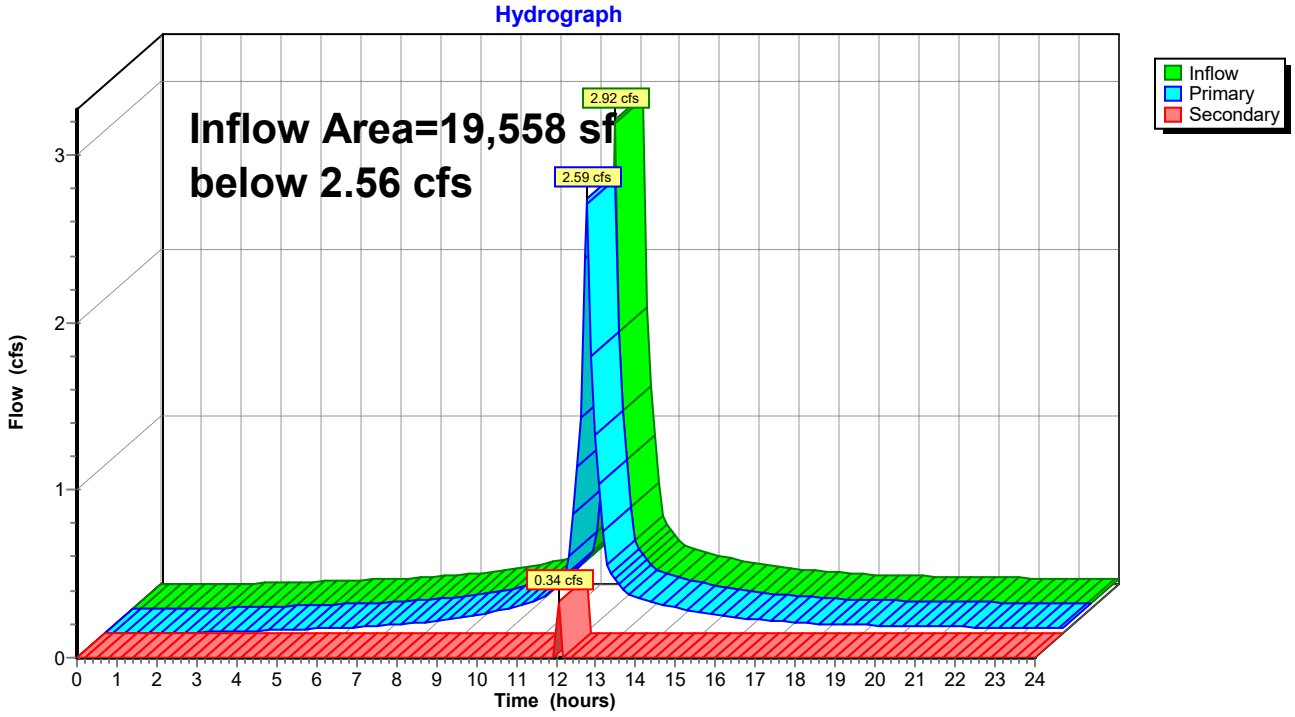


Summary for Link D-01: Diversion-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 6.56" for 50 YEAR event
Inflow = 2.92 cfs @ 12.08 hrs, Volume= 10,699 cf
Primary = 2.59 cfs @ 12.08 hrs, Volume= 10,577 cf, Atten= 11%, Lag= 0.0 min
Secondary = 0.34 cfs @ 12.10 hrs, Volume= 122 cf

Primary outflow = Inflow below 2.56 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-01: Diversion-01

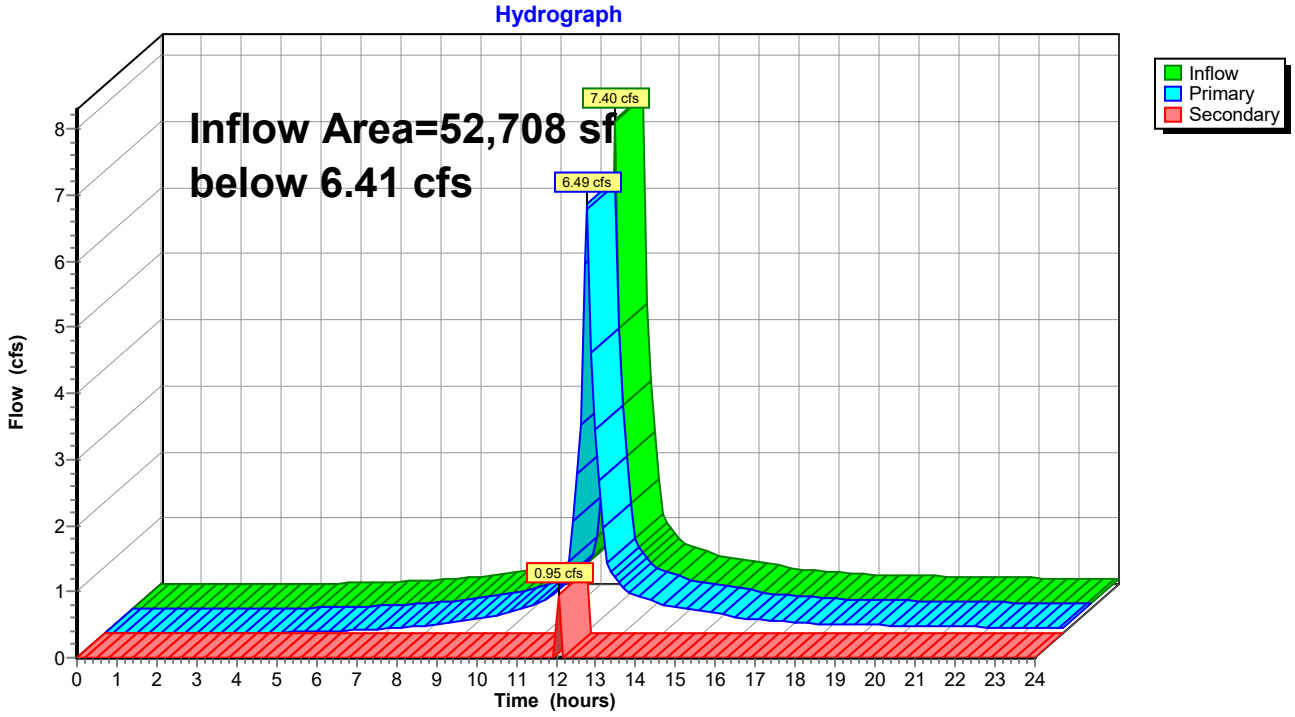


Summary for Link D-02: Diversion-02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 5.86" for 50 YEAR event
Inflow = 7.40 cfs @ 12.09 hrs, Volume= 25,756 cf
Primary = 6.49 cfs @ 12.08 hrs, Volume= 25,415 cf, Atten= 12%, Lag= 0.0 min
Secondary = 0.95 cfs @ 12.10 hrs, Volume= 341 cf

Primary outflow = Inflow below 6.41 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-02: Diversion-02

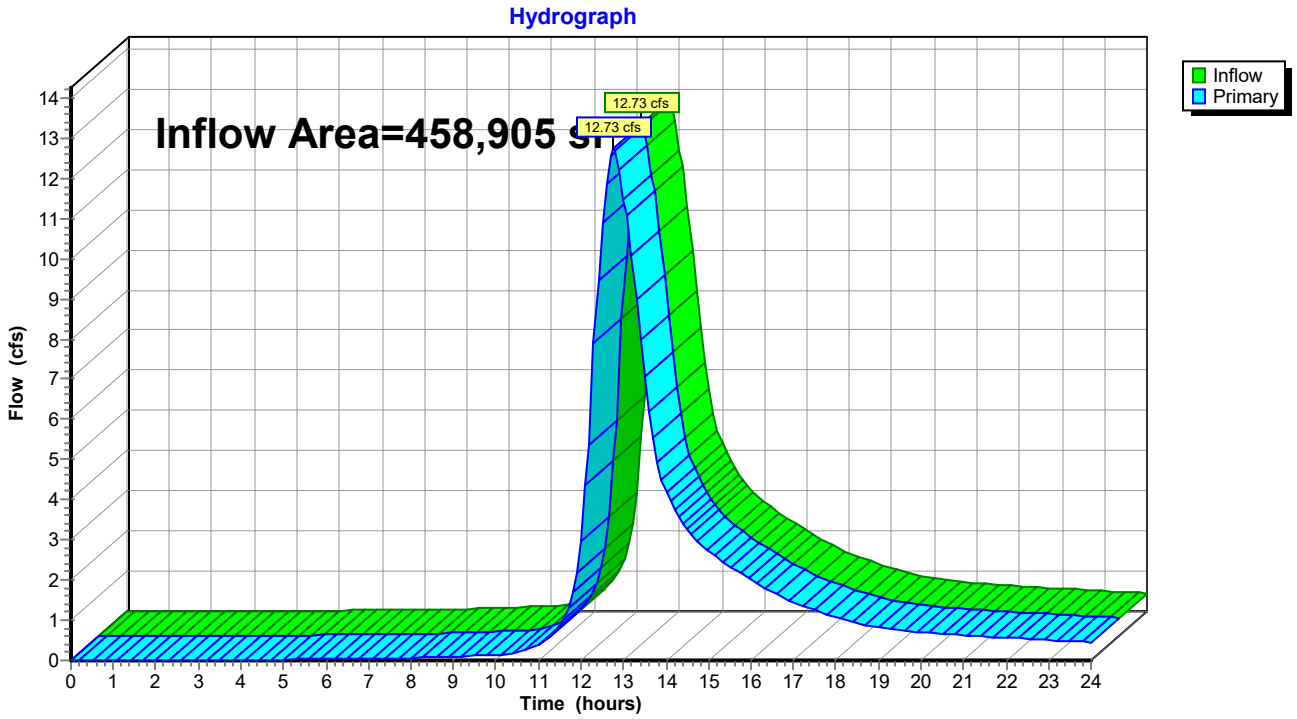


Summary for Link DP-A: Design Point A

Inflow Area = 458,905 sf, 4.01% Impervious, Inflow Depth > 2.93" for 50 YEAR event
Inflow = 12.73 cfs @ 12.77 hrs, Volume= 112,035 cf
Primary = 12.73 cfs @ 12.77 hrs, Volume= 112,035 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link DP-A: Design Point A



Summary for Subcatchment PR-WS-01: PR-WS-01

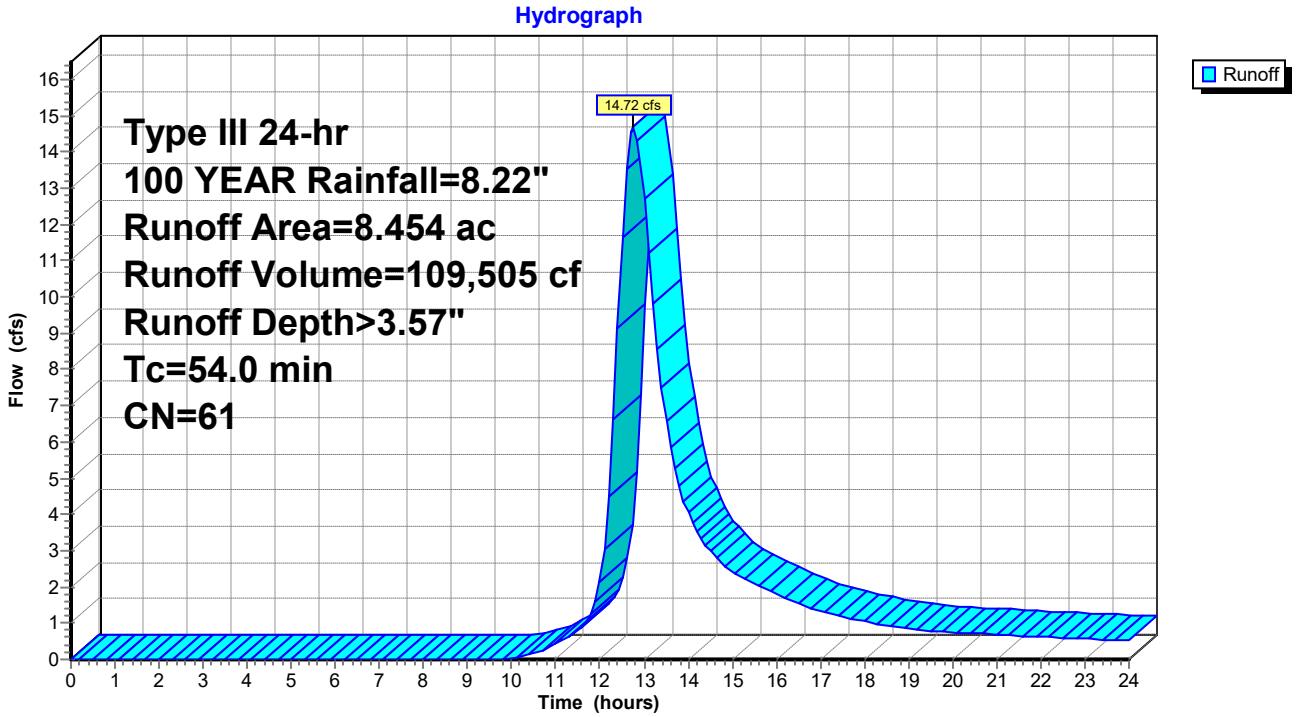
Runoff = 14.72 cfs @ 12.76 hrs, Volume= 109,505 cf, Depth> 3.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	8.454	61	
	8.454		100.00% Pervious Area

