# STORMWATER MANAGEMENT REPORT

## Owner/Applicant

NBPIV Constitution II LLC
401 Edgewater Place, Suite 265
Wakefield, MA 01880

# 55 CONSTITUTION BOULEVARD

PARCEL ID – 313-059

## FRANKLIN, MASSACHUSETTS

TOWN OF FRANKLIN CONSERVATION COMMISSION

ISSUED: OCTOBER 17, 2024

BEALS • ASSOCIATES INC.

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# 0.0 EXECUTIVE SUMMARY

On behalf of the owner and applicant NBPIV Constitution II LLC., c/o Northbridge Partners, and in compliance with Chapter 153 Town of Franklin Stormwater Management and the Massachusetts Department of Environmental Protection Stormwater Management Handbook, our office is pleased to submit this Stormwater Management Report detailing site conditions, calculations and supporting documentation to demonstrate compliance with all local and state regulations regarding stormwater management associated with the proposed development at 55 Constitution Boulevard.

Standard 1 – No Untreated Discharges or Erosion to Wetlands
All stormwater runoff from the developments impervious area will be treated through stormwater management devices. Existing outfalls are protected by riprap outlet aprons to prevent erosion from occurring in or adjacent to the wetland. **Standard 1 has been met.**

Standard 2 – Peak Rate Attenuation
The proposed project reduces the rate of runoff to the point of analysis through the use of onsite stormwater management facilities. Complete runoff calculations for the 2-, 10-, and 100- year storm events have been provided. The rainfall utilized is based on the NOAA Atlas 14 rainfall data. **Standard 2 has been met.**

Standard 3 – Stormwater Recharge
Due to high groundwater observed within the stormwater test pits, recharge cannot be provided for the redevelopment areas, however this standard been met for the new-development areas.
**Standard 3 has been met to the maximum extent practicable.**

Standard 4 – Water Quality
The project features various Best Management Practices and proprietary devices to improve the quality of the stormwater runoff prior to discharge. Calculations demonstrating that the runoff has been treated to remove a minimum of 80% of the Total Suspended Solids (TSS) has been included in the report. **Standard 4 has been met.**

Standard 5 – Land Uses with Higher Potential Pollution Loads
The required water quality flow rate has been accommodated within each water quality unit and proprietary media filter (WQU/PMF). **Standard 5 has been met.**

Standard 6 – Critical Areas
Discharges from the development lead to the onsite stormwater pond/wetland prior to discharging through a 1/3$^{rd}$ of a mile to Dix Brook, we do not believe this standard is applicable. **This Standard does not apply.**

Standard 7 – Redevelopment
Standard 7 of the Massachusetts Stormwater Handbook applies to redevelopment projects and requires that the goals of Standard 2, Standard 3, and the pretreatment and structure best management practices of Standards 4, 5, and 6 be met only to the maximum extent practicable. **Standard 7 has been met to the maximum extent practicable.**

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Standard 8 – Construction Period Controls
A complete erosion control plan and narrative has been provided with the project plans, which is available under separate cover. **Standard 8 has been met.**

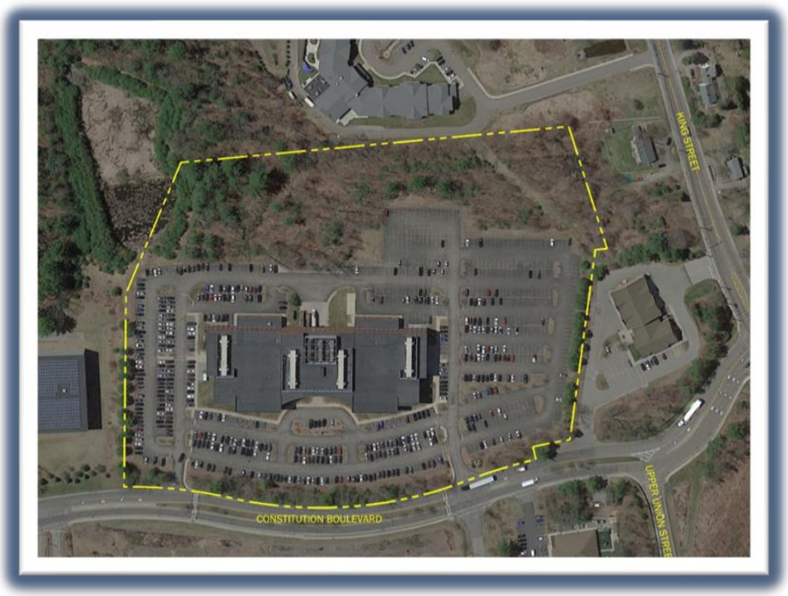
Standard 9 – Operation and Maintenance Plan
The project documentation includes a complete Stormwater Operation and Maintenance Manual for the site, which is available under separate cover. This manual meets all MA DEP checklist requirements. **Standard 9 has been met.**

Standard 10 – Illicit Discharges to Drainage System
The report includes a signed illicit discharge statement in Appendix B. **Standard 10 has been met.**

Based on the documentation and calculations in this report, the project meets or exceeds all the applicable Commonwealth of Massachusetts Stormwater Standards.

# 1.0 PROJECT LOCATION

The property identified as Parcel ID 313-059 is approximately 15.6 acres in size and was previously developed as an office building last occupied by Dell/EMC and has an address of 55 Constitution Boulevard. The project site is located within the Industrial (I) zone. The parcel is surrounded by various uses, to the north is the Franklin Fire Department, to the west is an assisted living facility and to the south and east are the other developments within the Franklin Industrial Park. There is an existing stormwater management pond on the southwest corner of the property that controls a majority of the stormwater from the 55 Constitution and Fire Department property.



*Aerial image of 55 Constitution Boulevard*

# 2.0 EXISTING CONDITIONS

## 2.1 SITE CONDITIONS

The site is currently developed with an existing three-story office building with a footprint of just over 70,000 square feet, parking and loading areas to support the office building, and a small 335 square foot building located near the delineated BVW that is abandoned and appears to be a former telecommunications building. There is approximately 9.6 acres of total impervious area across the property. The western edge of the property, outside of the impervious parking area, is primarily wooded area. Along the northeastern and central eastern edge of the site are small, wooded depressions adjacent to Constitution Boulevard. Portions of the project are located within buffer zones to wetland resource areas, as well areas under local jurisdiction including Isolated Vegetated Wetlands. There is an existing stormwater pond on the southwest corner of the property that controls a majority of the stormwater from the 55 Constitution and Fire Department properties.

The existing development contains 5 existing easements located within the property. Along the western edge of the property is a 30' wide easement, and along the northwest portion is a 20' wide sewer easement which encompasses an approximate 4" sewer force main. Along the northeast site entrance is a 4,000 square foot electric easement containing an electric and telecom box, as well as telecom and electric hand holes. The main water, sewer and drain lines run through the center of the site where a 30' wide utility and storm drain easement is located. The main storm drain trunk line flows from the north to the southwest portion of the property where there is a 50' wide drainage easement.

The existing development is serviced by public utilities. The water services are served by the existing water mains within Constitution Boulevard, as well as a water main that flows through the center of the site from the Fire Department property. The property is serviced by a gravity sanitary sewer system. A 4" force main is located along the northwestern edge of the property flowing east where it connects to a sewer manhole. Electric and telecom services are provided through underground electric conduit connecting to numerous utility poles surrounding the site. Gas services are provided from an existing line provided off Constitution Boulevard.

Existing drainage consists of a series of single and double grate catch basins located within the impervious surface of the development. The southern half of the existing building's roof runoff flows through roof leaders into the main storm drain trunk line. The northern adjacent Fire Department property's runoff flows to a rip rap swale located along the southern edge of its property. That stormwater flows through the swale and into a 24" RCP pipe, leading into the 55 Constitution drainage system. Stormwater is conveyed through a series of pipes where it eventually leads to the stormwater basin located along the Southwestern portion of the property. The northern half of the existing building's roof runoff flows through roof leaders where it eventually enters an infiltration system. The spillway of that system is set to eventually lead back into the main drainage trunk line, and into the stormwater basin along the southwest edge of the property.

## 2.2 Soil Analysis

A Natural Resources Conservation Service ("NRCS") soil resource report was obtained for the property and can be found as an appendix to this document. The NRCS Report provides base-level information about the soil conditions as well as hydrologic conditions for the property and surrounding area. According to the NRCS Report, the property contains 3 distinct Soil Series. The soils mapped onsite are Ridgebury Fine Sandy Loam (71B), Woodbridge Fine Sandy Loam (310B) Woodbridge Fine Sandy Loam (312B). Information about these soil series is listed below.

1. **Ridgebury Fine Sandy Loam**
   *Symbol: 71B*
   *Slope: 3-8%*
   *Hydrologic Soil Group: D*
   *Extremely stony*

2. **Woodbridge Fine Sandy Loam**
   *Symbol: 310B*
   *Slope: 3-8%*
   *Hydrologic Soil Group: C/D*

3. **Woodbridge Fine Sandy Loam**
   *Symbol: 312B*
   *Slope: 0-8%*
   *Hydrologic Soil Group: C/D*
   *Extremely Stony*


*NRCS Map for 55 Constitution Boulevard*

Onsite soil testing has been conducted by BAI. The test pits conducted by BAI were to assess the ability of the soil to handle stormwater management systems. The test pits ranged in depth up to approximately 11 feet below grade. The test pits indicated several strata of materials including topsoil/loam, disturbed areas as the result of the existing development, and glacial till. The glacial till varied between sandy loam and sandy loam and contained areas of dense firm in place material.

## 2.3 Natural Resource Areas

Natural resource areas located within the property include three wetland resource areas which are under the jurisdiction of the Wetlands Protect Act and Town of Franklin local bylaw. The northeast wetland is delineated as an isolated vegetated wetland (IVW) & isolated land subject to flooding (ILSF). This wetland is in an area that is bounded by a sanitary sewer easement that crosses the property from the assisted living facility, the Franklin Fire Department and the business that fronts on King Street. The wetland located in the west central portion of the site is delineated as an area of BVW. This wetland is separated by a short segment of concrete pipe which provides a hydraulic connection between the two areas. The wetland located along the southwestern corner of the site was delineated as a stormwater basin that provides stormwater management for the 55 Constitution Boulevard and the Franklin Fire Department. The basin is controlled by a downstream outlet control structure which flows to a series of swales and culverts to Dix Brook. These resource areas were mapped by Beals Associates Inc. and confirmed by the Conservation Commission through the issuance of an ORAD in July 2024.

# 3.0 PROPOSED DEVELOPMENT

## 3.1 PROJECT DESCRIPTION

The proposed construction plan includes two (2) warehouse buildings totaling approximately 185,175 square feet in area. Warehouse building “A” totals 124,875+/- square feet in area and warehouse building “B” totals 60,300+/- square feet in area. The development will also feature associated parking, loading, and utility infrastructure areas to service the proposed buildings. The site plan includes 311 total parking spaces with 31 loading spaces and 6 trailer spaces. Access to the development will be provided by two access off Constitution Boulevard.

Domestic and fire services for the proposed buildings will be provided via connections to the existing water main which serves the existing development. This water service is located within Constitution Boulevard. Sanitary sewer for the proposed buildings will connect to an existing sewer service located along the northern edge of the property and will pump towards the southern edge of the property where it enters the existing sewer service.

The project will be served by private utilities for electric, telecommunications and gas via connections to the existing mains / services which provided service to the prior buildings. Onsite stormwater management systems including best management practices (BMPs) will be constructed to meet or exceed all state requirements. Specific project details have been presented below regarding compliance with the MassDEP regulations for the proposed stormwater system.

## 3.2 SOIL MOVEMENT/CHANGES

The proposed development has been designed to minimize the amount of material required to be brought into the site or removed by balancing earthwork activities to the greatest extent practicable. This creates a balanced, more level pad for the proposed buildings and associates parking and loading. The southeastern edge of the property is higher in elevation, therefore Building A has been placed approximately one foot higher than Building B to help maintain existing drainage patterns, as well as to help balancing the site.

As this project is a redevelopment of an existing site, much of the development is within previously disturbed impervious area. new development areas are mainly located within the northwest portion of the property. This area includes a portion of Building B as well as associated parking and loading areas. The limit of disturbance spans outside of the limit of grading to account for the removal of existing structures that are located within the existing development. Disturbance within resource areas was limited by 2:1 slopes off the edges of the proposed impervious areas. Based on proposed grading, the proposed development will be in a 3,350+/- C.Y. fill. The largest areas of fill within the development, from 3-6 feet, will be located at the southwestern and west central areas of the site. The removal of material off-site will be limited due to the earthwork balance from the existing to proposed development.

## 3.3 WATERSHED DESCRIPTION

The proposed development has been designed to discharge stormwater runoff in a similar nature and pattern to existing conditions. It is important to mimic the runoff distribution of existing conditions so as to not dewater the adjacent resource areas. The existing watershed map shows the majority of the impervious areas are collected through a series of catch basins and released to stabilized outfall locations. A portion of the existing building discharges into an infiltration system, the spillway of that system is set to discharge back into the stormwater system and release into the BVW located along the southwestern edge of the site. The extent of the existing watershed is limited by a berm located along the southern edge of the site. Grades along the western edge of the site forces water into the wetland resource areas at the west central and northwestern edges of the site. The northern and eastern edges of the property are graded to force water back in the site and into the existing stormwater system.