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

Subcatchment PR-WS-01: PR-WS-01



Summary for Subcatchment PR-WS-02: PR-WS-02

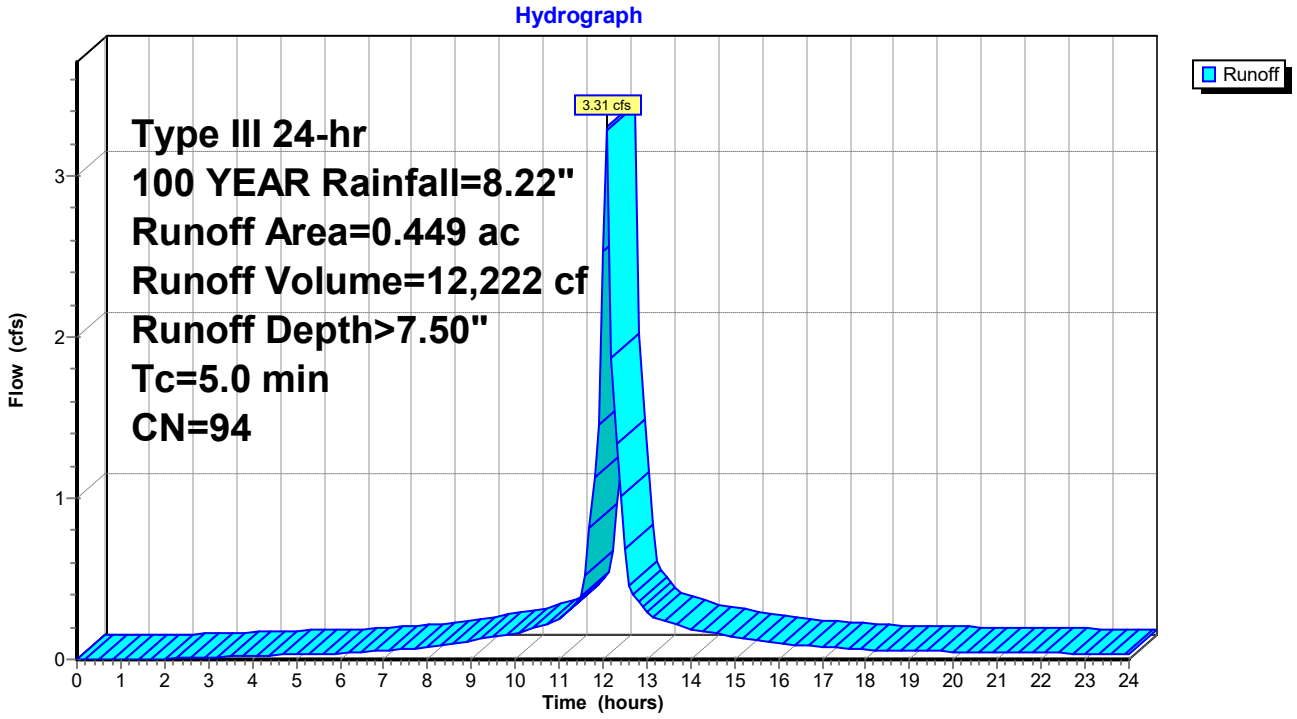
Runoff = 3.31 cfs @ 12.08 hrs, Volume= 12,222 cf, Depth> 7.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	0.449	94	
	0.449		100.00% Pervious Area

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

Subcatchment PR-WS-02: PR-WS-02



Summary for Subcatchment PR-WS-03: PR-WS-03

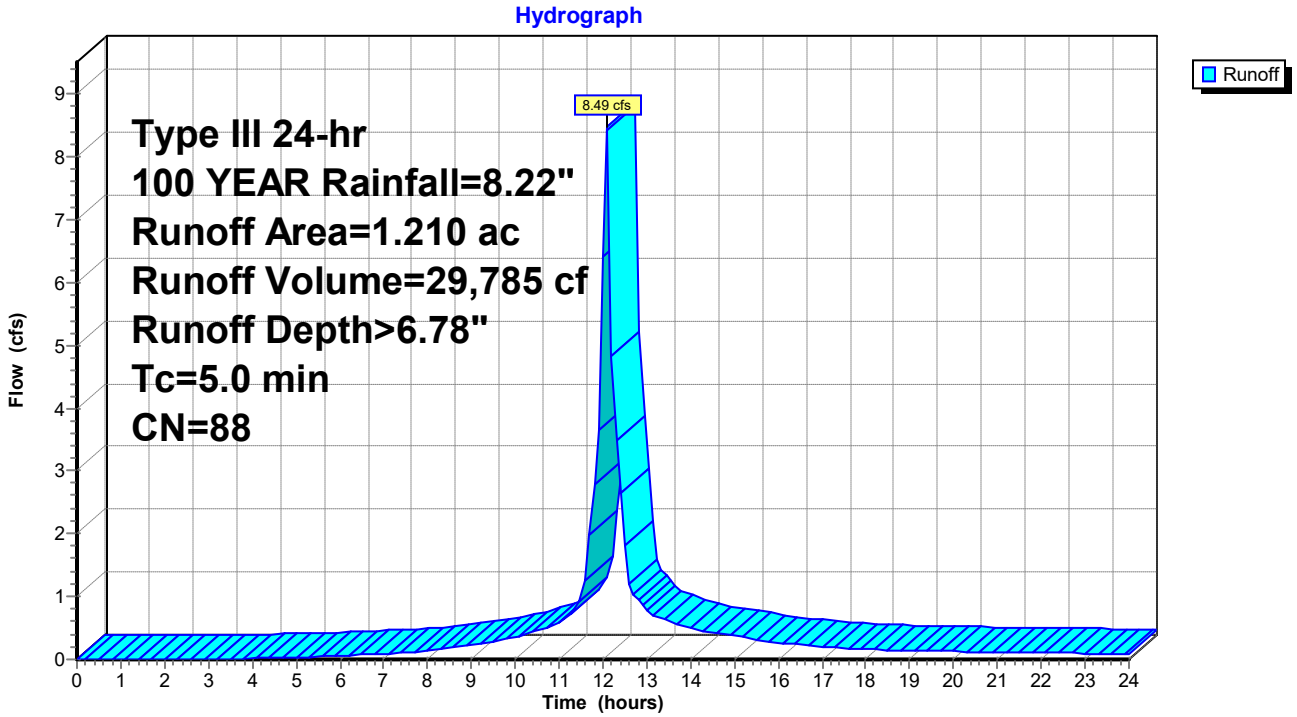
Runoff = 8.49 cfs @ 12.09 hrs, Volume= 29,785 cf, Depth> 6.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	1.210	88	
	1.210		100.00% Pervious Area

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

Subcatchment PR-WS-03: PR-WS-03



Summary for Subcatchment PR-WS-04: PR-WS-04

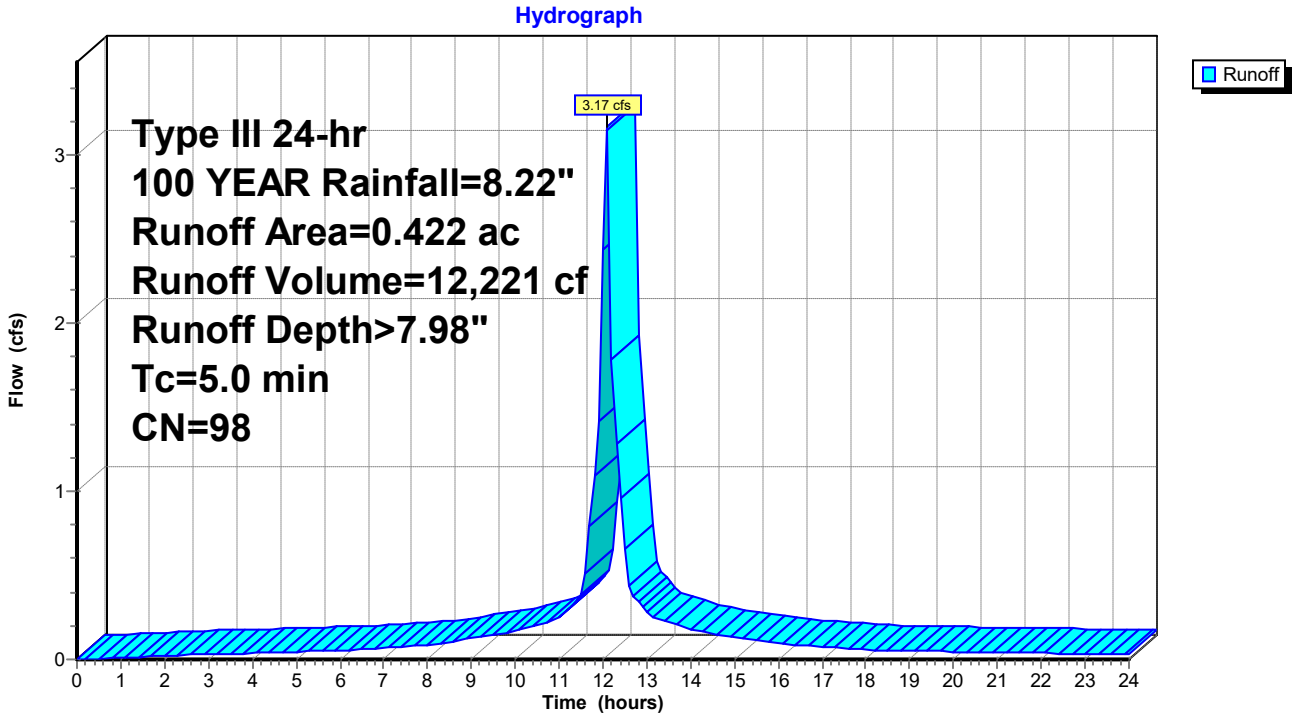
Runoff = 3.17 cfs @ 12.08 hrs, Volume= 12,221 cf, Depth> 7.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	0.422	98	
	0.422		100.00% Impervious Area

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

Subcatchment PR-WS-04: PR-WS-04



Summary for Subcatchment PR-WS-05: Design Point B

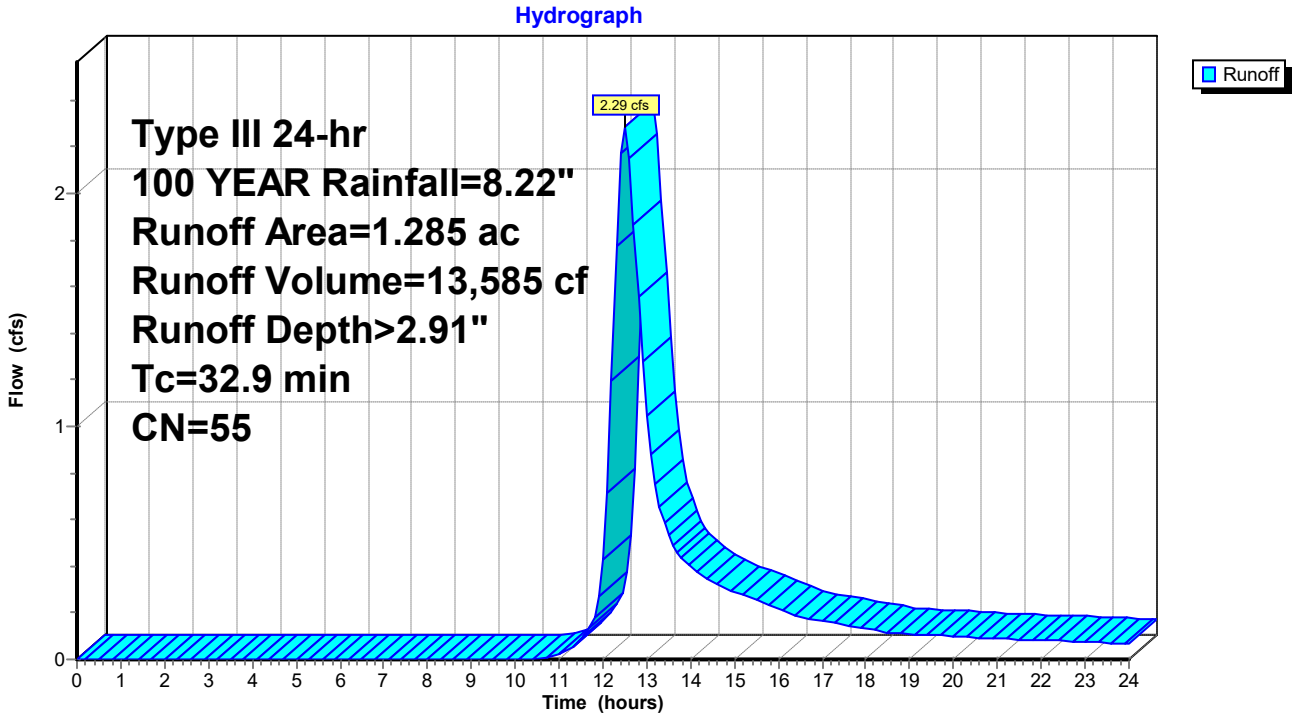
Runoff = 2.29 cfs @ 12.50 hrs, Volume= 13,585 cf, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs
Type III 24-hr 100 YEAR Rainfall=8.22"

	Area (ac)	CN	Description
*	1.285	55	
	1.285		100.00% Pervious Area

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

Subcatchment PR-WS-05: Design Point B



Summary for Pond INF-01: Infiltration-01

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 6.28" for 100 YEAR event
Inflow = 4.20 cfs @ 12.10 hrs, Volume= 27,564 cf
Outflow = 2.13 cfs @ 13.00 hrs, Volume= 18,745 cf, Atten= 49%, Lag= 53.9 min
Discarded = 0.10 cfs @ 13.00 hrs, Volume= 4,539 cf
Primary = 2.04 cfs @ 13.00 hrs, Volume= 14,205 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 346.47' @ 13.00 hrs Surf.Area= 2,064 sf Storage= 12,634 cf

Plug-Flow detention time= 189.6 min calculated for 18,745 cf (68% of inflow)
Center-of-Mass det. time= 106.6 min (901.8 - 795.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	339.00'	413 cf	**20.69'W x 99.77'L x 9.67'H Field A** 19,952 cf Overall - 18,920 cf Embedded = 1,032 cf x 40.0% Voids
#2A	339.50'	15,078 cf	**StormTrap ST1 DoubleTrap 8-0** x 21 Inside #1 Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf 3 Rows adjusted for 630.1 cf perimeter wall 20.69' x 98.44' Core + 0.00' x 0.67' Border = 20.69' x 99.77' System
#3	344.65'	126 cf	**4.00'D x 10.00'H Outlet Control Structure** -Impervious
		15,616 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	339.00'	**0.750 in/hr Exfiltration over Horizontal area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	344.46'	**15.0" Round RCP_Round 15"** L= 32.6' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 344.46' / 344.30' S= 0.0049 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.23 sf
#3	Device 2	344.46'	**4.0" Vert. Orifice/Grate** C= 0.600
#4	Device 2	346.25'	**5.0' long x 1.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.10 cfs @ 13.00 hrs HW=346.47' (Free Discharge)
└**1=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=1.98 cfs @ 13.00 hrs HW=346.47' (Free Discharge)
└**2=RCP_Round 15"** (Passes 1.98 cfs of 5.49 cfs potential flow)
  ├**3=Orifice/Grate** (Orifice Controls 0.57 cfs @ 6.54 fps)
  └**4=Broad-Crested Rectangular Weir** (Weir Controls 1.41 cfs @ 1.27 fps)

Pond INF-01: Infiltration-01 - Chamber Wizard Field A

Chamber Model = StormTrap ST1 DoubleTrap 8-0 (StormTrap ST1 DoubleTrap® Type I/III/VI)
Inside= 82.7"W x 96.0"H => 51.06 sf x 14.06'L = 718.0 cf
Outside= 82.7"W x 110.0"H => 63.21 sf x 14.06'L = 888.9 cf
3 Rows adjusted for 630.1 cf perimeter wall

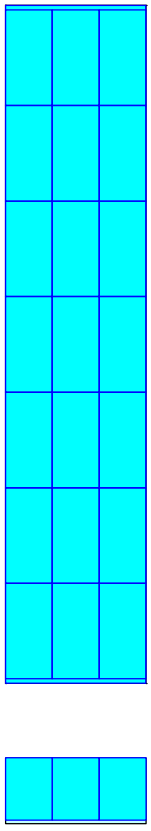
7 Chambers/Row x 14.06' Long = 98.44' Row Length +8.0" Border x 2 = 99.77' Base Length
3 Rows x 82.7" Wide = 20.69' Base Width
6.0" Base + 110.0" Chamber Height = 9.67' Field Height

24.0 cf Sidewall x 7 x 2 + 49.0 cf Endwall x 3 x 2 = 630.1 cf Perimeter Wall
21 Chambers x 718.0 cf - 630.1 cf Perimeter wall = 14,448.0 cf Chamber Storage
21 Chambers x 888.9 cf + 252.8 cf Border = 18,920.1 cf Displacement

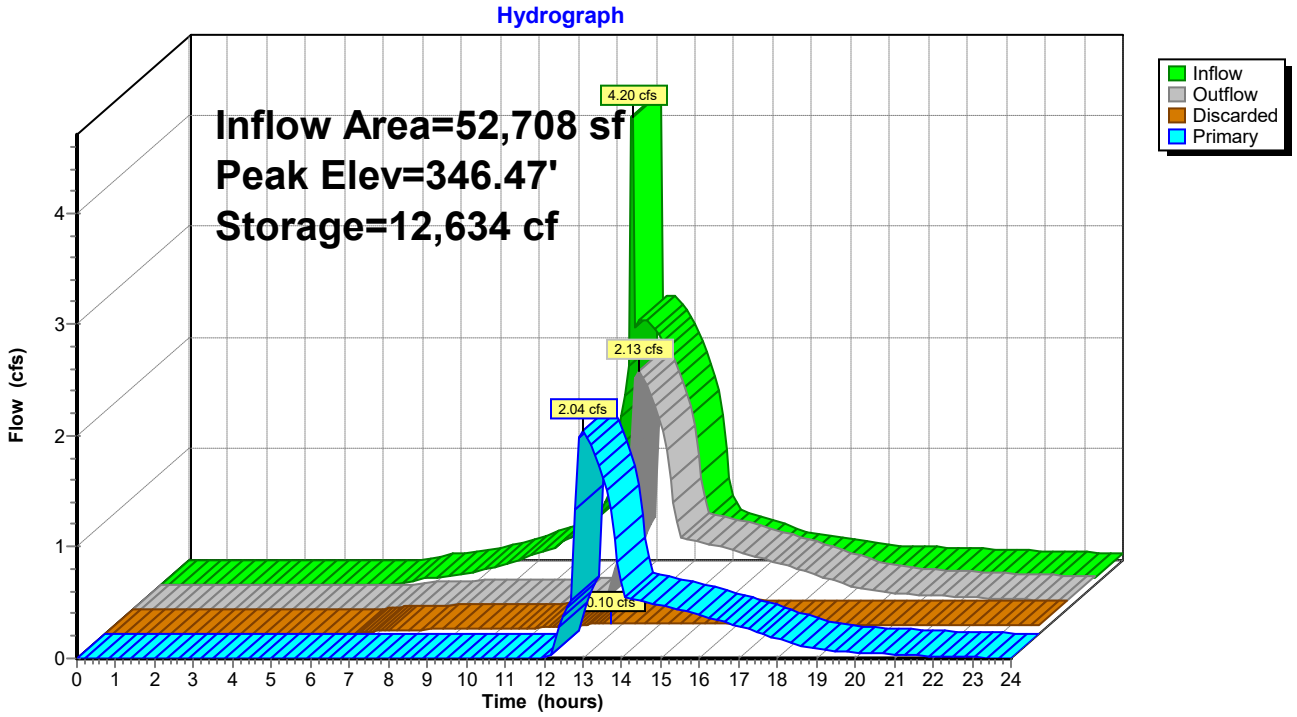
19,952.1 cf Field - 18,920.1 cf Chambers = 1,032.0 cf Stone x 40.0% Voids = 412.8 cf Stone Storage

Chamber Storage + Stone Storage = 14,860.8 cf = 0.341 af
Overall Storage Efficiency = 74.5%
Overall System Size = 99.77' x 20.69' x 9.67'

21 Chambers (plus border)
739.0 cy Field
38.2 cy Stone



Pond INF-01: Infiltration-01



Summary for Pond INF-02: Infiltration-02

Inflow Area = 18,382 sf,100.00% Impervious, Inflow Depth > 7.98" for 100 YEAR event
Inflow = 3.17 cfs @ 12.08 hrs, Volume= 12,221 cf
Outflow = 2.20 cfs @ 12.22 hrs, Volume= 10,078 cf, Atten= 31%, Lag= 8.2 min
Discarded = 0.09 cfs @ 12.23 hrs, Volume= 5,782 cf
Primary = 2.11 cfs @ 12.22 hrs, Volume= 4,296 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 353.25' @ 12.23 hrs Surf.Area= 2,112 sf Storage= 4,302 cf

Plug-Flow detention time= 162.0 min calculated for 10,078 cf (82% of inflow)
Center-of-Mass det. time= 89.8 min (829.6 - 739.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	350.00'	2,132 cf	**39.50'W x 53.46'L x 3.75'H Field A** 7,918 cf Overall - 2,589 cf Embedded = 5,329 cf x 40.0% Voids
#2A	350.75'	2,589 cf	**ADS_StormTech DC-780 +Cap** x 56 Inside #1 Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 8 Rows of 7 Chambers
		4,721 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	351.10'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 351.10' / 350.55' S= 0.0275 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	352.10'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	353.00'	**5.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#4	Discarded	350.00'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.09 cfs @ 12.23 hrs HW=353.21' (Free Discharge)
└**4=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=1.88 cfs @ 12.22 hrs HW=353.22' (Free Discharge)
└**1=Culvert** (Passes 1.88 cfs of 4.81 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.24 cfs @ 4.80 fps)
  └**3=Sharp-Crested Rectangular Weir** (Weir Controls 1.64 cfs @ 1.52 fps)

Pond INF-02: Infiltration-02 - Chamber Wizard Field A

Chamber Model = ADS_StormTech DC-780 +Cap (ADS StormTech® DC-780 with cap length)
Effective Size= 45.4"W x 30.0"H => 6.49 sf x 7.12'L = 46.2 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

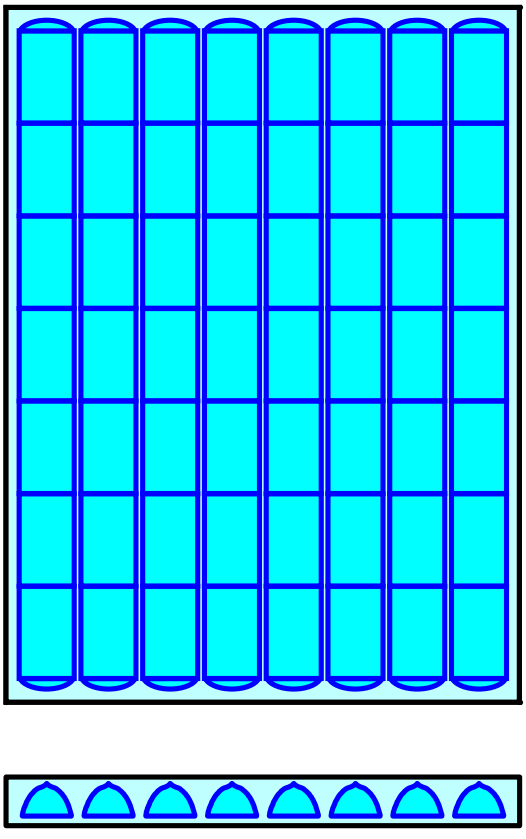
7 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 51.46' Row Length +12.0" End Stone x 2 = 53.46' Base Length
8 Rows x 51.0" Wide + 6.0" Spacing x 7 + 12.0" Side Stone x 2 = 39.50' Base Width
9.0" Base + 30.0" Chamber Height + 6.0" Cover = 3.75' Field Height

56 Chambers x 46.2 cf = 2,589.4 cf Chamber Storage

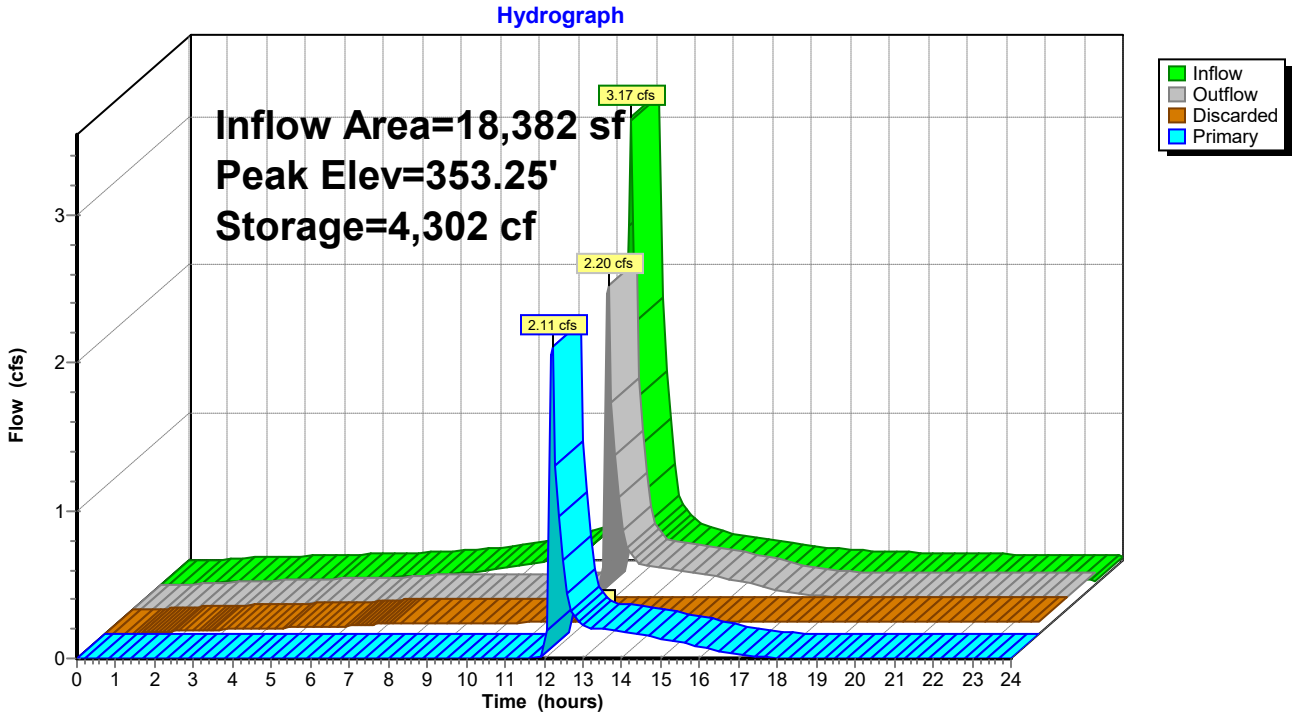
7,918.3 cf Field - 2,589.4 cf Chambers = 5,328.9 cf Stone x 40.0% Voids = 2,131.6 cf Stone Storage

Chamber Storage + Stone Storage = 4,720.9 cf = 0.108 af
Overall Storage Efficiency = 59.6%
Overall System Size = 53.46' x 39.50' x 3.75'

56 Chambers
293.3 cy Field
197.4 cy Stone



Pond INF-02: Infiltration-02



Summary for Pond SF-01: Sand Filter-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 7.34" for 100 YEAR event
Inflow = 2.64 cfs @ 12.05 hrs, Volume= 11,960 cf
Outflow = 1.86 cfs @ 12.21 hrs, Volume= 11,905 cf, Atten= 30%, Lag= 9.6 min
Discarded = 0.01 cfs @ 12.21 hrs, Volume= 346 cf
Primary = 1.84 cfs @ 12.21 hrs, Volume= 11,559 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 350.28' @ 12.21 hrs Surf.Area= 699 sf Storage= 910 cf

Plug-Flow detention time= 8.5 min calculated for 11,856 cf (99% of inflow)
Center-of-Mass det. time= 5.6 min (765.9 - 760.4)

Volume	Invert	Avail.Storage	Storage Description
#1	345.17'	300 cf	**Sand Filter (Conic)** Listed below (Recalc) 749 cf Overall x 40.0% Voids
#2	348.50'	2,112 cf	**Sand Filter (Conic)** Listed below (Recalc)
		2,412 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
345.17	225	0	0	225
348.50	225	749	749	402