As most of the proposed development area has been already developed, most of the stormwater is collected and released to stabilized outfall locations. Runoff from the adjacent Fire Department property flows would be collected through the proposed stormwater system and released to the existing stormwater basin/wetland at the southwestern corner of the property. The southeastern portion of the site and a portion of Building A is collected by a series of catch basins, conveyed through a Water Quality Unit and directed through a subsurface infiltration system to achieve the required recharge volume. The overflows for the infiltration system will discharge to the BVW along the southwestern edge. The runoff from the rest of Building A and the entirety of Building B is collected and directed to the subsurface detention system, where it eventually discharges through a series of WQU's and into the BVW along the southwestern edge of the site. The rest of the property's impervious areas are collected and discharged into the BVW. The proposed watershed altered the internal catchment areas of the site, however the overall limit of the watershed remained the same.

## 3.4 METHOD OF HYDROLOGY AND HYDRAULIC ANALYSIS

Methodology

The hydrologic analyses for pre-development and post-development conditions have been conducted based upon the methodology contained in the USDA Soil Conservation Service's Technical Release No. 20 (TR-20). A 24-hour SCS Type III storm distribution was used for the analysis using the following storm frequencies and rainfall values for the Town of Franklin, Massachusetts area based on data obtained from NOAA Atlas 14 Plus, Volume 10, Version 3. A table of Point Precipitation Frequency Estimates has been included in Appendix H.

| Storm Event, Recurrence Interval | 24-Hour Precipitation |
|---|---|
| 2-Year | 3.36 inches |
| 10-Year | 5.21 inches |
| 25-Year | 6.37 inches |
| 100-Year | 8.15 inches |

The HydroCAD computer program was used in the analyses. This program examines the critical points of the overall drainage system and uses SCS TR-20 methodologies for evaluation of the anticipated conditions at these points. Travel times, storage capacity and the effects of hydraulic head are considered for analysis within the program. The model uses reservoirs and pipes to model actual conditions and can assess storage and kinematic effects.

Time of Concentration

Time of Concentration flow paths were developed using TR-55 methodologies. Sheet flow was limited to no more than 50 feet in length. The minimum time of concentration used for this analysis was 6.0 minutes.

Runoff Curve Numbers

The runoff curve numbers for the various soil types and land use covers were initially developed in accordance with TR-55 methodologies.

Points of Analyses

For this project, there are three main points of analysis located on the western portion of the site. Two of the points of analysis are BVW's and the third is an IVW. The BVW located along the southwestern portion of the site takes all the impervious surface runoff from the development, as well as interior landscaped areas, and other pervious areas throughout the site. The BVW in the central west portion of the site takes a portion of the pervious areas of the development as well as existing undisturbed areas. The IVW along the northwestern portion of the site takes a portion of the pervious areas of the property as well as existing undisturbed areas. A portion of runoff from the adjacent Fire Department property flows through an existing concrete pipe, eventually entering the proposed stormwater system and discharges to the BVW along the southwestern portion of the site.

# 4.0 WATER QUALITY ANALYSIS

## 4.1 TSS REMOVAL

TSS Removal is required by the MassDEP Stormwater Management Handbook in order to properly treat runoff from impervious areas discharging from developments. There are certain levels of TSS removal required at various stages of the treatment process which is usually accomplished by a combination of stormwater BMPs. The proposed development utilizes various treatment methods such as deep sump hooded catch basins, a proprietary hydrodynamic separator, a proprietary filtration unit, and a subsurface infiltration system. The requirements set forth by the Town of Franklin Stormwater Management Standards (Chapter 153-16) requires 90% TSS Removal. A breakdown of how the goals of the Massachusetts Stormwater Handbook are met through the use of these various BMPs can be found in Section 5.4 of this report.

## 4.2 Phosphorous Loading

Increases in phosphorus loading can lead to negative effects within waterbodies as phosphorus typically limits the aquatic plant growth and lead to increased levels of algal blooms which creates a cycle of increased phosphorus levels as algal cells die and decompose at the bottom of water bodies. The decomposition process leads to depleted oxygen affecting the growth of aquatic plants and life.

In stormwater systems, phosphorus is transported by sediment, either by absorption or adsorption, a process generally referred to as sorption. Stormwater systems that aim to reduce Total Suspended Solids and prevent them from contacting nature surface waters can significantly reduce the phosphorus load. The most effective method to reduce the phosphorus content of storm water from the site is to eliminate potential sources of phosphorus from the property. Additionally, avoiding single point-source discharges and spreading the stormwater outfalls to multiple discharge points, thereby reducing the volume of stormwater at each point can aid in reducing phosphorus loading. Prior to entering surface waters, runoff discharged from the development must flow through existing vegetated wetlands where the vegetation significantly aids in reduction of phosphorus levels.

The stormwater management system proposed at this development utilizes an infiltration system, water quality unit and a Kraken Filter to effectively treat and recharge stormwater. These types of systems are very effective in reducing the phosphorus load as both require runoff to percolate through various soil medias. Soil has an extraordinary capacity to absorb phosphorus and renders it immobile. Infiltration systems result in 90 percent phosphorus removal and the kraken filter results in 75 percent phosphorus removal.

## 4.3 TMDL Requirements – Dix Brook

The BVW located along the southwestern edge of the site is connected to Dix Brook through a reach of overland flow heading generally southwest from the property line through the back yards of the homes along Rachael Circle, LoRusso Drive and Forest Street and then crossing under Forest Street before heading to Dix Brook. Dix Brook is located over 1,600 feet away from the property to the southwest. Dix Brook has not been identified as having a TMDL under the Chapter 303(d) “Waters Requiring a TMDL,” therefore TMDL is not required.

# 5.0 Low Impact Development

Low Impact Development (LID) is crucial in considering Best Management Practices (BMPs) for developments to reduce constructed infrastructure and overall footprints of a development. Typically, a conventional stormwater management system is designed to collect runoff through a series of catch basin and discharge to a large detention facility. These types of designs can be difficult on constrained sites and require additional clearing to accommodate large open basins. An LID approach reduces the impacts of a conventional design by reducing required clearing and land area and the amount of infrastructure needed.

One of the most important principles in LID design is treating rainwater as a resource by promoting the capture, treatment, and recharge of stormwater runoff.

## 5.1 LID STRATEGY

The proposed development utilizes LID methods to collect, treat and recharge stormwater runoff were conditions allow. These methods promote water quality and groundwater recharge while also minimizing the environmental impact and enhancing the sustainability of the development. The overall strategy of the proposed stormwater design is to collect, convey and treat stormwater through water quality units and a subsurface infiltration system. Areas that are not draining to the subsurface infiltration system are collected through deep sump catch basins and conveyed through hydrodynamic separators and proprietary media filter known as the Jellyfish filter. The combination of these methods helps minimize the overall development's footprint of stormwater management facilities while enhancing the treatment of stormwater runoff.

## 5.2 LID TECHNIQUES

The proposed development will utilize hydrodynamic separators, water quality filtration device and subsurface infiltration system as LID techniques. The subsurface infiltration system is located beneath the Building A trailer parking spaces. The hydrodynamic separators are located within the Building A parking and loading areas. The proprietary media filter is located within the Building A loading area. Roof runoff is collected through roof drains and conveyed through a series of pipes into the detention system located in the loading apron. Areas not draining to the subsurface infiltration/detention system flow through the filtration device where the stormwater is treated before eventually discharging to the wetland.

### 5.2.1 SUBSURFACE INFILTRATION SYSTEM

Stormwater is collected and conveyed through a hydrodynamic separator where it is treated before discharging into the subsurface infiltration system. Compared to conventional open-air infiltration basins, the subsurface systems are typically placed beneath impervious surfaces to minimize the overall footprint of the development. This eliminates the need for excess clearing to install open-air basins or other above ground stormwater management facilities.

### 5.2.2 OTHER LID TECHNIQUES

Another LID technique commonly used are bioretention areas/rain gardens. Rain gardens are small depressions that use soils, plants and microbes to treat stormwater before it is eventually infiltrated. This technique is typically constructed within landscaped islands or areas of open space. For this project, space is extremely limited and there were no feasible areas to implement this LID technique.

Green roofs are another LID technique that can be used to reduce stormwater runoff. This LID technique is not common practice for this type of project, therefore it was not included in the stormwater management design.

Constructed wetlands are another example of a LID technique, which are used to temporarily store runoff in shallow pools and maximize the removal of pollutants from stormwater runoff through wetland vegetation, retention and settling. This particular LID technique requires large amounts of open space, high construction costs and consistent maintenance. Due to the proposed development, open space is limited and additional clearing would need to take place to implement the constructed wetland, therefore this LID technique was not included in the stormwater management design.

# 6.0 MASSACHUSETTS STORMWATER CHECKLIST

## 6.1 STANDARD 1 – NO UNTREATED DISCHARGES

The stormwater management system has been designed to collect, treat and infiltrate stormwater in accordance with the Massachusetts Stormwater Handbook. The proposed design will not result in any new stormwater conveyance discharging untreated stormwater directly to the waters of the Commonwealth. Further documentation demonstrating stormwater treatment compliance is provided in Sections 6.4 and 6.5. of this report.

Flow discharge points have been reviewed to determine if additional protection is required to prevent erosive velocities. MassDEP requires evaluation for sheet flow from the 2-year, 24 hour storm. Discharge velocities from the 25-year, 24-hour discharge rates were used to determine flow velocities. Velocities over 5 feet per second are seen as erosive and require additional reinforcement during construction.

**Table 1 – Discharge Locations**

| Outlet | Effective Pipe Size | Q25, cfs | V25, fps | Min. Required Treatment |
|---|---|---|---|---|
| **EX 24" FES** | 24" | 10.24* | 3.26 | Riprap (Existing) |
| **EX 36" FES** | 36" | 43.40 | 6.14 | Riprap (Existing) |
| ***Value obtained from HydroCAD** | | | | |

As a result of this, it can be stated that the entire stormwater runoff from the development's impervious areas will be treated through stormwater management devices and will not result in untreated discharge. The existing outfalls are currently protected by riprap outlet aprons to prevent erosion from occurring in or adjacent to waters or wetlands of the Commonwealth. **This Standard has been met.**

## 6.2 STANDARD 2 - PEAK RATE ATTENUATION

The Peak Rate Attenuation Standard requires that stormwater management systems be designed such that post development peak discharge rates do not exceed predevelopment discharge rates. The only time this standard may be waived is for discharges to land subject to coastal storm flowage. The project site does not fall into this category. The project has been designed to collect, infiltrate and detain stormwater in compliance with this standard. Infiltration of stormwater on-site allows for a reduction of off-site runoff preventing increases in post-development conditions.

Pre-development Subcatchments:

| **Table 1 - Tributary to Point of Analysis #1 (POA #1)** | | |
|---|---|---|
| **Subcatchment ID** | Total Area, acres | Runoff Curve Number |
| **Catchment 1S** | 10.32 | 92 |
| **Catchment 3S** | 0.81 | 98 |
| **Catchment 5S** | 1.48 | 87 |
| **P.O.A. Totals** | | |
| | 12.61 | 92(P.O.A. composite) |

| **Table 2 - Tributary to Point of Analysis #2 (POA #2)** | | |
|---|---|---|
| **Subcatchment ID** | Total Area, acres | Runoff Curve Number |
| **Catchment 2S** | 2.73 | 75 |
| **P.O.A. Totals** | | |
| | 2.73 | 75 (P.O.A. composite) |

| **Table 3 - Tributary to Point of Analysis #3 (POA #3)** | | |
|---|---|---|
| **Subcatchment ID** | Total Area, acres | Runoff Curve Number |
| **Catchment 4S** | 1.22 | 70 |
| **P.O.A. Totals** | | |
| | 1.22 | 70 (P.O.A. composite) |

Post-development Subcatchments:

| **Table 1 - Tributary to Point of Analysis #1 (POA #1)** | | |
|---|---|---|
| **Subcatchment ID** | Total Area, acres | Runoff Curve Number |
| **Catchment 1S** | 2.35 | 98 |
| **Catchment 2S** | 1.38 | 98 |
| **Catchment 3S** | 1.35 | 95 |
| **Catchment 4S** | 6.05 | 91 |
| **Catchment 5S** | 1.43 | 87 |
| **Catchment 6S** | 0.57 | 72 |
| **Catchment 9S** | 0.52 | 98 |
| **P.O.A. Totals** | | |
| | 13.65 | 92 (P.O.A. composite) |

| **Table 2 - Tributary to Point of Analysis #2 (POA #2)** | | |
|---|---|---|
| **Subcatchment ID** | Total Area, acres | Runoff Curve Number |
| **Catchment 7S** | 2.09 | 77 |
| **P.O.A. Totals** | | |
| | 2.09 | 77 (P.O.A. composite) |

| Table 3 - Tributary to Point of Analysis #3 (POA #3) | | |
|---|---|---|
| **Subcatchment ID** | Total Area, acres | Runoff Curve Number |
| **Catchment 8S** | 0.82 | 71 |
| **P.O.A. Totals** | | |
| | 0.82 | 71 (P.O.A. composite) |

Stormwater Runoff Calculations:

In order to compare the existing conditions to design flow rates and volumes, our office set up a simple model to compute the existing flow rates. By using this as a baseline, a comparison can be made to the design project that will check to ensure anticipated flow rates are meeting the goals of Mass DEP Stormwater Management Standards. The results of the overall stormwater modeling indicate the following:

| Peak Runoff Rates – P.O.A. #1 | | | | | |
|---|---|---|---|---|---|
| | | Existing | | Proposed | |
| **Storm** | Rainfall | Rate, cfs | Volume (acre-feet) | Rate, cfs | Volume (acre-feet) |
| **2-Year** | 3.36” | 27.94 | 2.540 | 27.18 | 2.828 |
| **10-Year** | 5.21” | 46.31 | 4.286 | 45.53 | 4.790 |
| **100-Year** | 8.15” | 78.52 | 7.211 | 78.24 | 8.009 |

| Peak Runoff Rates – P.O.A. #2 | | | | | |
|---|---|---|---|---|---|
| | | Existing | | Proposed | |
| **Storm** | Rainfall | Rate, cfs | Volume (acre-feet) | Rate, cfs | Volume (acre-feet) |
| **2-Year** | 3.36” | 2.82 | 0.299 | 2.35 | 0.250 |
| **10-Year** | 5.21” | 6.12 | 0.613 | 4.89 | 0.497 |
| **100-Year** | 8.15” | 12.00 | 1.183 | 9.37 | 0.938 |

| Peak Runoff Rates – P.O.A. #3 | | | | | |
|---|---|---|---|---|---|
| | | Existing | | Proposed | |
| **Storm** | Rainfall | Rate, cfs | Volume (acre-feet) | Rate, cfs | Volume (acre-feet) |
| **2-Year** | 3.36” | 1.12 | 0.096 | 0.72 | 0.066 |
| **10-Year** | 5.21” | 2.85 | 0.227 | 1.84 | 0.154 |
| **100-Year** | 8.15” | 6.02 | 0.473 | 3.88 | 0.321 |

Based on the results above and the discussion of the pre- and post- development methodology, the project reduces the runoff rates for the 2-, 10-, and 100- year storm events for each Point of Analysis. **This Standard has been met.**

## 6.3 STANDARD 3 - STORMWATER RECHARGE

Standard 3 of the Massachusetts Stormwater Handbook states that loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

The first step in documenting compliance with this Standard is to compute the required recharge volume for the soil type that the site impacts. One component of this calculations is to determine the total area of new impervious surface over each soil type on the site.
The required volume of recharge is expressed as:

Rv = F x Impervious Area

where F is a factor dependent on Hydrologic Soil Groups. In this case, the development area soils are Hydrologic Group B soils. The corresponding F value to Hydrologic Soil Group B is shown below.

| **Hydrologic Soil Group** | **F** |
|---|---|
| **A** | 0.60 |
| **B** | 0.35 |
| **C** | 0.25 |
| **D** | 0.10 |

The impervious area is spread over Hydrologic Soil Group B. The recharge volume is calculated by applying the F factor to the change in impervious area from existing to proposed impervious areas, as well as the existing area being sent to the infiltration system that is on site today. Applying this to the impervious site area yields:

Total Change in Impervious Areas = 48,267 $ft^2$ (from AutoCAD)
Total Existing Impervious Area to Existing Infiltration System = 35,039+/- $ft^2$ (from AutoCAD)

The Massachusetts Stormwater Standards require that new development area be recharged, and redevelopment area be recharged to the maximum extent practicable. To calculate the amount of area required to be recharged, the area tributary to the existing infiltration system has been added to the new impervious area. This yields the following:

New Development and Existing Recharge Area (goal recharge area) = 48,257 $ft^2$ + 35,039 $ft^2$ = 83,296 $ft^2$

Multiplying this area by the F factor yields the following required recharge volume:

Rv = [(0.35”) x (1 ft/12”) x 83,296 $ft^2$)] =**2,429 $ft^3$**

The total impervious area draining to the infiltration system is 73,432 SF, and the goal recharge area is 83,306 S.F. Since the total goal recharge area is not draining to the system, adjustment factor has been applied.

$$\text{Capture Area Adjustment} = \frac{Goal\ Impervious\ Area}{(Goal\ Impervious\ Area - \text{Goal}\ Area\ not\ draining\ to\ Infiltration\ Systems)}$$

$$\text{Capture Area Adjustment} = \frac{83{,}296}{(83{,}296 - 9{,}884)} = 1.14$$

As documented in Section 2.2, test pits have been conducted for stormwater testing. The test pits indicated generally high elevations of estimated seasonal high groundwater. Due to the high groundwater and firm in place Soil Horizon C, the potential locations of recharge systems were very limited. A subsurface infiltration system was introduced at the trailer parking spaces to achieve recharge to the maximum extent practicable. The total volume of infiltration storage available was determined using static conditions (the "Static" method) within the system below elevation 341.00, the overflow weir within Outlet Control Structure #1. The available volume is as follows:

| **Table 1 – Required Recharge Volumes** | | | |
|---|---|---|---|
| **Basin ID** | Tributary Impervious Area (square-feet) | Required Recharge Volume (cubic-feet) | Available Recharge Volume (cubic-feet) |
| **Infiltration System 1** | 73,432 | 2,769 | 4,142 |

It has been documented in the table above that the available recharge exceeds the required goal recharge volume.
Drawdown times have been analyzed for these basins as well. Per Massachusetts Stormwater Management Standards, the infiltration BMP (best management practice) must drain within 72 hours for the recharge volume. To determine whether an infiltration BMP will drain within 72 hours, the formula below has been used.

$$\text{Time drawdown} = \frac{Rv}{(K)*(Bottom\ Area)}$$

Where:
Rv=Storage Volume
K = Saturathed Hydraulic Conductivity for the Static Method utilizing Rawls Rates of the in-situ saturated hydraulic conductivity.
Bottom Area = Bottom area of the recharge structure.

| Table 2 – Drawdown Time | | | | |
|---|---|---|---|---|
| Name of System | Storage Volume (Rv) | Saturated Hydraulic Conductivity (K) | Bottom Area of Recharge Structure | Drawdown Time (Hours) |
| Infiltration System 1 | 4,142 | 1.02 | 2,800 | 17.40 |

As documented above, due to high groundwater observed within the stormwater test pits, recharge cannot be provided for the redevelopment areas, however this standard been met for the new-development areas. T**his Standard has been met to the extent practicable.**

## 6.4 STANDARD 4 - WATER QUALITY

Massachusetts Stormwater Standard 4 requires stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS) and 44% of TSS in high infiltrative soils. In order to meet these criteria, BMPs must be designed into the overall site to provide treatment of runoff from impervious areas. Design criteria for many of these BMPs are based on a water quality volume of either ½" or 1", depending on several criteria for the project and site location. Water quality volumes must be based on a volume of 1/2" or 1" for each BMP when calculating effectiveness. The proposed project is considered a LUHPPL, and 1" must be used for each BMP.
Treatment trains for the project have been computed using the Massachusetts DEP TSS Removal Worksheets based on the DEP removal credits for properly designed and implemented measures and are located in Appendix I. The various treatment devices include:

- Deep Sump Catch Basins (25% TSS Removal) (Massachusetts Stormwater Handbook)
- CDS Systems (80% TSS Removal) (Contech Parameter Brief)
- Subsurface Infiltration System (80% TSS Removal) (Massachusetts Stormwater Handbook)
- Jellyfish Filter (85% TSS Removal) (NJCAT Certified) (WA DOE TAPE Testing)

All documentation regarding TSS removal for these devices can be found in Appendix I of this report.

**Treatment Train 1 – Deep Sump Catch Basins to CDS System to Subsurface Infiltration System**
Impervious area associated with the pavement and building are directed into deep sump catch basins. The deep sump catch basins act as the first structure to provide treatment, then discharge into the CDS2020 system and is ultimately conveyed to a subsurface infiltration system. This treatment train receives 97% TSS removal credit.

**Treatment Train 2 – Deep Sump Catch Basins to Jellyfish Filter**

| TSS Removal (New Development) | | |
|---|---|---|
| **BMP Train** | Impervious Area (sf) | TSS Removal Rate |
| **Deep Sump CBs** | 48,257 | 25% |
| **CDS System** | 48,257 | 80% |
| **Infiltration** | 48,257 | 80% |
| **Composite TSS Removal** | | **97%** |

| TSS Removal (Redevelopment) | | |
|---|---|---|
| **BMP Train** | Impervious Area (sf) | TSS Removal Rate |
| **Deep Sump CBs** | 191,477 | 25% |
| **CDS Systems** | 213,977 | 80% |
| **Infiltration** | 25,175 | 80% |
| **Jellyfish Filter** | 188,802 | 85% |
| **Composite TSS Removal** | | **99%** |

Impervious area associated with the pavement are directed into deep sump catch basins. The deep sump catch basins act as the first structure to provide treatment, then discharge into the Jellyfish filtration unit, then later discharge through the existing rcp pipe to the wetland. This treatment train receives 85% TSS removal credit.

| | | Cumulative Load Reduction | | | | |
|---|---|---|---|---|---|---|
| Infiltration Rate (in/hr) | Depth of Runoff from Impervious Area (inches) | TSS | Phosphorus | Nitrogen | Zinc | Runoff Volume |
| 1.02 | 0.1 | 67% | 41% | 59% | 78% | 25% |
| | 0.2 | 94% | 60% | 77% | 92% | 42% |
| | 0.4 | 96% | 81% | 92% | 99% | 66% |
| | 0.6 | 99% | 90% | 96% | 100% | 79% |
| | 0.8 | 100% | 94% | 98% | 100% | 87% |
| | 1.0 | 100% | 97% | 100% | 100% | 91% |
| | 1.5 | 100% | 99% | 100% | 100% | 96% |
| | 2.0 | 100% | 100% | 100% | 100% | 98% |

| **Phosphorus Removal (New Development)** | | | |
|---|---|---|---|
| **BMP Train** | Impervious Area (sf) | Phosphorus Removal Rate | Percentage of Impervious Area |
| **Infiltration** | 48,267 | 90% | 100% |
| **Composite Phosphorus Removal** | | **90%** | |

| **Phosphorus Removal (Redevelopment)** | | | |
|---|---|---|---|
| **BMP Train** | Impervious Area (sf) | Phosphorus Removal Rate | Percentage of Impervious Area |
| **Infiltration** | 25,175 | 90% | 7% |
| **JellyFish Filter** | 188,802 | 75% | 93% |
| **Composite Phosphorus Removal** | | **77%** | |

| **Phosphorus Removal (Overall Development)** | | | |
|---|---|---|---|
| **BMP Train** | Impervious Area (sf) | Phosphorus Removal Rate | Percentage of Impervious Area |
| **Infiltration** | 73,432 | 90% | 28% |
| **JellyFish Filter** | 188,802 | 75% | 72% |
| **Composite Phosphorus Removal** | | **79%** | |

The TSS Removal Calculation has been provided with the calculations in the appendices and demonstrates that a minimum of 97% TSS will be removed prior to discharge into the infiltration system. When analyzing the overall development and combination of each BMP, the development provides a total of 99% TSS and 79% total phosphorus will be removed by the entire Stormwater Management System **This Standard has been met.**

## 6.5 STANDARD 5 - LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

This project features a land use with higher potential pollution loads. Upstream of the infiltration system is a water quality unit that will provide the required pretreatment prior to discharging into the system. In the event a spill occurs within the loading apron area or other higher potential pollutant load area, there will be spill prevention in place located in the vicinity of catch basins that can be used to cover each catch basin and prevent pollutants from discharging into the stormwater management system. The required water quality volume flow rate equals 1-inch times the total impervious area of the post-development site. This water quality volume can be converted to a discharge rate that is used for sizing flow for manufactured proprietary stormwater treatment practices. The flow rate is calculated using the following equation:

$$Q_{1.0} = qu * A * WQV$$

$$Q_{1.0} = Flow\ rate\ associated\ with\ the\ first\ inch\ of\ runoff$$

qu=the unit peak discharge, in csm/in.

A = impervious surface drainage area (in square miles)

WQV= Water quality volume in watershed inches (1 inch in this case)

**Table 3 – Water Quality Flow Rate**

| Model | Unit peak discharge ‘qu’ (csm/in) | Impervious Drainage Area ‘A’ (sq-ft) | Impervious Drainage Area ‘A’ (sq-miles) | $Q_{1.0}$ (cfs) | Model (min.) |
|---|---|---|---|---|---|
| **WQU #1** | 774 | 73,432 | 2.64E-03 | 2.04 | CDS 2020-5-C |
| **WQU #2** | 774 | 188,802 | 6.77E-03 | 5.24 | CS-8 |
| **PMF #1** | 774 | 188,802 | 6.77E-03 | 5.24 | JFPD0814-36 |

The CDS Hydrodynamic Separator devices provide total suspended solids removal while the Jellyfish proprietary media filters provide total suspended solids and total phosphorus removal. The inspection and maintenance requirements for each device are included with the Operation and Maintenance Plan found in the appendices. As demonstrated in the table above, the required water quality flow rate has been accommodated within each water quality unit and proprietary media filter (WQU/PMF). **This Standard has been met.**

## 6.6 STANDARD 6 - CRITICAL AREAS

Standard 6 applies to Zone IIs, Interim Wellhead Protection Areas or Areas near or to other Critical Areas: Shellfish Growing Areas, Bathing Beaches, Outstanding Resource Waters, Special Resource Waters, and Cold-Water Fisheries. The project is not located within any of these resource areas, however Dix Brook has been identified as a Division of Fisheries and Wildlife Coldwater Fishery. Dix Brook is located approximately 1/3rd of a mile away from the discharge location of the existing stormwater pond/wetland resource area. As the discharge from the development first discharges to the onsite stormwater pond/wetland prior to discharging through a 1/3rd of a mile to Dix Brook, we do not believe this standard is applicable. **This Standard does not apply.**

## 6.7 STANDARD 7 – REDEVELOPMENT

Standard 7 of the Massachusetts Stormwater Handbook applies to redevelopment projects and requires that the goals of Standard 2, Standard 3, and the pretreatment and structure best management practices of Standards 4, 5, and 6 be met only to the maximum extent practicable. This project proposes an increase in impervious area, therefore the project classifies as a new development for the increase in impervious area, as well as a redevelopment for the equivalent impervious area. **This standard has been met.**

## 6.8 STANDARD 8 - CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION AND SEDIMENTATION CONTROL

Pollution prevention and erosion and sedimentation control measures will be implemented during all construction phases of the project. Control measures will address construction related impacts and land disturbance activities. An Erosion Control Plan is included in the plan set and incorporates the use of silt fences and silt socks along the downstream slope of the property. Silt sacks will be installed in existing catch basins to prevent sediment accumulation within them. **This standard has been met.**

## 6.9 STANDARD 9 - OPERATION AND MAINTENANCE PLAN

For this project, a Long-Term Operations and Maintenance manual has been developed under separate cover. This manual has been developed for the property owner and operator to maintain records of all required inspections and maintenance activities as the project site is operated in the future. The requirements listed in the Massachusetts Stormwater Checklist have been incorporated into the Manual. **This Standard has been met.**

## 6.10 STANDARD 10 - PROHIBITION OF ILLICIT DISCHARGES

This standard requires a signed statement regarding illicit discharges. A stamped and signed statement reading the following is included in the appendices.