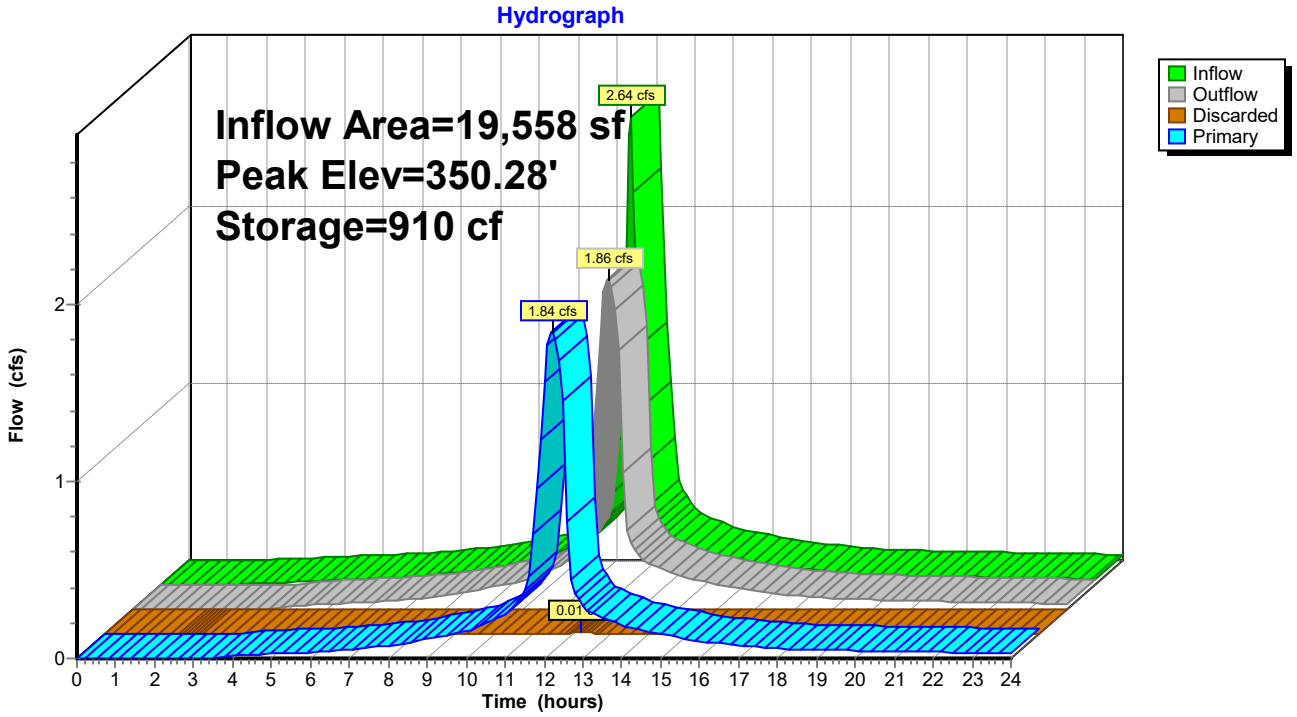
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
348.50	225	0	0	225
349.00	287	128	128	293
350.00	430	356	484	451
351.00	599	512	996	638
352.00	793	694	1,690	853
352.50	899	423	2,112	971

Device	Routing	Invert	Outlet Devices
#1	Discarded	345.17'	**0.750 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'
#2	Primary	345.67'	**6.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 345.67' / 345.57' S= 0.0050 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf

Discarded OutFlow Max=0.01 cfs @ 12.21 hrs HW=350.25' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=1.84 cfs @ 12.21 hrs HW=350.25' (Free Discharge)
↑—**2=Culvert** (Barrel Controls 1.84 cfs @ 9.35 fps)

Pond SF-01: Sand Filter-01



Summary for Pond SF-02: Sand Filter 02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 6.61" for 100 YEAR event
Inflow = 6.76 cfs @ 12.05 hrs, Volume= 29,052 cf
Outflow = 2.51 cfs @ 12.42 hrs, Volume= 28,886 cf, Atten= 63%, Lag= 22.0 min
Discarded = 0.12 cfs @ 12.42 hrs, Volume= 2,055 cf
Primary = 2.39 cfs @ 12.42 hrs, Volume= 26,830 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs / 2
Peak Elev= 352.06' @ 12.42 hrs Surf.Area= 2,457 sf Storage= 6,209 cf

Plug-Flow detention time= 21.4 min calculated for 28,886 cf (99% of inflow)
Center-of-Mass det. time= 17.7 min (799.2 - 781.5)

Volume	Invert	Avail.Storage	Storage Description
#1	344.17'	799 cf	**Sand Filter (Prismatic)** Listed below (Recalc) 1,998 cf Overall x 40.0% Voids
#2	347.50'	7,308 cf	**Sand Filter (Prismatic)** Listed below (Recalc)
		8,107 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
344.17	600	0	0
347.50	600	1,998	1,998

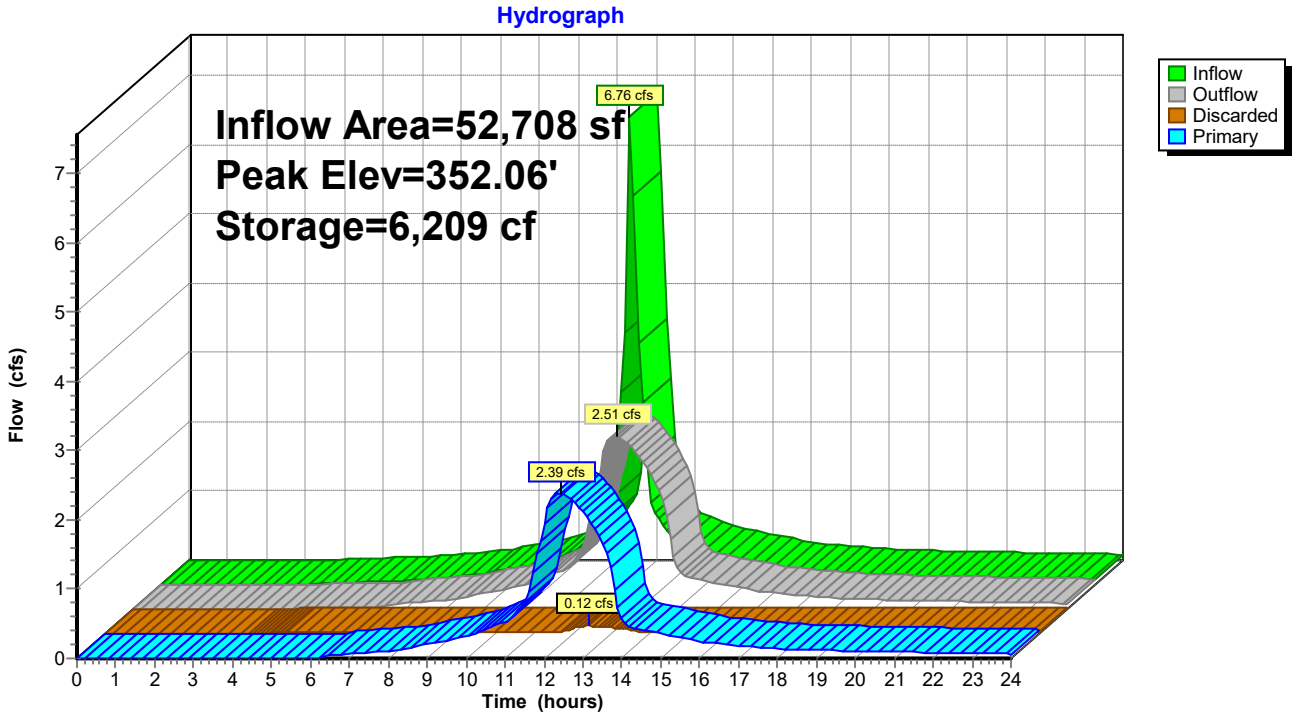
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
347.50	600	0	0
348.00	712	328	328
349.00	955	834	1,162
350.00	1,224	1,090	2,251
351.00	1,518	1,371	3,622
352.00	1,837	1,678	5,300
353.00	2,180	2,009	7,308

Device	Routing	Invert	Outlet Devices
#1	Primary	344.67'	**6.0" Round Culvert** L= 20.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 344.67' / 344.47' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.20 sf
#2	Discarded	344.17'	**1.500 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 334.50'

Discarded OutFlow Max=0.12 cfs @ 12.42 hrs HW=352.05' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.12 cfs)

Primary OutFlow Max=2.39 cfs @ 12.42 hrs HW=352.05' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 2.39 cfs @ 12.16 fps)

Pond SF-02: Sand Filter 02

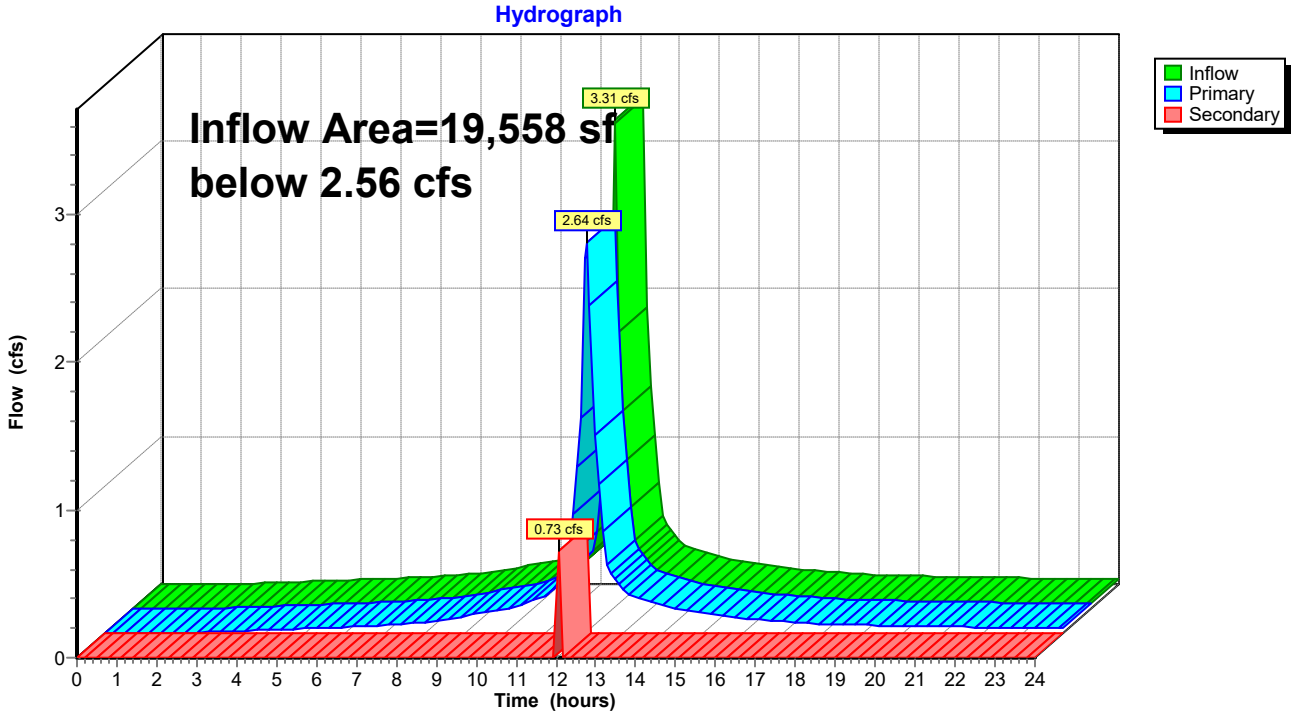


Summary for Link D-01: Diversion-01

Inflow Area = 19,558 sf, 0.00% Impervious, Inflow Depth > 7.50" for 100 YEAR event
Inflow = 3.31 cfs @ 12.08 hrs, Volume= 12,222 cf
Primary = 2.64 cfs @ 12.05 hrs, Volume= 11,960 cf, Atten= 20%, Lag= 0.0 min
Secondary = 0.73 cfs @ 12.10 hrs, Volume= 262 cf

Primary outflow = Inflow below 2.56 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-01: Diversion-01

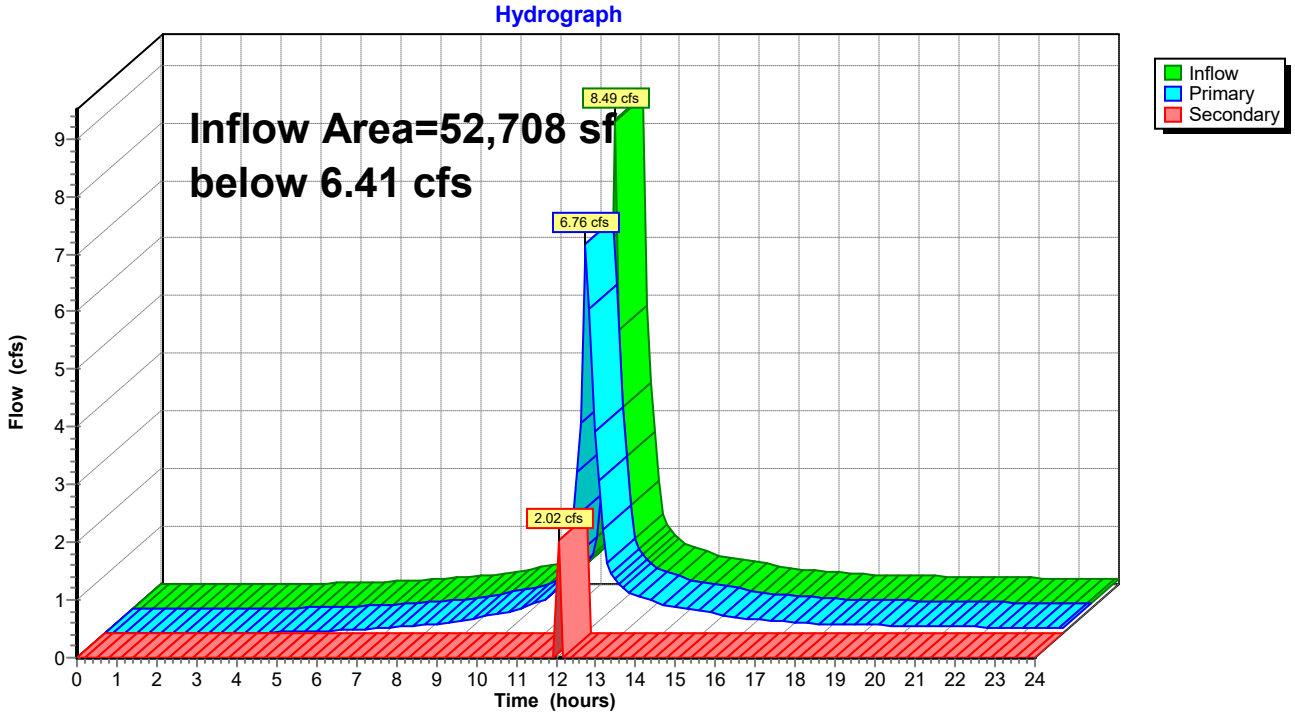


Summary for Link D-02: Diversion-02

Inflow Area = 52,708 sf, 0.00% Impervious, Inflow Depth > 6.78" for 100 YEAR event
Inflow = 8.49 cfs @ 12.09 hrs, Volume= 29,785 cf
Primary = 6.76 cfs @ 12.05 hrs, Volume= 29,052 cf, Atten= 20%, Lag= 0.0 min
Secondary = 2.02 cfs @ 12.10 hrs, Volume= 733 cf