> The stormwater management system is the system for conveying, treating, and infiltrating stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

It is our belief and understanding, to the best of our knowledge, that there are no known illicit discharges on the site at 55 Constitution Boulevard in Franklin, Massachusetts (Parcel ID 313-059).

Standard 10 also requires that, in addition to the Illicit Discharge Compliance Statement, a site map, drawn to scale, must identify the location of all systems conveying stormwater on the site and display that no connections between these systems and any waste management system exist. Engineering drawings accompanying this report display the location of all stormwater management components. These drawings serve as site maps and establish that no illicit discharges are proposed for this project. **This Standard has been met.**

# 7.0 LOCAL STORMWATER MANAGEMENT REQUIREMENTS

The proposed development has been designed in accordance with all standards of the Massachusetts Stormwater Management Handbook. In addition to these standards, the proposed development has been designed to comply with the local regulations of the Town of Franklin in accordance with Chapter 153, Stormwater Management.

## 7.1 CHAPTER 153 SECTION 12 - SOIL EROSION AND SEDIMENT CONTROL PLAN

*A soil erosion and sediment control plan at the same scale as the site plan, which meets the design requirements of this bylaw, shall be prepared and submitted to the Department of Public Works. The plan shall include, but not be limited to, the items listed below and, at a minimum, be designed to provide sufficient information to evaluate the effectiveness and acceptability of measures proposed for soil erosion and sediment control during construction to protect the environment, public welfare/health, and municipal facilities and utilities.*

The proposed development plans incorporate an Erosion and Sedimentation Control Plan, a Drainage Plan, and various other plans that incorporate information required in this section the plans.

## 7.2 CHAPTER 153 SECTION 15 - STORMWATER MANAGEMENT PLAN

*A stormwater management plan at the same scale as the site plan, which meets the design requirements of this bylaw, shall be prepared by a licensed civil engineer and submitted to the Department of Public Works. The plan shall include, but not be limited to the items listed below and, at a minimum, be designed to provide sufficient information to evaluate the environmental characteristics of the affected areas, the potential impacts of the proposed development on water resources, and the effectiveness and acceptability of measures proposed for managing stormwater runoff. The applicant shall certify on the drawings that all clearing, grading, drainage, construction, and development shall be conducted in strict accordance with the plan. The minimum information, in addition to the name, address and telephone number of the owner,* *licensed civil engineer and person responsible for implementation of the plan, submitted for support of a stormwater management plan shall be as follows:*

A Stormwater Management Report and Project Plans have been prepared by a licensed Civil Engineer. These documents provide information on the potential impacts of the proposed development on water resources and the applicable required information.

## 7.3 CHAPTER 153 SECTION 16 - STANDARDS

*Control of stormwater runoff shall meet all federal and state requirements, including the Massachusetts Stormwater Handbook (as amended), the requirements of the Town of Franklin's Subdivision of Land Stormwater Management Regulations, (300-11), the most recent Town of Franklin MS4 stormwater permit and the Town of Franklin's Best Development Practices Guidebook. All assumptions, methodologies and procedures used to design stormwater treatment practices and stormwater management practices shall accompany the design. All activities, project design, stormwater treatment practices and stormwater management practices should aim to minimize stormwater runoff, maximize infiltration and recharge where appropriate, and minimize pollutants in stormwater runoff.*

The proposed development plans and stormwater report are prepared in accordance with the federal, state and Town of Franklin requirements.

*In addition to meeting the requirements of the Massachusetts Stormwater Standards, as required under the Town of Franklin MS4 stormwater permit, all stormwater management systems shall meet the following criteria:*
*For new development sites, all stormwater management systems shall be designed to:*

- *Retain the volume of runoff equivalent to, or greater than, 1.0 inch multiplied by the total post-construction impervious surface area on site, and/or:*
- *Remove 90% of the average annual load of total suspended solids generated from the total post-construction impervious area on the site and 60% of the average annual load of total phosphorus (TP) generated from the total post-construction impervious surface area on site.*

The proposed stormwater management system will remove 97% of the average annual load of total suspended solids and 90% of the total phosphorus generated from the development's new impervious area. This requirement has been met.

*For redevelopment sites, stormwater management system shall also improve existing conditions by being designed to the following criteria:*

- *Retain the volume of runoff equivalent to, or greater than 0.80 inch multiplied by the total post-construction impervious surface area on the site, and/or*
- *Remove 80% of the average annual post-construction load of total suspended solids (TSS) generated from the total post-construction impervious area on the site and 50% of the average annual load of total phosphorus (TP) generated from the total post construction impervious surface area on the site.*

The proposed stormwater management system will remove 98% of the average annual load of total suspended solids and 78% of the total phosphorus generated from the redevelopment impervious area. This requirement has been met.

### 7.3.1 CHAPTER 300 SECTION 11 – STORMWATER MANAGEMENT

A.

(1) Control of stormwater runoff shall meet all federal and state requirements, including the Massachusetts Stormwater Management Standards, the requirements of Chapter **153**, Stormwater Management of the Town of Franklin's Town Code, and the Town of Franklin's Best Development Practices Guidebook. All assumptions, methodologies and procedures used to design stormwater treatment practices and stormwater management practices shall accompany the design. All activities, project design, stormwater treatment practices and stormwater management practices should aim to minimize stormwater runoff, maximize infiltration and recharge where appropriate, and minimize pollutants in stormwater runoff.

The stormwater management design for the proposed project meets all federal, state and Town of Franklin regulations. All methodologies, assumptions, procedures and calculations used to design the stormwater management system are included in this stormwater report accompanied by the project plans.
The stormwater design proposes deep sump catch basins to collect and and convey stormwater to water quality units, proprietary filtration devices and the infiltration system to provide treatment and recharge before discharging to wetland resource areas. **This standard has been met.**

(2) Protection. The definitive plan shall provide adequate drainage facilities within the subdivision for collecting, conveying and disposing of stormwater in a manner which will ensure proper protection of the roadway and the areas adjacent thereto. The definitive plan shall provide for groundwater recharge and adequate treatment for water quality, and shall not create an increase in flow.

**This standard is not applicable to this project.**

(3) On-site recharge. Developers will submit a detail of the stormwater treatment facility showing side stabilization, depth and soil character. Stormwater treatment facilities shall be employed to trap possible pollutants and handle peak stormwater flow into any off-site wetland, water body or drainage facility so that said flow will, in a two-year-, ten-year-, and one-hundred-year storm, be no higher following development than it was previously. The grading for these components must blend in naturally with existing contours. Post-development conditions may not increase the peak rate and volume of stormwater flow, or increase the contaminant burden from stormwater flows. The Board may authorize an increase following applicant demonstration that such increase will cause no environmental harm or damage to public or private property. Where the only method of drainage is via public or private property, the subdivider shall furnish plans, obtain easements where necessary in the Town's behalf and assume all financial responsibility for drainage of the area. All drainage facilities proposed shall utilize best management practices as outlined in the Massachusetts Stormwater Management Standards.

The proposed stormwater system provides a decrease in flow rate to the discharge areas compared to existing conditions at the 2, 10 and 100-year storms. The grading within the development blends naturally to existing contours, intending to limit the disturbance to resource areas to the best extent possible. Drainage facilities were designed to utilize the best management practices outlined in the Massachusetts Stormwater Management Standards. **This standard has been met.**

(4) Stormwater management components must be located on a separate lot of sufficient size and with sufficient access.

**This standard is not applicable to this project.**

(5) Drainage systems. Closed drainage systems shall not utilize catch-basin-to-catch-basin connections.

The drainage system will not utilize any catch-basin-to-catch-basin connections. **This standard has been met.**

(6) Lot drainage. Lots shall be prepared and graded in such a manner that development of one shall not cause detrimental drainage on another. If provision is necessary to carry drainage to or across a lot, an easement or drainage right-of-way of a minimum width of 20 feet and proper side slope of at least three to one shall be provided. Storm drainage shall be designed in accordance with the specifications of the Board. Where required by the Planning Board, the applicant shall furnish evidence as to any lot or lots for which adequate provision has been made for the proper drainage of surface and underground waters from such lot or lots.

The proposed development is prepared and graded to prevent damage to adjacent lots. An existing reinforced concrete pipe that connects the fire department stormwater runoff to the proposed projects drainage system, is being maintained to mimic existing conditions. Calculations related to the design of the stormwater management system are prepared in Appendix I of this document.

(7) Setbacks. Stormwater management facilities shall be constructed to maintain the following setback distances from structures and other facilities:

(a) The minimum distance from the edge of the maximum pond water surface to property lines and structures shall be 20 feet.

(b) The distance from the toe of the pond berm embankment to the nearest property line shall be a minimum of 10 feet.

The stormwater management design abides by the setback restrictions in this standard. **This standard has been met.**

(1) General. Culverts shall be designed to accommodate a fifty-year-frequency storm; underground storm drains, catch basins and related installations shall be designed to accommodate a twenty-five-year-frequency storm with a design velocity of between 2.5 feet and 10.0 feet per second. In high volume conditions [greater than 15 cubic feet per second (CFS)], the maximum design velocity shall not exceed eight feet per second.
[Amended 6-3-1996]

Underground storm drains, catch basins, and related installations have been designed to accommodate a 25-year storm utilizing a hydraulic grade line The design velocities vary between 0.3 feet per second and 7.1 feet per second. Due to constraints from existing outfall locations, and to limit excessive pipe trenches, the slopes of various pipes were designed to provide a full flow design velocity of at least 2.5 feet per second. **Waiver requested.**

(2) Piping.

(a) The drainage pipe shall be reinforced concrete, with bell and spigot gasketed joints. The pipe shall be Class III in accordance with ASTM C-76. The gaskets shall be O-ring type in accordance with ASTM C-443. The minimum diameter shall be 12 inches. The pipe shall be laid in undisturbed trenches below the grade of pipes, starting with the downstream end on a firm bedding. All bells shall be facing upstream. Reference bench marks shall be clearly marked to enable the Department of Public Works Director to check the grade and invert elevations. The joints of all concrete pipes shall include a pre-molded neoprene continuous O-ring flexible compression gasket. No backfilling of pipes or culverts shall be done until the installation has been inspected and approved by the Department of Public Works Director. Backfilling shall be in layers not exceeding 12 inches, with each layer compacted by an appropriately sized plate vibrator, regardless of the method of final compaction at the subbase or gravel base level. The minimum cover is 42 inches above the top of the pipe.
[Amended 3-23-1998 by Bylaw Amendment S-98-19]

For the stormwater management system, the use of HDPE pipe is being proposed. A waiver will be requested for the use of HDPE pipe in lieu of reinforced concrete pipe. HDPE provides a significant cost savings, meets HS-20 loading requirements, and is acceptable practice for private developments.
**Waiver requested.**

(b) If required by the Department of Public Works Director, side underdrains shall be installed on both sides of all streets, except in fill sections, and connected to the surface drainage system. In circumstances where the groundwater table is not within four feet of the finished grade and each linear foot of underdrain would serve a surface drainage area of not more than 20 square feet, or in other circumstances which would render such underdrains superfluous, the Department of Public Works may waive such requirement. The side drains shall be shown in cross-section detail.

There are no streets proposed in this project. **This standard is not applicable.**

(c) At each outfall of a drain line, a Type B winged headwall of reinforced concrete shall be constructed according to the detail shown in the Appendix.[1]

[1] *Editor's Note: See Appendix 2 included at the end of this chapter.*

There are no new proposed outfalls for this project. **This standard is not applicable.**

(3) Catch basins and drain manholes.

(a) Catch basins shall be installed on both sides of the roadway on continuous grades at intervals not exceeding 300 feet, at low points on the roadway, at the corners of intersecting streets, within each turnaround and at such other locations as required by the Board. Three catch basins and two manholes are required in turnarounds sloped towards the bulbed end. Two catch basins and one manhole are required in turnarounds sloped towards the entering roadway. No catch basins are allowed in driveway openings.

The proposed project does not contain any roadways. **This standard is not applicable.**

(b) Catch basins and drain manholes shall be constructed of concrete-block masonry eight inches in thickness with an inside diameter of four feet or more. They shall be built with horizontal and vertical mortared joints. The arch or cone section shall be 24 inches in height consisting of a first row, second row, third row and a ring row (either round or square as appropriate). The cone section shall be mortared on the exterior. The faces of all pipes shall be flush with or project not more than four inches into the basin or manhole. Precast catch basins and manholes may be used in lieu of concrete-block-masonry structures. Flat-topped structures are not allowed, unless with written authority of the Department of Public Works Director.
[Amended 6-3-1996]

Precast concrete catch basins and drain manholes will be used in lieu of the concrete-block masonry structures, which is standard practice for private developments.
**The standard has been met.**

(c) Catch basins shall have a minimum sump of 48 inches. They shall have a base of precast concrete plates, four inches thick, laid flat with a twelve-inch weep hole in the center.
[Amended 3-23-1998 by Bylaw Amendment S-98-19]

A waiver is requested for the twelve-inch weep hole in the center of the base. Catch Basins cannot directly infiltrate stormwater from the catch basin in a LUHPPL. **Waiver requested**

(d) Drain manholes shall have a four-inch-thick concrete base. At least one row of blocks shall be set on the base to allow the construction of a brick table within the manhole. Arched inverts of 1/2 the pipe diameter shall be sloped upward to the sides of the manhole. The tops of the main drain lines entering and leaving a manhole shall be matched.

A waiver is being requested for this standard; the storm drainage pipes have been sized utilizing a Hydraulic Grade Line. Matching the tops of the drain lines is neither necessary nor feasible given the flatness of the site. **Waiver requested**

(e) No more than four pipe openings shall be allowed in any one manhole. Four-foot-diameter manholes will be used for drains up to 30 inches in diameter. Five-foot-diameter manholes are necessary for pipe diameters between 36 and 48 inches. All flows into a manhole shall be in the same direction (no reverse flows allowed), with a maximum angle between the main and any connecting line of 90°. All connecting lines shall have bricked inverts rounded into the direction of flow.

A waiver is being requested for the brick invert requirement; the storm drainage pipes have been designed using the Hydraulic Grade Line. Brick inverts are not necessary for this drainage system.
**Waiver requested.**

(f) Drain manholes shall be installed at all catch basin connections, at changes in grade, size and alignment, but in no event shall the distance between manholes exceed 300 feet.

It appears that this standard is meant for roadways, where there are changes in grade that could result in pipes having inadequate cover depth. Drainage manholes have been located at all catch basin connections, are not separated further than 300 feet, and have sufficient cover depth over the drainage pipes.

(g) Catch basins and drain manholes shall be constructed with cast-iron frames and covers or grates. Frames must be set in a full bed of cement mortar. Bricks shall be used between the frame and top course for grade adjustment. They shall be laid in a radial fashion with full bearing on the ring row. A maximum of two brick courses will be allowed. Frames shall be at least 265 pounds and shall be of North American manufacture. Covers or grates shall be no less than 210 pounds, in accordance with the Standard Specifications and shall be of North American manufacture. The word "drain" shall be cast into the solid cover in letters at least three inches in height.
[Amended 3-23-1998 by Bylaw Amendment S-98-19]

A waiver is being requested, this project proposes the use of standard catch basin and manhole frames and grates/covers. The weight of these structures is less than the required amount by this standard. BAI is open to the use of a different specification for these structures, if proposed by the Town of Franklin DPW.

(h) Manhole casting shall be set flush with the designed finish grade of the pavement. Catch basin grates shall be set one inch below the finished gutter grade and shall be of the eggbox variety (square openings). Manhole castings and catch basin grates shall not be raised until thirty days prior to final paving. If paving does not occur within said thirty days, they shall be lowered immediately. Ramping is prohibited.
[Amended 3-23-1998 by Bylaw Amendment S-98-19]

Manhole casting will be set flush with the finish grade of the proposed pavement areas. Catch basin grates will be set one inch below the finished grade and the grates will have square openings.
**This standard has been met.**

(i) Details of standard manhole, catch basin, frame and grate and curb inlet are shown in the Appendix.[2]

[2] *Editor's Note: See Appendix 2 included at the end of this chapter.*

Noted

(j) Drain manholes shall have rung manhole steps 15 inches on center built into the vertical side.
[Added 2-6-1989]

Manhole steps will built into the vertical side of each structure.

## 7.4 CHAPTER 153 SECTION 18 – OPERATION AND MAINTENANCE PLANS

*An operation and maintenance plan (O&M Plan) is required at the time of application for all projects. The maintenance plan shall be designed to ensure compliance with the permit in all seasons and throughout the life of the system. The Director shall make the final decision of what maintenance option is appropriate in a given situation. The Director will consider natural features, proximity of site to water bodies and wetlands, extent of impervious surfaces, size of the site, the types of stormwater management structures, and potential need for ongoing maintenance activities when making this decision. The O&M Plan shall identify and include all required documents, including, but not limited to, maintenance agreements and* *stormwater management easements. All documents shall be submitted to the Town Attorney for review and must be in a form satisfactory to the Town Attorney. The operation and maintenance plan shall remain on file with the Department of Public Works and shall be an ongoing requirement. The O&M Plan shall include:*

An Operation and Maintenance Manual Project Plans have been prepared by a licensed Civil Engineer. These documents provide information such as the responsible party for financing maintenance and emergency repair, as well as a maintenance schedule for all drainage structures.

# 8.0 EROSION CONTROL NARRATIVE

## 8.1 OVERVIEW OF SOIL EROSION AND SEDIMENTATION CONCERNS

The characterization of the site indicates that there is the presence of wooded regions that would need to be cleared as well as previously developed areas that will require demolition and regrading to accommodate the proposed development. These types of activities have the potential to produce large amounts of runoff through earth disturbing activities and transport sediment from destabilized areas through runoff, dust or tracking. With this in mind, the primary emphasis of the erosion and sedimentation control plan to be implemented for this project will be:

- Plan the project to be constructed from areas of flatter grades and away from resources or the property boundaries to the extent practical.
- Develop a careful construction sequence.
- Rapid stabilization of denuded areas to minimize the period of soil exposure.
- Rapid stabilization of drainage paths to avoid rill and gully erosion.
- The use of onsite measures to capture sediment (straw bales, silt fence, silt sock, etc.,)
- Protection of Natural Resource areas and drainage courses through buffering and the use of Best Management Practices.
- The implementation of long-term measures for erosion/sediment pollution treatment through the construction of permanent water quality measures.

## 8.2 DESCRIPTION AND LOCATION OF LIMITS OF ALL PROPOSED EARTH MOVEMENTS

The proposed development will require areas of cuts and fills to create a balance site. The proposed net earthwork requires a 3,350+/- fill throughout the development. Cut and fill amounts vary throughout the site, with the largest amount of fill located in the southwestern and west central locations requiring 3-6 feet of fill. Along the eastern portion of the site will require 1-2 feet of fill to bring elevations up to the proposed building finished floor elevations. The largest area of cuts will be primarily within the loading aprons, where grade drops 4 feet from the finished floor elevation for loading docks.

## 8.3 EXISTING AND PROPOSED DRAINAGE FEATURES

The proposed project will feature a stormwater management system. The systems on the site will consist of subsurface infiltration/detention systems and water quality units. This system is described and analyzed in the Stormwater Management Report for this project. The existing drainage infrastructure serves the existing development along with a portion of the fire departments property. The majority of infrastructure will be removed during the demolition phase of development.

## 8.4 CRITICAL AREAS

The proposed development does not feature any areas of critical concern, however there are Bordering Vegetated Wetlands and Isolated Land Subject to Flooding along the western edge of the property. Proper care should be taken to ensure that no turbid discharges are directed to these resource areas.

## 8.5 EROSION AND SEDIMENTATION CONTROL DEVICES

Prior to and during the development of the construction activities, the site contractor shall implement the following erosion and sedimentation control measures.

### Siltation Fence & Silt Sock

Siltation fence shall be installed downstream of any disturbed areas to trap runoff borne sediments until the site has been stabilized. The silt fence shall be installed per the details on the construction plans along with a silt sock and inspected immediately after each rainfall and at least daily during prolonged rainfall. Repairs shall be made immediately by the Contractor if there are any signs of erosion or sedimentation below the silt fence line. If such erosion is observed, the contractor shall take proactive action to identify the cause of the erosion and take action to avoid its reoccurrence. Typically, this requires that stabilization measure be taken to the disturbed tributary area. Proper placement of stakes and keying the bottom of the fabric into the ground is critical for the filter's effectiveness. If there are signs of undercutting at the center or the edges, or impounding of large volumes of water behind the fence, the barrier shall be replaced with a stone check dam and measures taken to avoid the concentration of flows not intended to be directed to the silt fence and silt sock.

### Straw Mulch

Straw mulch including hydro seeding is intended to provide cover for denuded or seeded areas until revegetation is established. Mulching should be occurring several times per week when the site construction activity is high and at sufficient intervals to reduce the period of exposure of bare soils to the time limits set forth in this plan. Mulch placed on slopes of less than 10 percent shall be anchored by applying water; mulch placed on slopes steeper than 10 percent shall be covered with fabric netting as immediately after mulching as practicable and anchored with staples in accordance with the manufacturer's recommendations. Proposed drainage channels, which are to be revegetated, shall receive Curlex blankets by American Excelsior or North American Green selected for the slope, velocity, and whether the measure is temporary or intended to be in place for a sustained period. Straw mulch shall be available on site at all times in order to provide immediate temporary stabilization when necessary.

### Temporary Stormwater Settlement Basins

Temporary stormwater settlement basins may be constructed to provide sedimentation control for stormwater runoff from the individual site areas during construction. These basins may become necessary where other erosion control measures are not adequate to prevent offsite sedimentation. The basin should only be used where there is sufficient space and appropriate topography. The basin should be large enough to handle the maximum amount of expected site drainage. The basin may be constructed by excavation, construction of a compacted embankment or a combination of both. It may have one or more inflow points carrying polluted runoff. To improve trap efficiency, the basin should have the maximum surface area possible and sediment should enter the basin as far from the outlet as possible.

### Riprap Slopes and Ditch Linings

Riprap can be used as a temporary (or permanent) method to protect denuded ground from runoff with erosive velocities by dissipating energy and slowing down surface water runoff. Well graded riprap forms a dense, flexible, self-healing cover that adapts well to uneven surfaces. Riprap should be placed on a proper filter material of sand, gravel or fabric to prevent soil from piping through the stone. For most applications, graded riprap is preferred to uniform riprap. Graded riprap forms a flexible self-healing cover while uniform riprap is more rigid and cannot withstand the movement of the stones. Graded riprap is cheaper to install, requiring only that the stones be dumped so that they remain in a well-graded mass. Hand or mechanical placement of individual stones is limited to that necessary to achieve the proper thickness and line. Uniform riprap requires placement in a more or less uniform pattern, requiring more hand or mechanical labor.

### Stone Check Dams

A check dam is a small dam constructed across a drainage ditch, swale or channel to reduce the velocity of the surface runoff. Reduced runoff velocity reduces erosion and gullying in the channel and allows the sediment to settle out. Where temporary channels or permanent channels are not yet vegetated, channel lining is infeasible and velocity checks are required. This practice may be used as a temporary or emergency measure to limit erosion by reducing flow in small open channels.

### Straw Bale Barriers

Straw bale barriers are used similarly to silt fence specifically where the area below the barrier is undisturbed and vegetated. Bale barriers require more maintenance than silt fence barriers and permeability through bale barriers is slower than silt fence. Bale barriers should be located where they will trap sediment. Bales located along the top of a ridge serve no useful purpose. Straw bale barriers should be removed when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

### Culvert Outlet Aprons

Outlet protection should be installed at all pipe, culvert or swale outlets where velocity of flow may cause erosion at the pipe outlet and in the receiving channel. Erosion at these locations is common and can cause structural failure with serious downstream problems. A riprap lined apron is the most commonly used structure for this purpose because it has relatively low cost and can be installed easily on most sites.

### Construction Entrance

A construction entrance will be constructed at all access points onto the site to prevent tracking of soil onto adjacent local roads. Proposed construction entrances are shown on the Erosion Control plan. Construction entrances provide an area where mud can be removed from vehicle tires before they enter a public road. If the action of the vehicle travelling over the gravel pad is not sufficient to remove the majority of the mud, then tires must be washed before the vehicle enters a public road.

### Inlet Protection

Storm drain catch basin inlet protection shall be provided through the use of stone sediment barriers or a premanufactured SiltSack as distributed by A.H. Harris. The barriers shall be inspected after each rainfall and repairs made as necessary. Sediment shall be removed and the barrier restored to its original dimensions when sediment has accumulated to 1/3 the design depth of the barrier. The barrier shall be removed when the tributary drainage area has been stabilized.

### Filter Bags

Filter bags will be required to be onsite and available for construction dewatering. The use of filter bags will be required in the event that trench dewatering activities cannot be discharged through a natural buffer area at least 100 feet in length or at any signs of any turbid discharge from the site.

### Slope Protection

Additional slope protection will be required in areas of steep slopes and where proposed grades meet existing grades at acute angles that could cause gully erosion. This protection will be mainly in the form of the installation of erosion control blankets in areas where slopes exceed 3:1, H:V, up to 2:1, H:V. Areas where slopes exceed 2:1, H:V, should be stabilized with rip rap slope stabilization at the toe of slope except where otherwise specified.

### Loam and Seed

Loam and seed is intended to serve as the primary permanent revegetative measure for all denuded areas not provided with other erosion control measures, such as riprap or permanently covered with roadway gravel, pavement or building area.

## 8.6 Temporary Erosion and Sedimentation Control Measures

The following are planned as temporary erosion and sedimentation control measures during construction:

- A crushed stone-stabilized construction entrance shall be placed at any construction access points into the site. The locations of the construction entrances shown on the drawings should be considered illustrative and adjusted as appropriate and located at any area where tracking of mud and debris onto existing roads, previously paved areas within the project, or streets is a potential. Stone stabilized construction entrances will require the stone to be removed and replaced as it becomes covered or filled with mud and material tracked by vehicles exiting the site.