Primary outflow = Inflow below 6.41 cfs, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link D-02: Diversion-02

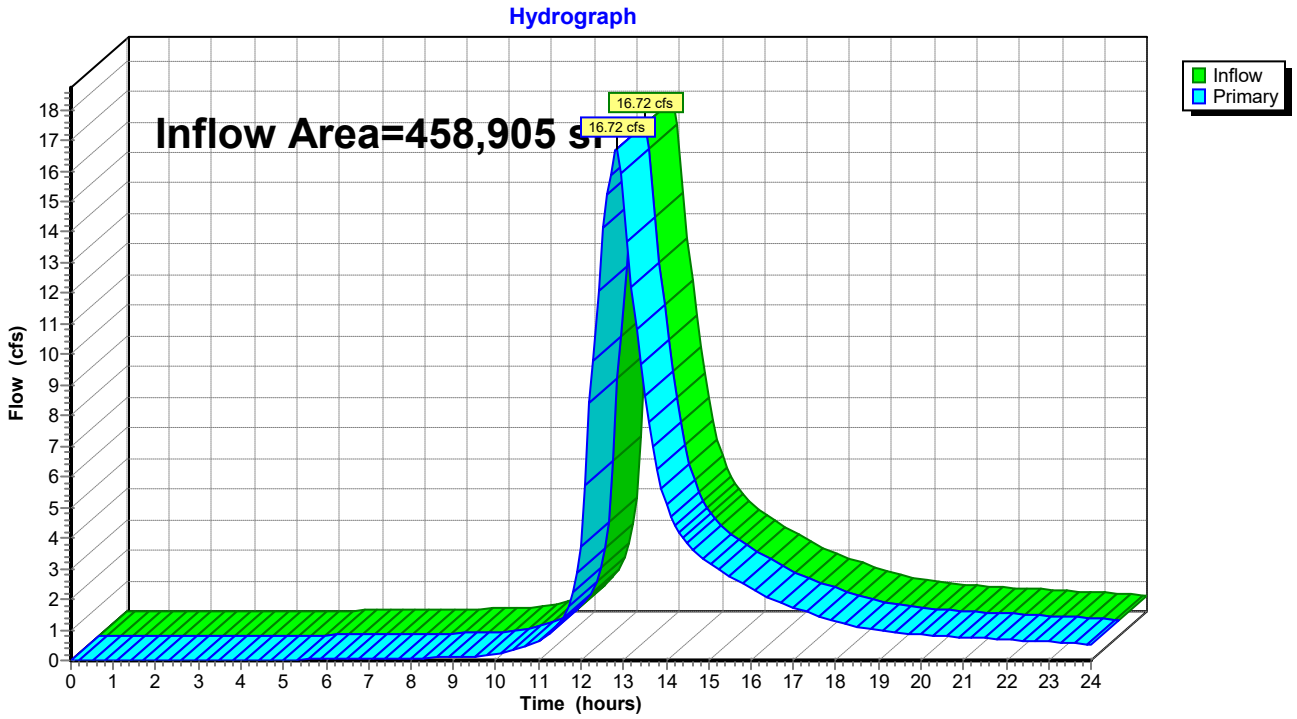


Summary for Link DP-A: Design Point A

Inflow Area = 458,905 sf, 4.01% Impervious, Inflow Depth > 3.66" for 100 YEAR event
Inflow = 16.72 cfs @ 12.84 hrs, Volume= 139,828 cf
Primary = 16.72 cfs @ 12.84 hrs, Volume= 139,828 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.10 hrs

Link DP-A: Design Point A



Tighe&Bond

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Comparative Hydrology**
Prepared By: **PAR** Checked By: **APW**
Date: **November 24, 2020**

Design Point A

Peak Flow	2 YR	10 YR	25 YR	50 YR	100 YR
Q_{pk} - Existing	1.700	6.660	10.570	13.700	16.850
Q_{pk} - Proposed	1.700	6.160	9.860	12.730	16.720
Reduction in Peak Flow	**0.00%**	**7.51%**	**6.72%**	**7.08%**	**0.77%**

Volumetric Runoff	2 YR	10 YR	25 YR	50 YR	100 YR
Volume - Existing	21,274	62,197	93,370	118,445	147,341
Volume - Proposed	19,872	57,345	87,796	112,035	139,828
Reduction in Volume	**6.59%**	**7.80%**	**5.97%**	**5.41%**	**5.10%**

Design Point B

Peak Flow	2 YR	10 YR	25 YR	50 YR	100 YR
Q_{pk} - Existing	0.130	0.760	1.310	1.770	2.300
Q_{pk} - Proposed	0.130	0.760	1.310	1.770	2.300
Reduction in Peak Flow	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**

Volumetric Runoff	2 YR	10 YR	25 YR	50 YR	100 YR
Volume - Existing	1,491	5,382	8,549	11,166	14,235
Volume - Proposed	1,491	5,382	8,549	11,166	14,235
Reduction in Volume	**0.00%**	**0.00%**	**0.00%**	**0.00%**	**0.00%**

APPENDIX E

NORTHROP ROAD

PROPOSED CULVERT

YD-01

YD-02

YD-03

ROOF 02

YD-04

YD-05

YD-06

CB-01

CB-02

CB-03

CB-04

ROOF 01

YD-08

YD-09

YD-10

YD-11

YD-07

A

B

C

D

LEGEND:

WATERSHED BOUNDARY

Tc FLOW PATH A B

0 80' 160'

SCALE: 1" = 80'

CONNECTICUT PROTON THERAPY CENTER
WALLINGFORD, CT

INLET WATERSHED MAP

DATE: 10/16/2020
SCALE: 1" = 80'
FIGURE: WM-03

Tighe&Bond

Nov 25, 2020-2:13pm Plotted By: PAReady
Tighe & Bond, Inc. J:\P\P5050 Proton International\004 Northrop Road Facility - Civil\Design\Drainage\P5050-004-Inlet Watershed.dwg

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **CB-01**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.382	0.90	0.344
Landscaped and Lawns	0.047	0.30	0.014
	0.429		0.358

Weighted C: **0.83**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-02**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.315	0.90	0.284
Landscaped and Lawns	0.033	0.30	0.010
	0.348		0.293

Weighted C: **0.84**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **CB-03**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.160	0.90	0.144
Landscaped and Lawns	0.112	0.30	0.034
	0.272		0.177

Weighted C: **0.65**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **CB-04**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.410	0.90	0.369
Landscaped and Lawns	0.148	0.30	0.044
	0.557		0.413

Weighted C: **0.74**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **YD-01**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.032	0.30	0.010
	0.032		0.010

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **YD-02**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.027	0.30	0.008
	0.027		0.008

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **YD-03**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.022	0.30	0.007
	0.022		0.007

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **YD-04**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.006	0.90	0.006
Landscaped and Lawns	0.015	0.30	0.005
	0.022		0.010

Weighted C: **0.47**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **YD-05**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.009	0.90	0.008
Landscaped and Lawns	0.023	0.30	0.007
	0.032		0.015

Weighted C: **0.47**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **YD-06**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.008	0.90	0.008
Landscaped and Lawns	0.020	0.30	0.006
	0.029		0.014

Weighted C: **0.47**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **YD-07**
Location:

Cover Type	Area, ac	Coef.	A x C
Wooded	0.459	0.50	0.230
Landscaped and Lawns	1.172	0.30	0.352
	1.631		0.581

Weighted C: **0.36**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Overland

Segment	Surface "n"	Flow Length (ft.)	Slope (ft/ft)	Time (min.)
Segment A - B	0.8	150	0.06	34.0

Shallow Concentrated Flow

Segment		Slope (ft/ft)	V (ft/s)	Length (ft)	Time (min.)
Segment B - C	unpaved	0.040	3.23	263	1.4
Segment C - D	unpaved	0.027	2.65	280	1.8

Total Tc (min.) = **37.1**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **YD-08**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.034	0.30	0.010
	0.034		0.010

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **YD-09**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.197	0.30	0.059
	0.197		0.059

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **YD-10**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.129	0.30	0.039
	0.129		0.039

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **YD-11**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Landscaped and Lawns	0.040	0.30	0.012
	0.040		0.012

Weighted C: **0.30**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **ROOF-01**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.399	0.90	0.359
Landscaped and Lawns	0.000	0.30	0.000
	0.399		0.359

Weighted C: **0.90**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **ROOF-02**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.020	0.90	0.018
Landscaped and Lawns	0.000	0.30	0.000
	0.020		0.018

Weighted C: **0.90**

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = **5.0**

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Proposed C & Tc Calculations**
Prepared By: **PAR** Date: **November 16, 2020**

Designation: **NORTHROP ROAD**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.231	0.90	0.208
Landscaped and Lawns	0.000	0.30	0.000
	0.231		0.208

Weighted C: 0.90

Time of Concentration

(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Total Tc (min.) = 5.0

Note: Overland time of concentration computed using "Kinematic Wave" equation
Gutter and pipe time of concentration computed using Manning's equation

Designation: **PROPOSED CULVERT**
Location:

Cover Type	Area, ac	Coef.	A x C
Pavement	0.000	0.90	0.000
Wooded	4.234	0.50	2.117
	4.234		2.117

Weighted C: 0.50

Time of Concentration

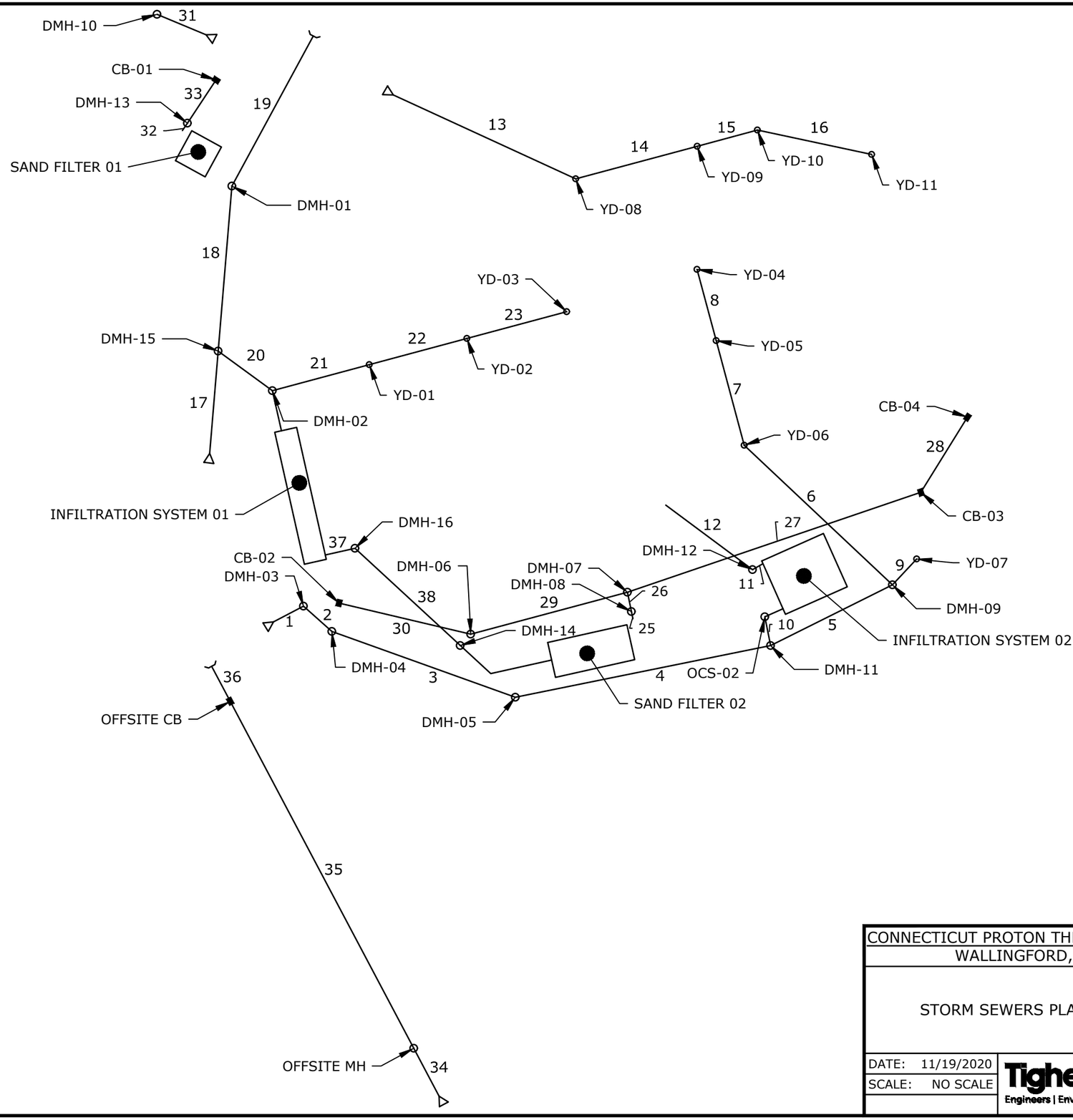
(computed in accordance with ConnDOT Drainage Manual, Sec. 6C)

Segment		Slope (ft/ft)	V (ft/s)	Length (ft)	Time (min.)
Segment C - D	paved	1	20.33	0	0.0
Segment D - E	unpaved	1	16.13	0	0.0
Segment E - F	paved	1	20.33	0	0.0

Shallow Concentrated Flow

Segment		Slope (ft/ft)	V (ft/s)	Length (ft)	Time (min.)
Segment B - C	unpaved	0.014	1.91	209	1.8
Segment C - D	unpaved	0.015	1.98	231	1.9