- Siltation fence or an equivalent sediment barrier shall be installed along the downgradient side of the proposed improvement areas. The siltation fence will remain in place and properly maintained until the site is acceptably revegetated. Siltation fence is to be used along the contour of significant fill slopes as illustrated on the erosion control plan site drawings. Siltation fence needs to be checked to insure the bottom is properly keyed in and inspected after significant rains. Wood chips from clearing are often used on the construction site in front of the silt fence to provide an extra margin of safety and security for the silt fence. This practice is encouraged, provided the chips are removed or dispersed into forested areas when the fence is removed.

- Filter bags shall be installed in accordance with the details in the plan set. The filter bag's function on the project is to receive any water pumped from excavations during construction. A filter bag shall be installed and prepared for operation prior to any trenching on site. When filter bags are observed to be at 50% capacity, they shall be cleaned or replaced. Stone under the filter bags shall be removed and replaced concurrently.

- Temporary stockpiles of common excavation will be protected as follows:

    - Temporary stockpiles shall not be located within 100 feet of critical areas and at least 50 feet upgradient of the perimeter silt fence and silt sock.
    - Inactive stockpiles shall be stabilized within 5 days by either temporarily seeding the stockpile with a hydro seed method containing an emulsified mulch tackifier or by covering the stockpile with mulch. If necessary, mesh shall be installed to prevent wind from removing the mulch.

- Open areas of the site shall be limited to 5 acres. All denuded areas which have been rough graded shall receive mulch or erosion control mesh fabric within 7 days of initial disturbance of soil. Disturbed areas within 75' of critical areas must receive temporary erosion control measures within 48 hours.

- Between November 1 and April 1, open area shall be limited to three acres, and disturbed soil shall be covered with mulch within 5 days of disturbance, prior to any predicted storm event of the equivalent of ½" of equivalent rainfall in a 24-hour period, or prior to any work shutdown lasting more than 48 hours (including weekends and holidays). The mulch rate shall be double the normal rate.

    - For work that is conducted between November 1 and April 15 of any calendar year, all denuded areas will be covered with hay mulch, applied at twice the normal application rate, and (in areas over 10% grade) anchored with a fabric netting. The time period for applying mulch shall be limited to 5 days for all areas or immediately in advance of a predicted rainfall event.

- The paved access roads shall be swept to control mud and dust as necessary. A street sweeper shall be available from the contractor on immediate notice or as requested by the Owner or regulatory agency.

- Stone check dams or hay bale barriers will be installed at any evident concentrated flow discharge points during construction and earthwork operations.

- Silt fencing with a maximum stake spacing of 8 feet should be used, unless the fence is supported by wire fence reinforcement of minimum 14 gauge and with a maximum mesh spacing of 6 inches, in which case stakes may be spaced a maximum of 10 feet apart. The bottom of the fence should be properly anchored a minimum of 6” per the plan detail and backfilled. Any silt fence and silt sock identified by the Owner or reviewing agencies as not being properly installed during construction shall be immediately repaired in accordance with the installation details.

- Storm drain catch basin inlet protection shall be provided through the use of stone sediment barriers or a premanufactured SiltSack® as distributed by A.H. Harris Company, Portland, Maine. Stone sediment barrier installation details are provided in the plan set. The barriers or SiltSacks® shall be inspected after each rainfall and repairs made as necessary, including the removal of sediment. Sediment shall be removed and the barrier or SiltSack® restored to its original dimensions when the sediment has accumulated to ½ the design depth of the barrier. Inlet protection shall be removed when the tributary drainage area has been stabilized.

- All slopes over 3:1 shall receive erosion control mesh.

- All areas which feature narrow angles of slope interface between proposed surfaces and existing surfaces shall receive erosion control mesh to prevent scouring.

- Additional siltation fences or sediment barriers shall be installed as construction progresses.

- Areas of visible erosion shall be stabilized with crushed stone or equivalent measures.

## 8.7 STANDARDS FOR STABILIZING SITES FOR WINTER

The construction of the project will extend into the winter season. The contractor shall schedule work to avoid construction of stormwater basins during the winter months. For permitted winter construction, the erosion control measures are substantially more stringent due to cold temperatures and lack of moisture which aids in drying the subgrade soils through evaporation.

The winter construction period is from November 15$^{th}$ through March 15$^{th}$. If the construction site is not stabilized with pavement, aggregate subbase gravel, 90% mature vegetation cover or riprap prior to November 15$^{th}$, then the site needs to be protected with over-winter stabilization. An area considered open is any area that is not stabilized with pavement, vegetation, mulching, erosion control mix, erosion control mats, riprap or subbase gravel.

During the winter construction period the Contractor shall install erosion control mix berms in lieu of silt fence.

During the winter construction period, a double row of sediment barriers shall be placed between any drainage path and the disturbed area.

In addition, during the winter construction period the amount of exposed area shall be limited to that which can be mulched within one day in the event of a predicted storm and shall not exceed a maximum open area of one acre.

Standard for the timely stabilization of ditches and channels: The contractor shall construct and stabilize all stone-lined ditches and channels on the site by November 15$^{th}$. The contractor shall construct and stabilize all grass lined ditches and channels on the site by September 1$^{st}$. If the contractor fails to stabilize a ditch or channel to be grass lined by September 1$^{st}$, then the contractor shall take one of the following actions to stabilize the ditch for late fall and winter.

i. Install a sod lining in the ditch. The contractor shall line the ditch with properly installed sod by October 1st. Proper installation includes the applicant pinning the sod onto the soil with wire pins, rolling the sod to guarantee contact between the sod and underlying soil, watering the sod to promote root growth into the disturbed soil, and anchoring the sod with jute or plastic mesh to prevent the sod strips from sloughing during flow conditions.

ii. Install a stone lining in the ditch. The contractor shall line the ditch with stone riprap by November 1st. The contractor shall hire a registered professional engineer to determine the stone size and lining thickness needed to withstand the anticipated flow velocities and flow depths within the ditch. If necessary, the contractor shall regrade the ditch prior to placing the stone lining so as to prevent the stone lining from reducing the ditch's cross sectional area.

Standard for the timely stabilization of disturbed slopes: The contractor shall construct and stabilize stone covered slopes by November 15th. The contractor shall seed and mulch all slopes to be vegetated by September 1st. A slope is considered any area having a grade of greater than 15% (10H:1V). If the contractor fails to stabilize any slope to be vegetated by September 15th, then the contractor shall take one of the following actions to stabilize the slope for late fall and winter:

i. Stabilize the soil with temporary vegetation and erosion control mesh. By October 1st the contractor shall seed the disturbed slope with winter rye at a seeding rate of 3 pounds per 1000 square feet and apply erosion control mats over the mulched slope. The contractor shall monitor growth of the rye over the next 45 days. If the rye fails to grow at least three inches or fails to cover at least 75% of the disturbed slope by November 15th, then the contractor shall cover the slope with a layer of wood waste compost as described in item iii of this standard or with stone rip rap as described in item iv of this standard.

ii. Stabilize the slope with sod. The contractor shall stabilize the disturbed slope with properly installed sod by October 1st. Proper installation includes the contractor pinning the sod onto the slope with wire pins, rolling the sod to guarantee contract between the sod and underlying soil, and watering the sod to promote root growth into the disturbed soil. The contractor shall not use late-season sod installation to stabilize slopes having a grade greater than 33% (3H: 1V) or having groundwater seeps on the slope face.

iii. Stabilize the slope with wood waste compost. The contractor shall place a six-inch layer of wood waste compost on the slope by November 15th. Prior to placing the wood waste compost, the contractor shall remove any snow accumulation on the disturbed slope. The contractor shall not use wood waste compost to stabilize slopes having grades greater than 50% (2H: 1V) or having groundwater seeps on the slope face.

iv. Stabilize the slope with stone riprap. The contractor shall place a layer of stone riprap on the slope by November 15th. The contractor shall hire a registered professional engineer to determine the stone size needed for stability and to design a filter layer for underneath the riprap.

Standard for the timely stabilization of disturbed soil: By September 15th, the contractor shall seed and mulch all disturbed soils on areas having a slope less than 15%. If the contractor fails to stabilize these soils by this date, then the contractor shall take one of the following actions to stabilize the soil for late fall and winter.

i. Stabilize the soil with temporary vegetation. By October 1st, the contractor shall seed the disturbed soil with winter rye at a seeding rate of 3 pounds per 1,000 square feet, lightly mulch the seeded soil with hay or straw at 75 pounds per 1,000 square feet, and anchor the mulch with plastic netting. The contractor shall monitor the growth of the rye over the next 45 days. If the rye fails to grow at least three inches or fails to cover at least 75% of the disturbed soil before November 1st, then the contractor shall mulch the area for over-winter protection as described in Item iii of this standard.

ii. Stabilize the soil with sod. The contractor shall stabilize the disturbed soil with properly installed sod by October 1st. Proper installation includes the contractor pinning the sod onto the soil with wire pins, rolling the sod to guarantee contact between the sod and underlying soil, and watering the sod to promote root growth into the disturbed soil.

iii. Stabilize the soil with mulch. By November 15th, the contractor shall mulch the disturbed soil by spreading hay or straw at a rate of at least 150 pounds per 1,000 square feet on the area so that no soil is visible through the mulch. Prior to applying the mulch, the contractor shall remove any snow accumulation on the disturbed area. Immediately after applying the mulch, the contractor shall anchor the mulch with plastic netting to prevent wind from moving the mulch off the disturbed soil.

Standard for timely stabilization of Soil Stockpiles: Stockpiles of soil or subsoil will be mulched for over winter protection with hay or straw at twice the normal application rate or with a four-inch thick layer of erosion control mix. This will be completed within 24-hours of stockpiling or re-established prior to any predicted rainfall or snowfall event. Any soil stockpile will not be placed (even covered with mulch) within 100 feet from a natural resource (i.e. wetland, etc.).

## 8.8 SPECIAL MEASURES FOR SUMMER CONSTRUCTION

The summer period is generally optimum for construction for this site but it is also the period where intense short duration storms are most common making denuded areas very susceptible to erosion, where dust control needs to be the most stringent, and where the potential to establish vegetation is often restricted by moisture deficit. During these periods the contractor must:

- Implement a program to apply dust control measures on a daily basis except those days where the precipitation exceeds 0.25 inches;

- Spray the mulch after anchoring with water to dampen the soil and encourage early growth. Temporary seed may be required until the late summer seeding season.

- Mulch, cover, and moisten stockpiles of fine-grained materials that are susceptible to erosion.

- Take additional steps needed to control fugitive dust emissions to minimize reductions in visibility and the airborne disbursement of fine-grained soils. These measures may also be required in the spring and fall during the drier periods of these seasons.

## 8.9 Permanent Erosion Control Measures

The following permanent erosion control measures have been designed as part of the Erosion and Sedimentation Control Plan:

- The drainage conveyance systems have been designed to intercept and convey the 25-year storm. In the case of open channels or swales, this includes the design of measures to resist scour of the channel.

- All storm drain pipes shall have riprap aprons at their outlet to protect the outlet and receiving channel of the culverts from scour and deterioration. Installation details are provided in the plan set. The aprons shall be installed and stabilized prior to directing runoff to the tributary pipe or culvert.

- All areas disturbed during construction, but not subject to other restoration (paving, riprap, etc.) will be loamed, limed, fertilized, mulched, and seeded. Fabric netting, anchored with staples, shall be placed over the mulch in areas where the finish grade slope is greater than 10 percent. Native topsoil shall be stockpiled and temporarily stabilized with seed and mulch and reused for final restoration when it is of sufficient quality.

- Catch basins shall be provided with sediment sumps for all outlet pipes that are 12” in diameter or greater.

## 8.10 Timing and Sequence of Erosion and Sedimentation Control Measures

The following construction sequence shall be required to insure the effectiveness of the erosion and sedimentation control measures are optimized.

Note: For all grading activities, the contractor shall exercise extreme caution not to overexpose the site by limiting the disturbed area and shall stabilize any steep slopes within 24 hours if final slope grading and stabilization will not be completed within 7 days. Any final slopes shall have the specified erosion control measures installed within 7 days of final stabilization.

- Install crushed stone-stabilized construction entrances as shown on the Erosion and Sedimentation Control Plan.
- Mark the grading and clearing limits and initiate clearing that will permit the contractor to access the site and install silt fence and silt sock.
- Install siltation fence where shown on the contract drawings. During periods of November 1st through April 15th, the Contractor shall install erosion control mix berms in lieu of silt fence.
- Establish and prepare filter bag areas.
- Shape the subgrade of the proposed infiltration basins for the area of the site that is under construction.
- Construct diversion and drainage channels to direct flow to the stormwater facilities from the lot development and roadway areas.
- Prepare area to receive excavated material recognizing the need to limit the denuded area of the site.
- Begin earthwork within the building pad areas.
- Construct the disturbed areas to subgrade and restore the slopes.
- Install stone and hay bale check dams at any concentrated flow discharge points.
- Install storm drain and other utility work. Install inlet and outlet protection immediately after the installation of any culverts. Pump any accumulated water within the trenches to a filter bag.
- Place gravels in the paved areas as soon as subgrade is prepared to minimize the period that the unprotected subgrade is exposed and vulnerable to erosion from runoff events.
- Raise catch basins to grade and install inlet protection devices, the SiltSack® inside the basin, and the external hay bales or stone filter (if applicable).
- Install binder pavement.
- Loam, lime, fertilize, seed and mulch all disturbed and denuded areas.
- Remove all accumulated sediment from silt barriers.
- Review stability of the site. Removal of erosion control measures shall be performed within 30 days of establishing permanent stabilization. Permanent stabilization in grassed areas is established with 90% catch of grass with no evidence of rilling or erosion.

This sequence is applicable to all phases of the project.

Soil will be considered disturbed if it does not have an established stand of vegetation covering at least 90% of the soil surface or has not been mulched with hay applied at a rate of 230 lb./1,000 sq. ft.

## 8.11 PROVISIONS FOR MAINTENANCE OF THE EROSION AND SEDIMENTATION CONTROL MEASURES

This project is subject to the requirements of a US EPA NPDES permit and an accompanying Stormwater Pollution Prevention Plan (SWPPP.) These documents require the Contractor to prepare a list and designate by name, address and telephone number all individuals who will be responsible for implementation, inspection and maintenance of all erosion control measures identified within this section and as contained within the contract drawings. Specific responsibilities of the inspector(s) will include, but not be limited to:

- Execution of the Contractor/Subcontractor certification by any and all parties responsible for erosion control measures on the site as required by the SWPPP.

- Assuring and certifying the Owner's construction sequence is in conformance with the specified schedule of this section. A weekly certification stating compliance, any deviations, and corrective measures necessary to comply with the erosion control requirements of this section shall be prepared and signed by the inspector(s).

- In addition to the weekly certifications, the inspector(s) shall maintain written reports recording construction activities on site which include dates when major grading activities occur in a particular area; dates when major construction activities cease in a particular area, either temporary or permanent; dates when an area is stabilized.

- Inspection of the project work site at least once every seven (7) calendar days and before and after each significant rainfall event (0.25 inches or more in any 24-hour period) during construction until permanent erosion control measures have been properly installed and the site has been stabilized. Such inspections shall be submitted to the DPW on a monthly basis as per Section 20c of the Stormwater Management Rules and Regulations. Inspection of the project work site shall include:

  A. Identification of proper erosion control measure installation in accordance with the erosion control detail sheet or as specified in this section.

  B. Determine whether each erosion control measure is properly operating. If not, identify damage to the control device and determine remedial measures.

C. Identify areas that appear vulnerable to erosion and determine additional erosion control measures that should be used to improve conditions.

D. Inspect areas of recent seeding to determine percent catch of grass. A minimum catch of 90 percent is required prior to removal of erosion control measures.

E. Record date of installation of sorbent bags in catch basins, dates of paving (if applicable), dates removed, and the disposal method and location.

- If inspection of the site indicates a change should be made to the erosion control plan, either to improve effectiveness or correct a site-specific deficiency, the inspector shall immediately implement the corrective measure and notify the owner of the change.

Once construction has been completed, long term maintenance of the facilities will be the responsibility of the applicant.

## 8.12 PRECONSTRUCTION CONFERENCE

Prior to any construction at the site, representatives of the contractor, Town Officials, and the site Design Engineer shall arrange for and meet with the Owner to discuss the scheduling of the site construction, and the designation of the responsible parties for implementing the plan. This meeting shall be scheduled by the contractor with reasonable advance notice for all attendees. Prior to the meeting the contractor shall prepare a detailed schedule and a marked-up site plan indicating areas and components of the work and key dates showing date of disturbance and completion of the work. If bid through a general contractor, the general contractor’s superintendent shall provide a written acknowledgement that the erosion control plan has definitive dates for implementation that may supersede the building schedule. The contractor shall conduct a meeting with employees and sub-contractors to review the erosion control plan, the construction techniques which will be employed to implement the plan, and provide a list of attendees and items discussed at the meeting to the Owner. Three copies of the schedule, the contractor’s meeting minutes, and marked-up site plan shall be provided to the Owner at the preconstruction meeting.

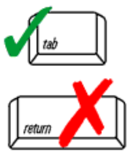
# APPENDIX A: MASSACHUSETTS STORMWATER CHECKLIST

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

# Checklist for Stormwater Report

## A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

# Checklist for Stormwater Report

## B. Stormwater Checklist and Certification

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

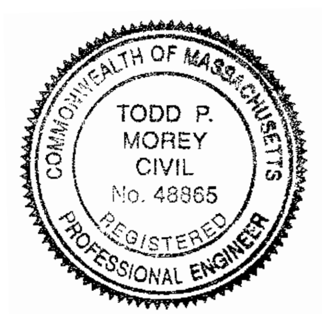
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that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

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

## Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature




10.15.2024

Signature and Date

## Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

# Checklist for Stormwater Report

## Checklist (continued)

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

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

**Standard 1: No New Untreated Discharges**

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

## **Checklist** (continued)

**Standard 2: Peak Rate Attenuation**

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

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

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

**Standard 3: Recharge**

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

## **Checklist** (continued)

**Standard 3: Recharge** (continued)

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

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

**Standard 4: Water Quality**

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

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

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

☐ is within the Zone II or Interim Wellhead Protection Area

☒ is near or to other critical areas

☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

☒ involves runoff from land uses with higher potential pollutant loads.

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

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

## **Checklist** (continued)

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

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

**Standard 6: Critical Areas**

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

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

## Checklist (continued)

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

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

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

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

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

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

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

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

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

## **Checklist** (continued)

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

- ☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.
- ☐ The project is ***not*** covered by a NPDES Construction General Permit.
- ☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- ☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

**Standard 9: Operation and Maintenance Plan**

- ☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - ☒ Name of the stormwater management system owners;
  - ☒ Party responsible for operation and maintenance;
  - ☒ Schedule for implementation of routine and non-routine maintenance tasks;
  - ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
  - ☒ Description and delineation of public safety features;
  - ☒ Estimated operation and maintenance budget; and
  - ☒ Operation and Maintenance Log Form.
- ☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - ☐ A copy of the legal instrument (deed, homeowner’s association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

**Standard 10: Prohibition of Illicit Discharges**

- ☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- ☒ An Illicit Discharge Compliance Statement is attached;
- ☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

# APPENDIX B: ILLICIT DISCHARGE STATEMENT

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2 Park Plaza, Suite 200, Boston, MA 02116
Phone: 617-242-1120

# ILLICIT DISCHARGE STATEMENT

The stormwater management system is the system for conveying and detaining stormwater on-site, including stormwater best management practices and any pipes intended to transport stormwater to the groundwater, a surface water, or municipal separate storm sewer system. Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing and water used to clean residential buildings without detergents.

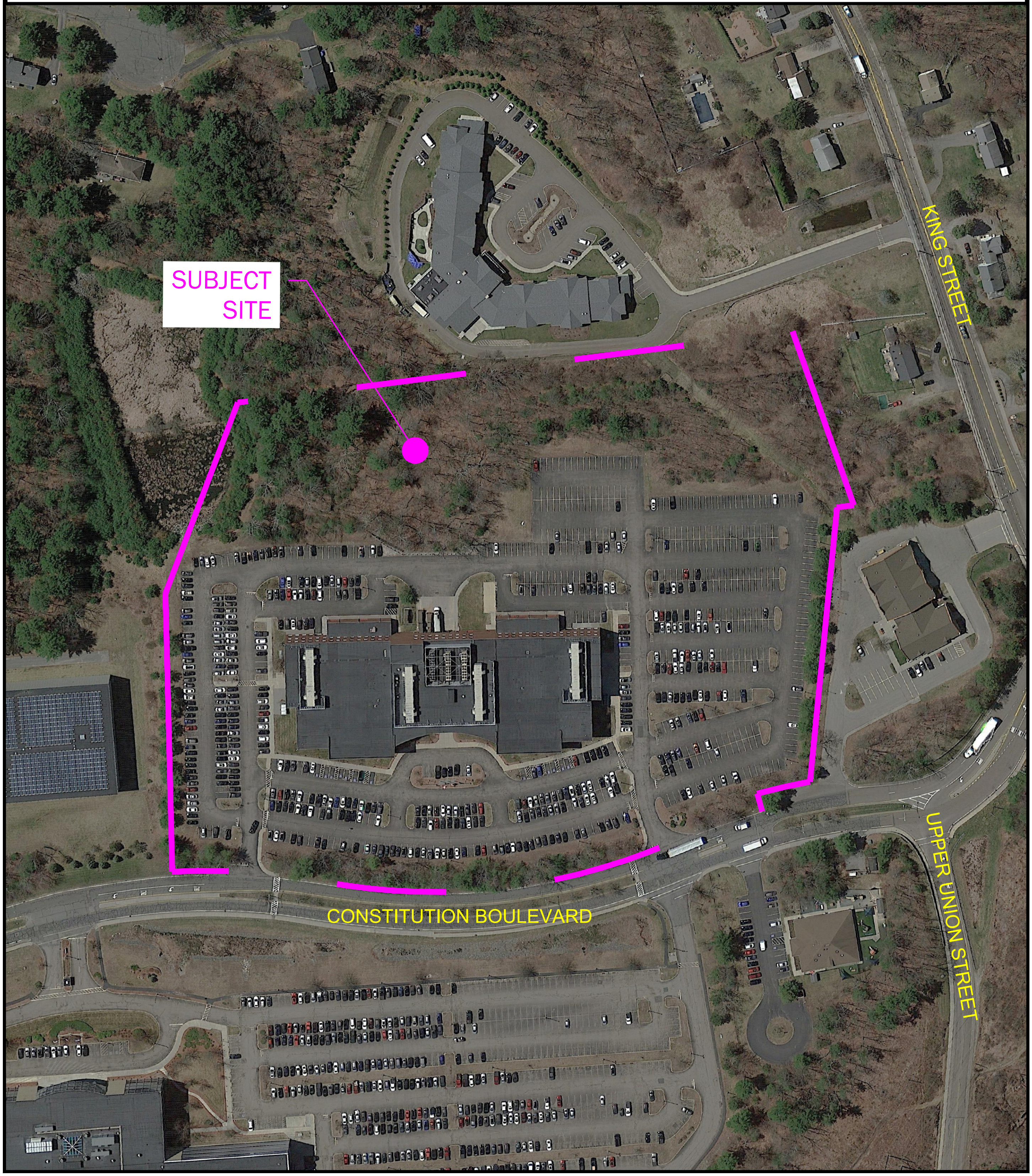
It is our belief and understanding, to the best of our knowledge, that there are no known illicit discharges on the site of 55 Constitution Boulevard in Franklin, Massachusetts.

10.15.2024

| Todd P. Morey, P.E. | Date | Massachusetts 48865 |
|---|---|---|

# APPENDIX C: LOCATION MAPS AND FIGURES

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. AERIAL PHOTOGRAPHY OBTAINED FROM GOOGLE IMAGERY,



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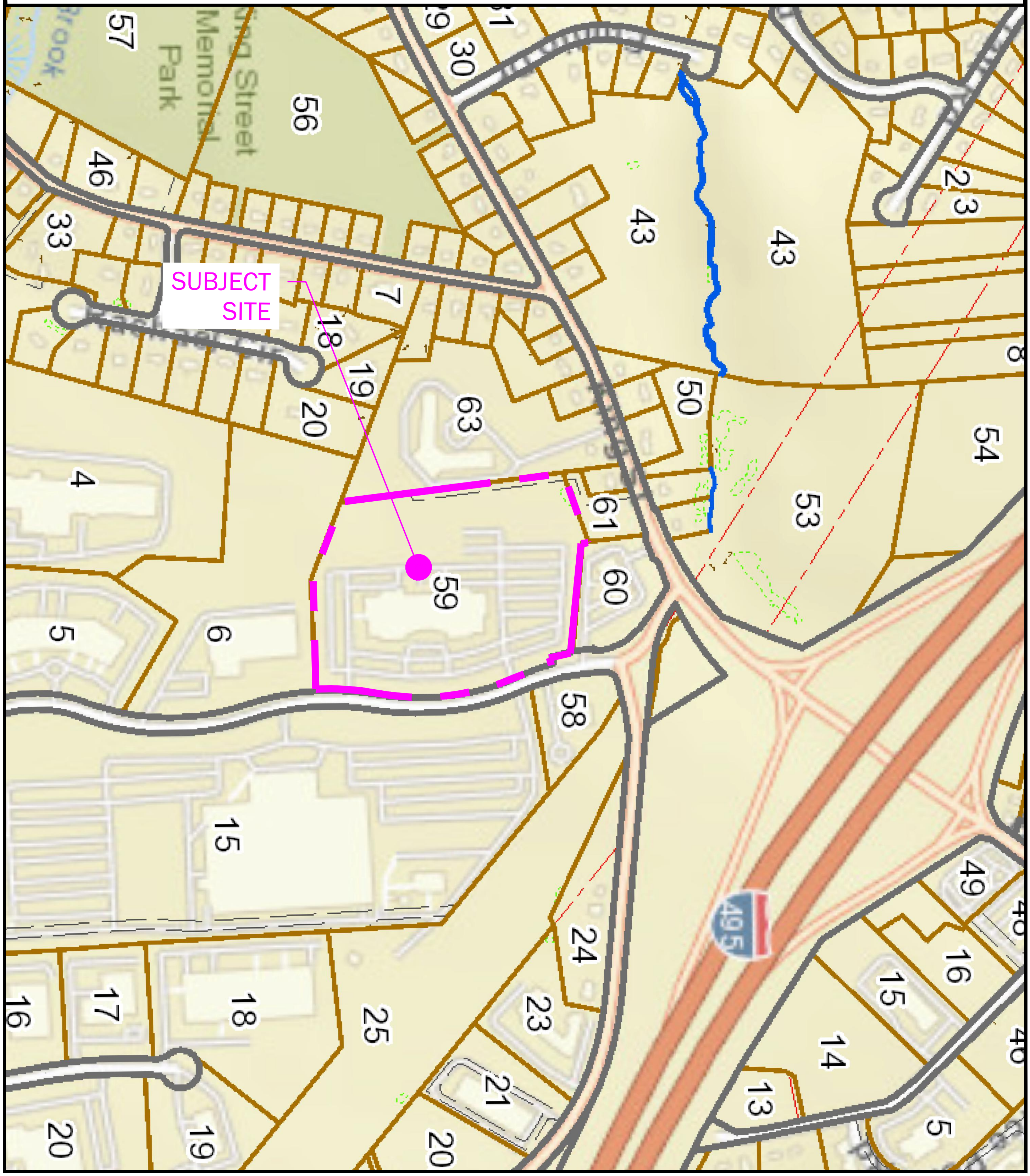
Aerial

Franklin
Massachusetts

Figure 1
Date: April, 2024

SCALE: 1"=200'
0 100 200

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. TAX MAP OBTAINED FROM TOWN OF FRANKLIN GIS DATABASE.