Total Tc = 53.0



CONNECTICUT PROTON THERAPY CENTER
WALLINGFORD, CT

STORM SEWERS PLAN VIEW

DATE: 11/19/2020
SCALE: NO SCALE

Tighe&Bond
Engineers | Environmental Specialists

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
1	Pipe - (85)	2.39	15	Cir	17.400	342.71	342.84	0.747	343.61	343.46	n/a	343.46	End	Manhole
2	Pipe - (40)	2.40	15	Cir	32.500	342.84	343.09	0.769	343.64	343.71	n/a	343.71 j	1	Manhole
3	Pipe - (39)	2.41	12	Cir	101.500	343.34	344.10	0.749	343.97	344.76	n/a	344.76	2	Manhole
4	Pipe - (22) (1)	2.43	12	Cir	118.100	344.10	344.99	0.754	344.91	345.66	n/a	345.66 j	3	Manhole
5	Pipe - (71)	1.88	12	Cir	80.700	345.76	349.81	5.019	346.08	350.39	n/a	350.39	4	Manhole
6	Pipe - (70)	0.27	12	Cir	112.627	349.81	351.32	1.341	350.64	351.53	n/a	351.53 j	5	Grate
7	Pipe - (69)	0.18	12	Cir	60.000	351.32	351.61	0.483	351.91	351.92	0.01	351.92	6	Grate
8	Pipe - (68)	0.09	12	Cir	51.400	351.61	351.88	0.525	352.17	352.17	0.00	352.17	7	Grate
9	Pipe - (86)	1.77	12	Cir	19.571	349.81	349.90	0.460	350.59	350.62	0.13	350.75	5	Grate
10	Pipe - (22)	0.55	12	Cir	8.000	345.06	345.10	0.500	345.93	345.41	n/a	345.41	4	Manhole
11	Pipe - (98)	3.24	12	Cir	1.300	350.00	350.00	0.000	350.88	350.90	0.26	351.16	End	Manhole
12	Pipe - (97)	3.29	12	Cir	58.500	351.15	351.76	1.043	351.85	352.54	0.39	352.54	11	None
13	Pipe - (75)	0.93	12	Cir	107.000	350.00	351.07	1.000	350.64	351.47	n/a	351.47 j	End	Grate
14	Pipe - (74)	0.88	12	Cir	72.100	351.07	351.43	0.499	351.61	351.82	0.07	351.82	13	Grate
15	Pipe - (73)	0.40	12	Cir	62.700	351.43	351.74	0.494	351.97	352.00	n/a	352.00 j	14	Grate
16	Pipe - (72)	0.30	12	Cir	38.500	351.74	351.94	0.520	352.09	352.17	n/a	352.17	15	Grate
17	Pipe - (29) (1)	7.69	24	Cir	52.000	343.90	344.16	0.500	345.43	345.15	n/a	345.15	End	Manhole
18	Pipe - (29) (1)(2)	6.73	24	Cir	89.100	344.16	344.60	0.494	345.46	345.52	n/a	345.52 j	17	Manhole
19	Pipe - (29)	5.04	24	Cir	92.300	344.60	345.52	0.997	345.83	346.31	n/a	346.31 j	18	OpenHeadwall
20	Pipe - (67)	1.17	15	Cir	33.000	344.34	344.49	0.455	345.50	344.92	n/a	344.92	17	Manhole
21	Pipe - (66)	0.31	12	Cir	55.490	349.15	349.42	0.487	349.77	349.77	0.01	349.79	20	Grate
22	Pipe - (65)	0.26	12	Cir	55.865	349.42	349.69	0.483	350.03	350.03	0.01	350.04	21	Grate
23	Pipe - (64)	0.22	12	Cir	57.174	349.69	349.96	0.472	350.29	350.29	0.02	350.32	22	Grate
24		0.16	6	Cir	41.200	350.49	350.90	0.995	350.67	351.10	n/a	351.10	23	None

Project File: Storm Sewers.stm | Number of lines: 38 | Run Date: 11/25/2020

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Summary Report

Line No.	Line ID	Flow rate (cfs)	Line Size (in)	Line shape	Line length (ft)	Invert EL Dn (ft)	Invert EL Up (ft)	Line Slope (%)	HGL Down (ft)	HGL Up (ft)	Minor loss (ft)	HGL Junct (ft)	Dns Line No.	Junction Type
25	Pipe - (18)	7.54	18	Cir	6.000	347.60	347.66	1.000	348.88	348.72	n/a	348.72	End	Manhole
26	Pipe - (16)	7.55	18	Cir	4.600	347.66	347.71	1.087	348.93	348.77	0.49	348.77	25	Manhole
27	Pipe - (11)	5.33	16	Cir	171.437	347.89	348.75	0.502	349.04	349.72	0.38	350.10	26	Grate
28	Pipe - (10)	3.79	12	Cir	48.951	349.25	349.74	1.001	350.11	350.57	n/a	350.57 j	27	Grate
29	Pipe - (84)	2.62	18	Cir	89.748	347.71	348.16	0.501	349.20	348.77	n/a	348.77	26	Manhole
30	Pipe - (15)	2.69	12	Cir	74.929	348.49	348.86	0.494	349.34	349.68	0.24	349.92	29	Grate
31	Pipe - (87)	1.90	12	Cir	29.392	349.00	350.28	4.355	349.79	350.87	n/a	350.87 j	End	Manhole
32	Pipe - (17) (1)	2.66	12	Cir	3.000	348.62	348.64	0.667	349.47	349.48	0.03	349.51	End	Manhole
33	Pipe - (17)	2.69	12	Cir	28.659	348.64	348.76	0.419	349.55	349.67	0.20	349.87	32	Grate
34		17.03	24	Cir	30.000	334.64	335.37	2.433	336.41	336.86	n/a	336.86 j	End	Manhole
35	(2)	17.36	24	Cir	217.118	335.37	340.61	2.413	337.10	342.11	n/a	342.11 j	34	Grate
36	(2)	9.86	24	Cir	21.927	340.61	341.14	2.417	342.57	342.26	0.46	342.26	35	OpenHeadwall
37		2.21	12	Cir	3.000	343.21	343.24	1.000	344.03	343.88	0.27	343.88	End	Manhole
38		2.21	12	Cir	62.700	343.24	343.87	1.005	344.03	344.51	n/a	344.51 j	37	Manhole

Project File: Storm Sewers.stm | Number of lines: 38 | Run Date: 11/25/2020

NOTES: Return period = 25 Yrs. ; j - Line contains hyd. jump.

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	17.400	0.00	1.71	0.00	0.00	0.63	0.0	38.5	2.9	2.39	6.05	3.24	15	0.75	342.71	342.84	343.61	343.46	344.00	349.50	Pipe - (85)
2	1	32.500	0.00	1.71	0.00	0.00	0.63	0.0	38.3	3.0	2.40	6.14	3.42	15	0.77	342.84	343.09	343.64	343.71	349.50	348.50	Pipe - (40)
3	2	101.500	0.00	1.71	0.00	0.00	0.63	0.0	37.9	3.0	2.41	3.34	4.49	12	0.75	343.34	344.10	343.97	344.76	348.50	353.70	Pipe - (39)
4	3	118.100	0.00	1.71	0.00	0.00	0.63	0.0	37.4	3.0	2.43	3.35	3.96	12	0.75	344.10	344.99	344.91	345.66	353.70	355.30	Pipe - (22) (1)
5	4	80.700	0.00	1.71	0.00	0.00	0.63	0.0	37.2	3.0	1.88	8.64	6.38	12	5.02	345.76	349.81	346.08	350.39	355.30	355.50	Pipe - (71)
6	5	112.627	0.03	0.08	0.47	0.01	0.04	5.0	9.2	6.9	0.27	4.47	1.29	12	1.34	349.81	351.32	350.64	351.53	355.50	354.71	Pipe - (70)
7	6	60.000	0.03	0.05	0.47	0.02	0.02	5.0	7.7	7.6	0.18	2.68	0.65	12	0.48	351.32	351.61	351.91	351.92	354.71	355.00	Pipe - (69)
8	7	51.400	0.02	0.02	0.47	0.01	0.01	5.0	5.0	9.2	0.09	2.80	0.32	12	0.53	351.61	351.88	352.17	352.17	355.00	355.80	Pipe - (68)
9	5	19.571	1.63	1.63	0.36	0.59	0.59	37.1	37.1	3.0	1.77	2.62	2.80	12	0.46	349.81	349.90	350.59	350.62	355.50	355.40	Pipe - (86)
10	4	8.000	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.55	2.73	1.72	12	0.50	345.06	345.10	345.93	345.41	355.30	355.10	Pipe - (22)
11	End	1.300	0.00	0.40	0.00	0.00	0.36	0.0	5.2	9.0	3.24	0.00	4.39	12	0.00	350.00	350.00	350.88	350.90	355.50	355.40	Pipe - (98)
12	11	58.500	0.40	0.40	0.90	0.36	0.36	5.0	5.0	9.2	3.29	3.94	5.32	12	1.04	351.15	351.76	351.85	352.54	355.40	355.00	Pipe - (97)
13	End	107.000	0.03	0.38	0.30	0.01	0.11	5.0	6.5	8.2	0.93	3.86	2.43	12	1.00	350.00	351.07	350.64	351.47	352.00	356.00	Pipe - (75)
14	13	72.100	0.20	0.35	0.30	0.06	0.10	5.0	6.0	8.5	0.88	2.73	2.57	12	0.50	351.07	351.43	351.61	351.82	356.00	355.43	Pipe - (74)
15	14	62.700	0.04	0.15	0.30	0.01	0.05	5.0	5.4	8.9	0.40	2.71	1.69	12	0.49	351.43	351.74	351.97	352.00	355.43	355.06	Pipe - (73)
16	15	38.500	0.11	0.11	0.30	0.03	0.03	5.0	5.0	9.2	0.30	2.78	1.75	12	0.52	351.74	351.94	352.09	352.17	355.06	354.64	Pipe - (72)
17	End	52.000	0.00	4.33	0.00	0.00	2.16	0.0	53.8	2.4	7.69	17.33	3.98	24	0.50	343.90	344.16	345.43	345.15	347.43	350.00	Pipe - (29) (1)
18	17	89.100	0.00	4.23	0.00	0.00	2.12	0.0	53.4	2.4	6.73	17.22	3.94	24	0.49	344.16	344.60	345.46	345.52	350.00	349.09	Pipe - (29) (1)(2)
19	18	92.300	4.23	4.23	0.50	2.12	2.12	53.0	53.0	2.4	5.04	24.46	3.42	24	1.00	344.60	345.52	345.83	346.31	349.09	347.78	Pipe - (29)
20	17	33.000	0.00	0.10	0.00	0.00	0.04	0.0	8.8	7.1	1.17	4.72	2.08	15	0.45	344.34	344.49	345.50	344.92	350.00	355.10	Pipe - (67)
21	20	55.490	0.03	0.10	0.30	0.01	0.04	5.0	7.8	7.5	0.31	2.69	0.94	12	0.49	349.15	349.42	349.77	349.77	355.10	355.00	Pipe - (66)
22	21	55.865	0.03	0.07	0.30	0.01	0.03	5.0	6.6	8.1	0.26	2.68	0.82	12	0.48	349.42	349.69	350.03	350.03	355.00	355.00	Pipe - (65)

Project File: Storm Sewers.stm

Number of lines: 38

Run Date: 11/25/2020

NOTES:Intensity = 43.30 / (Inlet time + 3.70) ^ 0.72; Return period =Yrs. 25 ; c = cir e = ellip b = box

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
23	22	57.174	0.02	0.04	0.30	0.01	0.02	5.0	5.3	8.9	0.22	2.65	0.70	12	0.47	349.69	349.96	350.29	350.29	355.00	355.00	Pipe - (64)
24	23	41.200	0.02	0.02	0.90	0.02	0.02	5.0	5.0	9.2	0.16	0.61	2.42	6	1.00	350.49	350.90	350.67	351.10	355.00	355.00	
25	End	6.000	0.00	1.18	0.00	0.00	0.88	0.0	5.9	8.5	7.54	11.38	5.16	18	1.00	347.60	347.66	348.88	348.72	353.70	353.70	Pipe - (18)
26	25	4.600	0.00	1.18	0.00	0.00	0.88	0.0	5.9	8.5	7.55	11.86	5.18	18	1.09	347.66	347.71	348.93	348.77	353.70	354.20	Pipe - (16)
27	26	171.437	0.27	0.83	0.65	0.18	0.59	5.0	5.2	9.0	5.33	5.89	4.54	16	0.50	347.89	348.75	349.04	349.72	354.20	353.20	Pipe - (11)
28	27	48.951	0.56	0.56	0.74	0.41	0.41	5.0	5.0	9.2	3.79	3.86	5.36	12	1.00	349.25	349.74	350.11	350.57	353.20	353.20	Pipe - (10)
29	26	89.748	0.00	0.35	0.00	0.00	0.29	0.0	5.3	8.9	2.62	8.06	2.67	18	0.50	347.71	348.16	349.20	348.77	354.20	352.80	Pipe - (84)
30	29	74.929	0.35	0.35	0.84	0.29	0.29	5.0	5.0	9.2	2.69	2.71	3.84	12	0.49	348.49	348.86	349.34	349.68	352.80	351.80	Pipe - (15)
31	End	29.392	0.23	0.23	0.90	0.21	0.21	5.0	5.0	9.2	1.90	8.05	3.41	12	4.35	349.00	350.28	349.79	350.87	350.16	353.22	Pipe - (87)
32	End	3.000	0.00	0.35	0.00	0.00	0.29	0.0	5.1	9.1	2.66	3.15	3.76	12	0.67	348.62	348.64	349.47	349.48	351.70	351.94	Pipe - (17) (1)
33	32	28.659	0.35	0.35	0.84	0.29	0.29	5.0	5.0	9.2	2.69	2.50	3.58	12	0.42	348.64	348.76	349.55	349.67	351.94	351.76	Pipe - (17)
34	End	30.000	0.00	0.91	0.00	0.00	0.82	0.0	5.6	8.8	17.03	38.22	6.30	24	2.43	334.64	335.37	336.41	336.86	337.00	348.00	
35	34	217.118	0.91	0.91	0.90	0.82	0.82	5.0	5.0	9.2	17.36	38.07	6.44	24	2.41	335.37	340.61	337.10	342.11	348.00	350.00	(2)
36	35	21.927	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	9.86	38.10	4.29	24	2.42	340.61	341.14	342.57	342.26	350.00	343.50	(2)
37	End	3.000	0.00	0.00	0.00	0.00	0.00	0.0	0.3	0.0	2.21	3.86	3.70	12	1.00	343.21	343.24	344.03	343.88	352.70	352.70	
38	37	62.700	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	2.21	3.87	3.77	12	1.00	343.24	343.87	344.03	344.51	352.70	352.00	

Project File: Storm Sewers.stm

Number of lines: 38

Run Date: 11/25/2020

NOTES:Intensity = 43.30 / (Inlet time + 3.70) ^ 0.72; Return period =Yrs. 25 ; c = cir e = ellip b = box

APPENDIX F

WQA 01
0.449 ac
SAND FILTER 01

WQA 02
1.210 ac
SAND FILTER 02

BYPASS MANHOLE

1000 GALLON OIL WATER
GRIT SEPARATOR

SAND FILTER 01

INFILTRATION SYSTEM 01

INFILTRATION SYSTEM 02

BYPASS MANHOLE

1500 GALLON OIL WATER
GRIT SEPARATOR

SAND FILTER 02

GENERATOR

STONE WALL

CHAIN LINK FENCE

WIRE FENCE

'C' CB
TF=349.21'

BOT 24" RCP
ELV.=341.14'

APPROX. 24" RCP

'C' CB
TF=348.15'

'C' CB
TF=347.90'

N

0 50' 100'

SCALE: 1" = 50'

LEGEND:

WATERSHED BOUNDARY

CONNECTICUT PROTON THERAPY CENTER
WALLINGFORD, CT

PROPOSED WATER QUALITY AREA MAP

DATE: 10/16/2020
SCALE: 1" = 50'
FIGURE: WM-04

Tighe&Bond

Nov 24, 2020-1:51pm Plotted By: PAReady
Tighe & Bond, Inc. J:\P\P5050 Proton International\004 Northrop Road Facility - Civil\Design\Drainage\P5050-004-PR-WQA.dwg

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Water Quality Volume**
Prepared By: **PAR** Date: **November 16, 2020**

Sand Filter 01

Required Water Quality Volume (WQV)

Total Area in acres (A)		=	0.449	
WQV =	(1")(A)/12	=	0.0374	ac*ft
		=	**1630**	**cf**

Provided Water Quality Volume (WQV)

Bottom Area (SF)=	225
Side Slopes =	2:1
100 Yr Surface Elevation=	350.58
Berm Elevation =	352.50
Provided WQV (CF)=	**1690 @ Elev 350.58**

Calculated in accordance with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Water Quality Volume**
Prepared By: **PAR** Date: **November 16, 2020**

Sand Filter 02

Required Water Quality Volume (WQV)

Total Area in acres (A)		=	1.210	
WQV =	(1")(A)/12	=	0.1008	ac*ft
		=	**4392**	**cf**

Provided Water Quality Volume (WQV)

Bottom Area (SF)=	600
Side Slopes =	2:1
100 Yr Surface Elevation=	352.22
Berm Elevation =	353.50

Provided WQV (CF)= 5742 @ Elev 352.22

Calculated in accordance with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Water Quality Volume**
Prepared By: **PAR** Date: **November 16, 2020**

Sand Filter 01
Oil/Water/Grit Separator Sizing

Area to Sand Filter = 0.449 Acres

TRIBUTARY DRAINAGE AREA (ACRES)	MAXIMUM RATE OF RUN–OFF FLOW THRU TANK (CFS)	NOMINAL SIZE OF REQUIRED TANK (GALLONS)	MINIMUM STATIC LIQUID STORAGE CAPACITY (GALLONS)	① MINIMUM HEIGHT OF "UNDERFLOW" BAFFLE (IN.)	② MINIMUM HEIGHT OF OPENING UNDER "UNDERFLOW" BAFFLE (SEE NOTE #1) (IN.)	③ MINIMUM HEIGHT OF "OVERFLOW" BAFFLE (IN.)	④ MINIMUM HEIGHT OF OPENING OVER "OVERFLOW" BAFFLE (SEE NOTE #1) (IN.)
≤ 0.5	3.7	1000	700	24	16	18	22
0.5 TO 1.0	6.6	1250	900	26	22	24	24
1.0 TO 1.5	9.2	1500	1100	28	28	30	26

Use 1000 Gallon Separator

Calculated in accordance with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

Tighe&Bond
Consulting Engineers
Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Water Quality Volume**
Prepared By: **PAR** Date: **November 16, 2020**

Sand Filter 02
Oil/Water/Grit Separator Sizing

Area to Sand Filter = 1.210 Acres

TRIBUTARY DRAINAGE AREA (ACRES)	MAXIMUM RATE OF RUN–OFF FLOW THRU TANK (CFS)	NOMINAL SIZE OF REQUIRED TANK (GALLONS)	MINIMUM STATIC LIQUID STORAGE CAPACITY (GALLONS)	① MINIMUM HEIGHT OF "UNDERFLOW" BAFFLE (IN.)	② MINIMUM HEIGHT OF OPENING UNDER "UNDERFLOW" BAFFLE (SEE NOTE #1) (IN.)	③ MINIMUM HEIGHT OF "OVERFLOW" BAFFLE (IN.)	④ MINIMUM HEIGHT OF OPENING OVER "OVERFLOW" BAFFLE (SEE NOTE #1) (IN.)
≤ 0.5	3.7	1000	700	24	16	18	22
0.5 TO 1.0	6.6	1250	900	26	22	24	24
1.0 TO 1.5	9.2	1500	1100	28	28	30	26

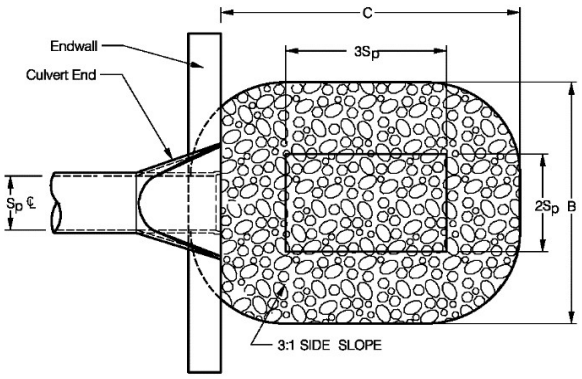
Use 1500 Gallon Separator

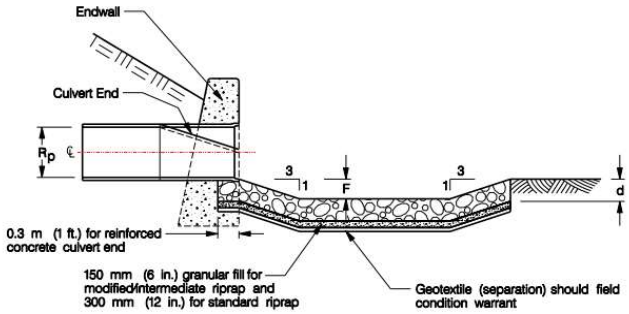
Calculated in accordance with the 2004 Connecticut Stormwater Quality Manual Sections 7.4.1 and 7.4.2

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Scour Hole Calculation**
Prepared By: **PAR** Date: **November 6, 2020**

Preformed Scour Hole - 01

Outlet Velocity =	3.41	fps	(From Hydraflow Storm Sewers Model)
25-year pipe discharge (Q_{25}) =	8.80	cfs	(From Hydraflow Storm Sewers Model)
Inside pipe diameter (S_p) =	24	in	





Use Type 1 Scour Hole

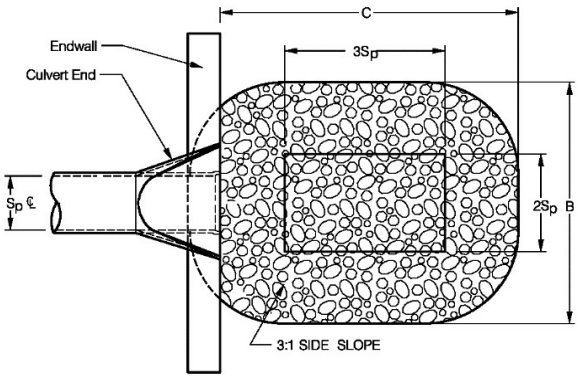
For Outlet Pipe 24" with Q_{25} = 8.80, Use Table 11-14.1
From ConnDOT Drainage Manual, Chapter 11

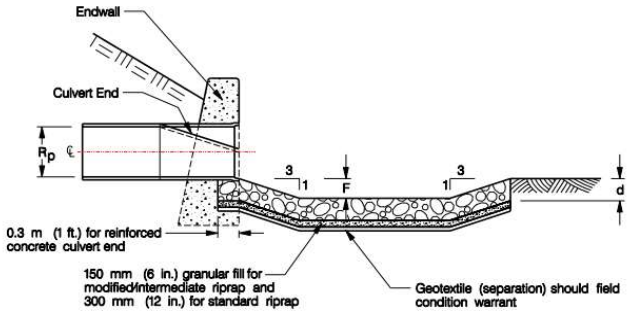
B =	10
C =	12
d =	6" Modified Riprap (velocity < 8 FPS)
$2S_p$ =	4.0
$3S_p$ =	6.0
F = $0.5S_p$ =	1.00

Project Name: **CT Proton Therapy Center**
Project Number: **P-5050-004**
Project Location: **Wallingford, CT**
Description: **Scour Hole Calculation**
Prepared By: **PAR** Date: **November 6, 2020**

Preformed Scour Hole - 02

Outlet Velocity =	2.04	fps	(From Hydraflow Storm Sewers Model)
25-year pipe discharge (Q_{25}) =	1.93	cfs	(From Hydraflow Storm Sewers Model)
Inside pipe diameter (S_p) =	15	in	





Use Type 1 Scour Hole

For Outlet Pipe 15" with Q_{25} = 1.93, Use Table 11-14.1
From ConnDOT Drainage Manual, Chapter 11

B =	6
C =	8
d =	6" Modified Riprap (velocity < 8 FPS)
$2S_p$ =	2.6
$3S_p$ =	3.9
$F = 0.5S_p$ =	0.625

Tighe&Bond
Engineers | Environmental Specialists

Project Name:	**CT Proton Therapy Center**
Project Number:	**P-5050-004**
Project Location:	**Wallingford, CT**
Description:	**Outlet Protection Calculations**
Prepared By:	**PAR** Checked By: **APW**
Date:	**November 24, 2020**

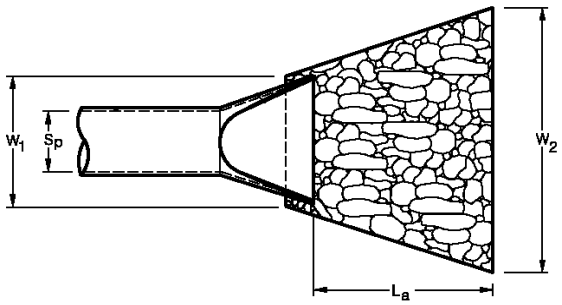
Flared End Section 1 (DMH-10)

Invert elevation =	349.00	ft
Tailwater elevation =	349.00	ft
Tailwater depth (TW) =	0.00	ft
Inside pipe diameter (S_p) =	1.00	ft
Pipe discharge (Q)=	1.90	cfs
Outlet Velocity (V)=	2.42	ft/s

Apron Type

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$
Type B Riprap Apron (Maximum Tailwater Condition) TW ≥ $0.5R_p$
TW = 0 < $0.5R_p$

Use Type A Apror



Apron Length

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$

L_a= $((1.8(Q-5.0))/Sp^{1.5})+10.0$

L_a= 4.42 ft

Apron Width

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$

W_1 = $3*S_p$
W_2 = $3*S_p+0.7L_a$

W_1 = 3.00 ft
W_2 = 6.09 ft

Riprap Specification

Outlet Velocity(V)=	0-8 ft/s		Modified
Outlet Velocity(V)=	8-10 ft/s		Intermediate
Outlet Velocity(V)=	10-14 ft/s		Standard
Outlet Velocity(V)=	2.420	ft/s	**Use modified riprap**

Outlet protection has been designed in accordance with the Section 11.13 of the ConnDOT Drainage Manual

Tighe&Bond
Engineers | Environmental Specialists

Project Name:	**CT Proton Therapy Center**
Project Number:	**P-5050-004**
Project Location:	**Wallingford, CT**
Description:	**Outlet Protection Calculations**
Prepared By:	**PAR** Checked By: **APW**
Date:	**November 24, 2020**

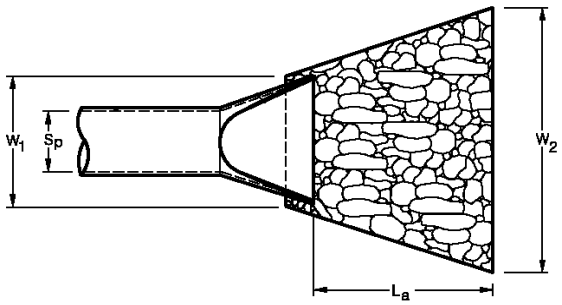
Flared End Section 2 (Diversion MH-01)

Invert elevation =	349.00	ft
Tailwater elevation =	349.00	ft
Tailwater depth (TW) =	0.00	ft
Inside pipe diameter (S_p) =	1.00	ft
Pipe discharge (Q)=	0.73	cfs
Outlet Velocity (V)=	0.93	ft/s

Apron Type

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$
Type B Riprap Apron (Maximum Tailwater Condition) TW ≥ $0.5R_p$
TW = 0 < $0.5R_p$

Use Type A Apror



Apron Length

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$

L_a= $((1.8(Q-5.0))/Sp^{1.5})+10.0$

L_a= 2.31 ft

Apron Width

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$

W_1 = $3*S_p$
W_2 = $3*S_p+0.7L_a$

W_1 = 3.00 ft
W_2 = 4.62 ft

Riprap Specification

Outlet Velocity(V)=	0-8 ft/s		Modified
Outlet Velocity(V)=	8-10 ft/s		Intermediate
Outlet Velocity(V)=	10-14 ft/s		Standard
Outlet Velocity(V)=	0.930	ft/s	**Use modified riprap**

Outlet protection has been designed in accordance with the Section 11.13 of the ConnDOT Drainage Manual

Tighe&Bond
Engineers | Environmental Specialists

Project Name:	**CT Proton Therapy Center**
Project Number:	**P-5050-004**
Project Location:	**Wallingford, CT**
Description:	**Outlet Protection Calculations**
Prepared By:	**PAR** Checked By: **APW**
Date:	**November 24, 2020**

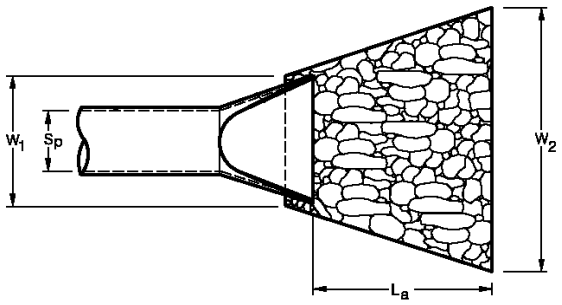
Flared End Section 3 (YD-08)

Invert elevation =	350.00	ft
Tailwater elevation =	350.00	ft
Tailwater depth (TW) =	0.00	ft
Inside pipe diameter (S_p) =	1.00	ft
Pipe discharge (Q)=	0.47	cfs
Outlet Velocity (V)=	0.60	ft/s

Apron Type

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$
Type B Riprap Apron (Maximum Tailwater Condition) TW ≥ $0.5R_p$
TW = 0 < $0.5R_p$

Use Type A Apror



Apron Length

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$

L_a= $((1.8(Q-5.0))/Sp^{1.5})+10.0$

L_a= 1.85 ft

Apron Width

Type A Riprap Apron (Minimum Tailwater Condition) TW < $0.5R_p$

W_1 = $3*S_p$
W_2 = $3*S_p+0.7L_a$

W_1 = 3.00 ft
W_2 = 4.29 ft

Riprap Specification

Outlet Velocity(V)=	0-8 ft/s		Modified
Outlet Velocity(V)=	8-10 ft/s		Intermediate
Outlet Velocity(V)=	10-14 ft/s		Standard
Outlet Velocity(V)=	0.599	ft/s	**Use modified riprap**

Outlet protection has been designed in accordance with the Section 11.13 of the ConnDOT Drainage Manual

Tighe&Bond

APPENDIX G

Connecticut Proton Therapy Center

932 Northrop Road

Wallingford, Connecticut

Maintenance and Inspection Plan

December 1, 2020

Section 1
Introduction

The following Stormwater Pollution Prevention Plan has been prepared for the stormwater management system at the proposed Apollo North facility. The purpose of the plan is to provide guidance and procedures for proper stormwater management following construction completion.

The proposed project has been designed in compliance with the Connecticut Department of Transportation Stormwater Standards and the Town of Wallingford Watershed Protection Standards to maintain or improve stormwater runoff quality and quantity.

Section 2
Ownership and Responsibilities

Proton International is responsible for maintaining and servicing the proposed Connecticut Therapy Center, its appurtenances and the proposed stormwater management facilities post construction.

During construction the contractor will be responsible for stormwater management system maintenance.

Property Owner:

Proton International, LLC
922 Hawkhorn Court
Alpharetta, Georgia 30005

Maintenance Contact:

Peter Carbone
Senior Vice President - Facility Development
Proton International, LLC
922 Hawkhorn Court
Alpharetta, Georgia 30005
617-640-8145

Section 3
Stormwater Pollution Prevention Plan

3.1 Good Housekeeping

The goal of the good housekeeping policy is to keep the site in a clean orderly condition. A disorderly site can lead to improper materials management, and can reduce the efficiency of any response to potential pollution problems.

The following good housekeeping measures will be followed at the site to aid in pollution prevention:

- The property is located in the Town of Wallingford Watershed area. The use of sodium chloride for ice control is prohibited.
- Promptly clean and remove any spills or contamination from vehicles.
- Perform preventative maintenance on all equipment and on the structural components of the stormwater system.
- Avoid or minimize the application of fertilizers and pesticides on green spaces which are in close proximity to connected impervious areas.
- Minimize applications of sand and/or deicing agents to large connected impervious areas, such as parking lots.
- Weekly sweep large connected impervious areas during the seasons when sand is applied to these surfaces.
- Promptly clean out of catch basin sumps during the spring after the snowmelt season.

Section 4
Stormwater Management System

The on-site stormwater management system is comprised of a series of catch basins, area drains, manholes, roof leaders, subsurface infiltration, oil/sediment separators, sand filter basins and stormwater outfalls. In general, runoff from the proposed development is collected via catch basin inlets, and area drains. Roof leaders discharge through to one of two underground infiltration systems. Stormwater is then piped from west to east via series of underground storm sewers to an infiltration basin at the western end of the site before it is discharged to the 24" culvert on the southern property line.

4.1 Inspections

The following stormwater management system features will be evaluated during each inspection:

4.1.1 Vegetated Surfaces

Inspection Frequency: Bi-annually in Summer and Winter

Special Inspection Event(s): Spring Snow Melt

All vegetative surfaces will be observed to identify locations of settlement, erosion and other impacts from construction.

4.1.2 Driveway and Walkway Sweeping

Inspection Frequency: Quarterly

Special Inspection Event(s): Spring Snow Melt

All pavement surfaces should be inspected annually for deterioration or spalling. Additionally, the pavement surface should be regularly monitored to make sure it drains properly after storms. Cleanings should be conducted on a quarterly basis to prevent clogging. For best management practices, vacuum sweeping machines should be used to clean and maintain the surface.

4.1.3 Oil/Sediment Separator

Inspection Frequency: Monthly

Special Inspection Event(s): Rainfall greater than 0.5 inches

Oil/Sediment separators are underground storage tanks with internal chambers designed to remove heavy particulates, floating debris and hydrocarbons from stormwater. Hydrodynamic separators should be inspected at least on a monthly basis and after every major storm. The Visual inspection should ascertain that the storage tanks are functioning properly (i.e. no blockages or obstructions to the inlets) and to measure the amount of solid materials that have accumulated in the sump. This can be done with a calibrated dipstick, tape measure or other measuring instrument so that the depth of deposition in the sump can be tracked. Inspections should be completed visually from the ground level. If further investigation is warranted that requires entering the structure, all applicable

Confined Space Entry safety regulations and procedures must be followed per 29 CFR 1910.146. Hydrodynamic separators should be cleaned at least twice per year at a minimum. The more frequent the cleaning, the less likely sediments will be resuspended and subsequently discharged. In addition, frequent cleaning also makes more volume available for future storms and enhances overall performance. Cleanings include removal of accumulated oil and grease and sediment using a vacuum truck or other ordinary catch basin cleaning device. Polluted water or sediments removed from an oil grit separator should be disposed of in accordance with all applicable local, state and federal laws and regulations including C.G.S. 22A-325 through 22A-329.

4.1.4 Sand Filter Basins

Inspection Frequency: Bi-annually

Special Inspection Event(s): Rainfall greater than 0.5 inches

Sand Filter Basins should be inspected after every major storm in the first few months following construction. The filter should be inspected at least every 6 months thereafter. Inspections should focus on:

- Checking the filter surface for standing water or other evidence of clogging, such as discolored or accumulated sediments.
- Checking the sedimentation chamber or forebay for sediment accumulation, trash, and debris.
- Checking inlets, outlets, and overflow spillway for blockage, structural integrity, and evidence of erosion.

Sediment should be removed from the sedimentation basin when it accumulates to a depth of more than 12 inches or 10 percent of the pretreatment volume. The sedimentation basin outlet devices should be cleaned when drawdown times exceed 36 hours.

Sediment should be removed from the filter bed when the accumulation exceeds one inch or when there is evidence that the infiltration capacity of the filter bed has been significantly reduced (i.e., observed water level above the filter exceeds the design level or drawdown time exceeds 36 to 48 hours). As a rule-of-thumb, the top several inches of the filter bed (typically dis-colored material) should be removed and replaced annually, or more frequently if necessary. The material should be removed with rakes where possible rather than heavy construction equipment to avoid compaction of the filter bed. Removed sediments should be dewatered (if necessary) and disposed of in accordance with all applicable local, state and federal laws and regulations including C.G.S. 22A-325 through 22A-329.

4.1.5 Subsurface Infiltration Systems

Inspection Frequency: Bi-annually

Special Inspection Event(s): Rainfall greater than 0.5 inches

Subsurface infiltration systems should be inspected bi-annually for standing water. If standing water is observed for longer than 72 hours, a pump should be placed in the basin and discharged through the outlet pipe. After the system is dewatered, it should be observed by a Professional Engineer. A Professional Engineer should provide an opinion as to why the infiltrations system is not draining and provide recommendations to restore

infiltration capacity to the system. Additionally, subsurface infiltration systems shall be observed to identify depths of sediment and occurrence of debris which would impact functionality.

4.1.6 Stormwater System Outfalls

Inspection Frequency: Bi-annually

Special Inspection Event(s): Rainfall greater than 0.5 inches

System outfalls should be inspected twice a year as well as after every major storm, for slope integrity, soil moisture, vegetated health, soil stability, soil compaction, soil erosion, ponding and sediment accumulation. If the rip rap has been displaced, undermined or damaged, it should be replaced immediately. The channel immediately below the outlet should be checked to see that erosion is not occurring. The downstream channel will be kept clear of obstructions, such as fallen trees, debris, leaves and sediment that could change flow patterns and/or tail water depths in pipes. Repairs must be carried out immediately to avoid additional damage to the outlet protection apron.

Stormwater Operation and Maintenance Log

Report Number:	Page:

Inspection Report Form for:

Vegetated Surfaces

Inspection Frequency: Bi-annually in Summer and Winter

Special Inspection Event(s): Spring Snow Melt

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Stormwater Operation and Maintenance Log

Report Number:	Page:

Inspection Report Form for:

Driveway & Walkway Sweeping

Inspection Frequency: Quarterly

Special Inspection Event(s): Spring Snow Melt

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Stormwater Operation and Maintenance Log

Report Number:	Page:

Inspection Report Form for:

Catch Basins

Inspection Frequency: Quarterly

Special Inspection Event(s): Rainfall greater than 0.5 inches

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Stormwater Operation and Maintenance Log

Report Number:	Page:

Inspection Report Form for:

Oil/Sediment Separator

Inspection Frequency: Monthly

Special Inspection Event(s): Rainfall greater than 0.5 inches

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Stormwater Operation and Maintenance Log

Report Number:	Page:

Inspection Report Form for:

Sand Filter Basin

Inspection Frequency: Bi-annually

Special Inspection Event(s): Rainfall greater than 0.5 inches

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Stormwater Operation and Maintenance Log

Inspection Report Form for:

Report Number:	Page:

Subsurface Infiltration Systems

Inspection Frequency: Bi-annually

Special Inspection Event(s): Rainfall greater than 0.5 inches

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Stormwater Operation and Maintenance Log

Report Number:	Page:

Inspection Report Form for:

Stormwater Outfalls

Inspection Frequency: Bi-annually

Special Inspection Event(s): Rainfall greater than 0.5 inches

Inspector: _____ **Date:** _____

Reason for Inspection (Routine / Significant Rainfall): _____

Comments:

Maintenance and Other Actions Required:

To be performed by: _____ **On or before:** _____

Tighe&Bond

APPENDIX H

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Temporary Sediment Trap Sizing Calculation**
Prepared By: **APW** Date: **December 2, 2020**

Temporary Sediment Trap 01

Sediment Storage Volume

Drainage Area = 1.41 Acres

Required Storage= 134 Cu. Yds / Acre

Required Storage= **188.88** Cu. Yds

Required Wet Storage

Wet storage volume may be approximated as follows:

$$Vw = 0.85 \times A_w \times D_w$$

where,

V_w = the wet storage volume in cubic feet
A_w = the surface area of the flooded area at the base of the stone outlet in square feet
D_w = the maximum depth in feet, measured from the low point in the trap to the base of the stone outlet.

V_W= 2549.88 1/2 total storage (Cu. Ft.)
D_W= 3 feet

A_W= 999.95 Sq. Ft.

Required Dry Storage

Dry storage volume may be approximated as follows:

$$V_d = \frac{(A_w + A_d)}{2} \times D_d$$

where,

V_d = the dry storage volume
A_w = the surface area of the flooded area at the base of the stone outlet in square feet.
A_d = the surface area of the flooded area at the top of the stone outlet (over flow mechanism), in square feet
D_d = the depth in feet, measured from the base of the stone outlet to the top of the stone outlet

A_W= 999.95 Sq. Ft.
A_d= 2041.0 feet
D_d= 2 feet

V_d= 3041.0 Cu. Ft.

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
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Project Location: **Wallingford, CT**
Description: **Temporary Sediment Trap Sizing Calculation**
Prepared By: **APW** Date: **December 2, 2020**

Provided Storage

Wet Storage	**2549.9**	**Cu. Ft.**
	94.4	**Cu. Yd.**
Dry Storage	**3041.0**	**Cu. Ft.**
	112.6	**Cu. Yd.**
Total Storage	**5590.8**	**Cu. Ft.**
	207.1	**Cu. Yd.**

Calculated in accordence with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control Section 5-11

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Temporary Sediment Trap Sizing Calculation**
Prepared By: **APW** Date: **December 2, 2020**

Temporary Sediment Trap 02

Sediment Storage Volume

Drainage Area = 2.72 Acres

Required Storage= 134 Cu. Yds / Acre

Required Storage= **364.48** Cu. Yds

Required Wet Storage

Wet storage volume may be approximated as follows:

$$Vw = 0.85 \times A_w \times D_w$$

where,

V_w = the wet storage volume in cubic feet
A_w = the surface area of the flooded area at the base of the stone outlet in square feet
D_w = the maximum depth in feet, measured from the low point in the trap to the base of the stone outlet.

V_W= 4920.48 1/2 total storage (Cu. Ft.)
D_W= 3 feet

A_W= 1929.60 Sq. Ft.

Required Dry Storage

Dry storage volume may be approximated as follows:

$$V_d = \frac{(A_w + A_d)}{2} \times D_d$$

where,

V_d = the dry storage volume
A_w = the surface area of the flooded area at the base of the stone outlet in square feet.
A_d = the surface area of the flooded area at the top of the stone outlet (over flow mechanism), in square feet
D_d = the depth in feet, measured from the base of the stone outlet to the top of the stone outlet

A_W= 1929.60 Sq. Ft.
A_d= 2000.0 feet
D_d= 2 feet

V_d= 3929.6 Cu. Ft.

Tighe&Bond
Engineers | Environmental Specialists

Project Name: **CT Proton Therapy Center**
Project Number: **P5050-004**
Project Location: **Wallingford, CT**
Description: **Temporary Sediment Trap Sizing Calculation**
Prepared By: **APW** Date: **December 2, 2020**

Provided Storage

Wet Storage	**4920.5**	**Cu. Ft.**
	182.2	**Cu. Yd.**
Dry Storage	**3929.6**	**Cu. Ft.**
	145.5	**Cu. Yd.**
Total Storage	**8850.1**	**Cu. Ft.**
	327.8	**Cu. Yd.**

Calculated in accordence with the 2002 Connecticut Guidelines for Soil Erosion and Sediment Control Section 5-11

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