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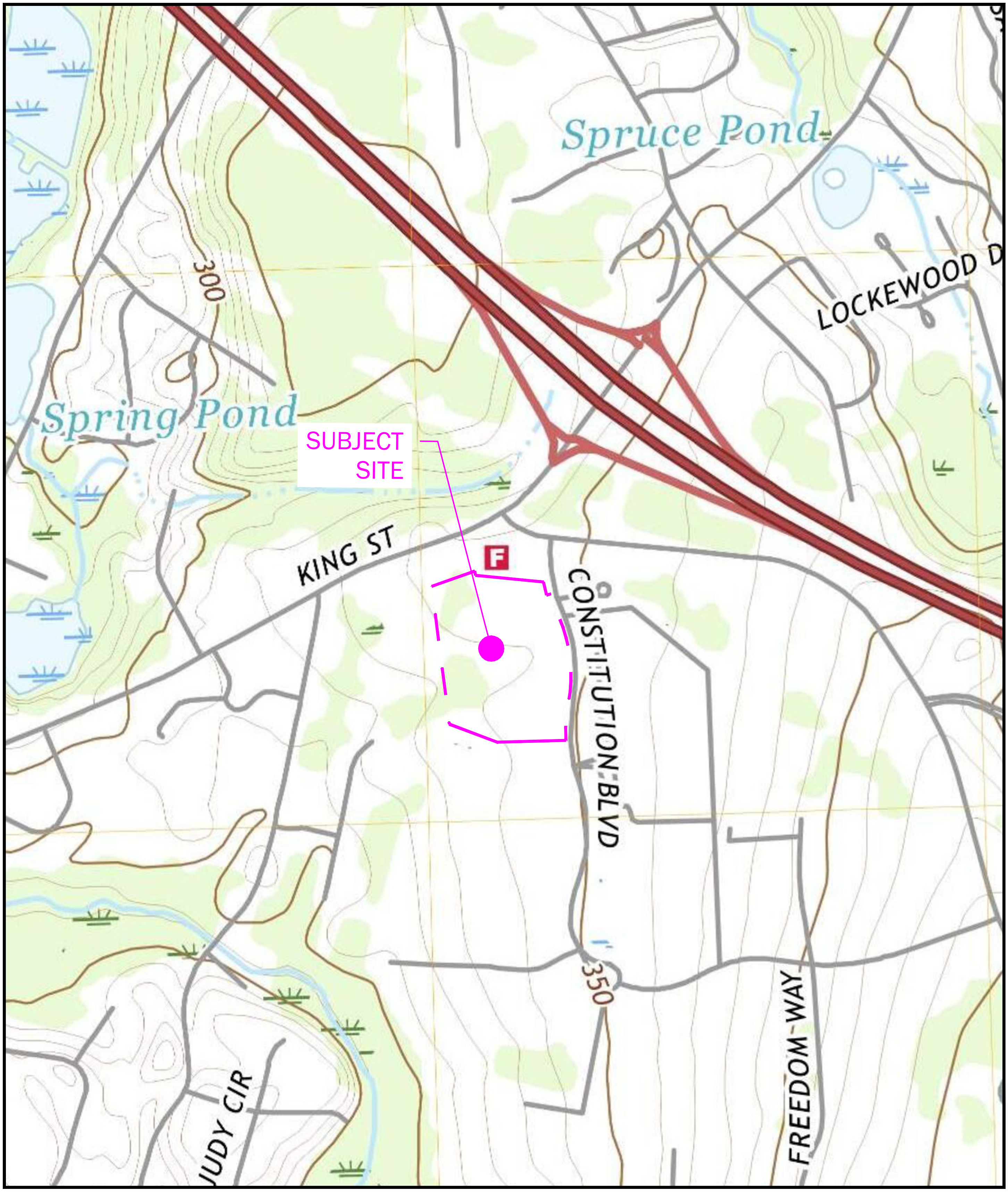
# Tax Map

Franklin
Massachusetts

Figure 2
Date: April, 2024

SCALE: 1"=500'
0 250 500



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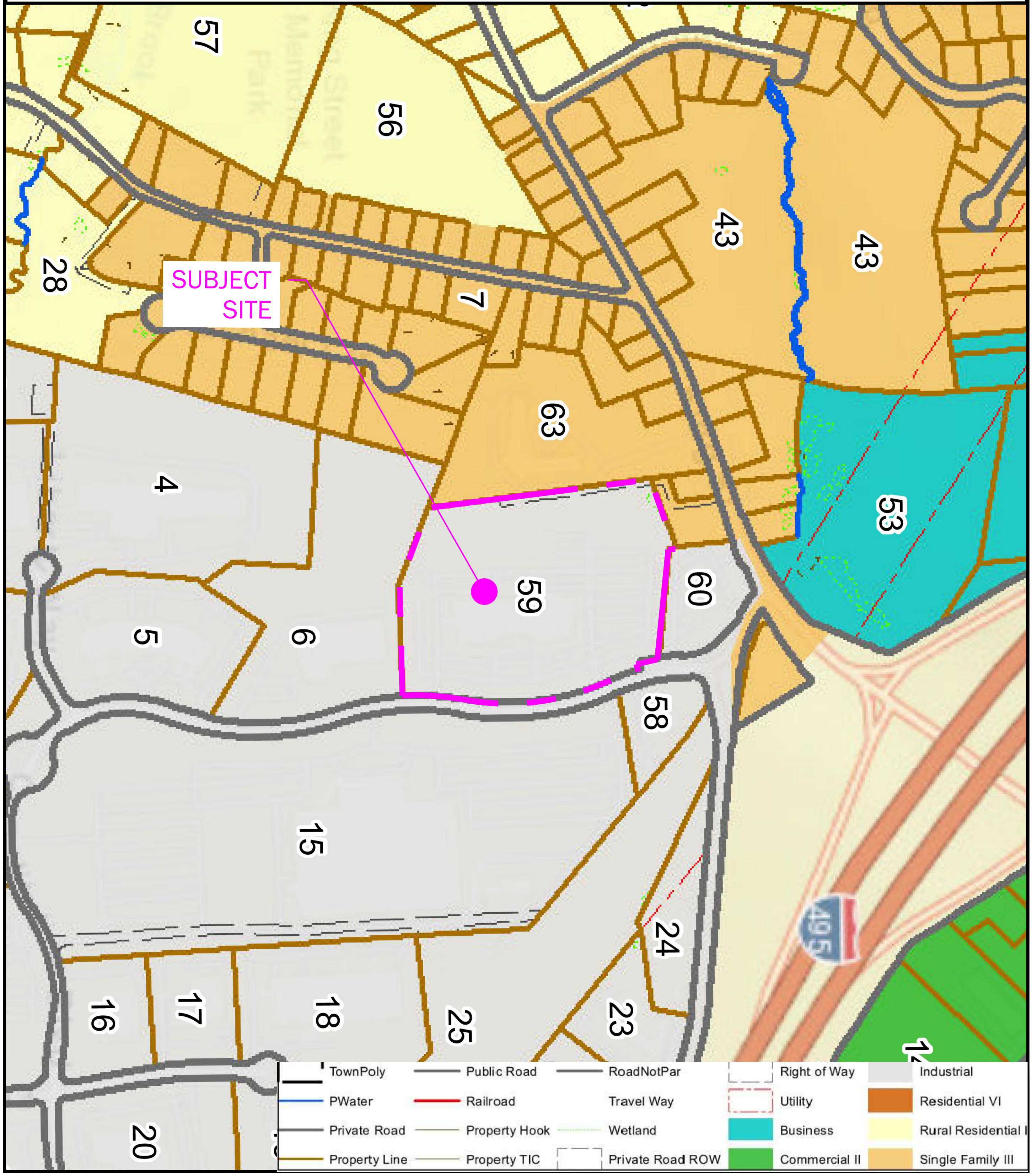
USGS Topographic Map

Franklin
Massachusetts

Figure 3
Date: April 26, 2024

SCALE = N.T.S

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. ZONING MAP OBTAINED FROM TOWN OF FRANKLIN GIS DATABASE



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Zoning Map

Franklin
Massachusetts

Figure 4
Date: April, 2024

SCALE: 1"=500'
0 250 500

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. FEMA MAP OBTAINED FROM FEMA FLOOD MAP SERVICE CENTER, MAP 25021C0317E.




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FEMA Map

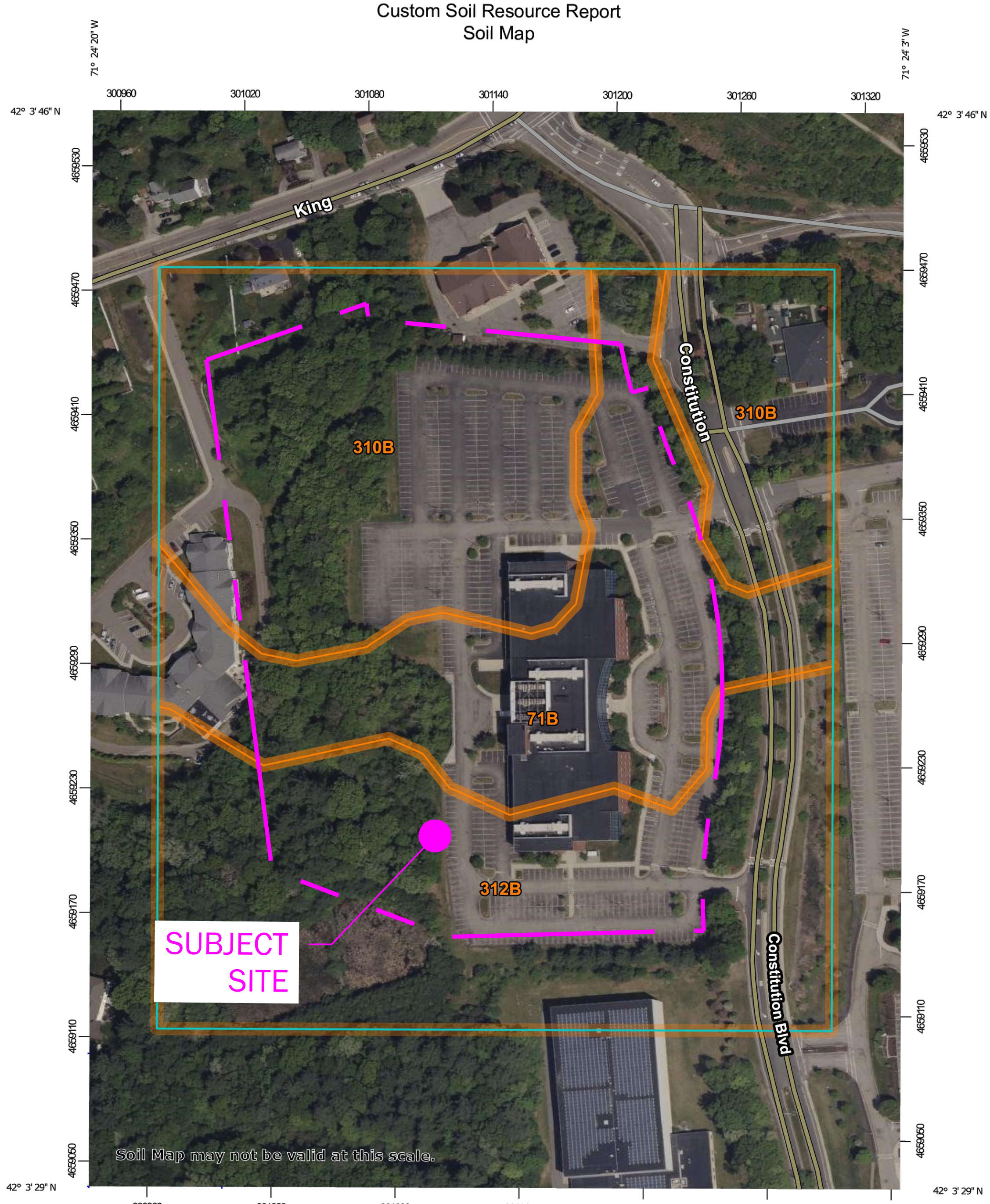
Franklin
Massachusetts

Figure 5
Date: April, 2024

SCALE: N.T.S

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. SOIL MAP AND MAP UNITS WERE OBTAINED FROM NRCS WEB SOIL SURVEY .

Custom Soil Resource Report
Soil Map




Map Scale: 1:2,530 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 19N WGS84

6



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NRCS Map

Franklin
Massachusetts

Figure 6
Date: April, 2024

SCALE: N.T.S

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 71B | Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony | 7.4 | 24.9% |
| 310B | Woodbridge fine sandy loam, 3 to 8 percent slopes | 11.6 | 38.9% |
| 312B | Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony | 10.8 | 36.2% |
| **Totals for Area of Interest** | | **29.7** | **100.0%** |



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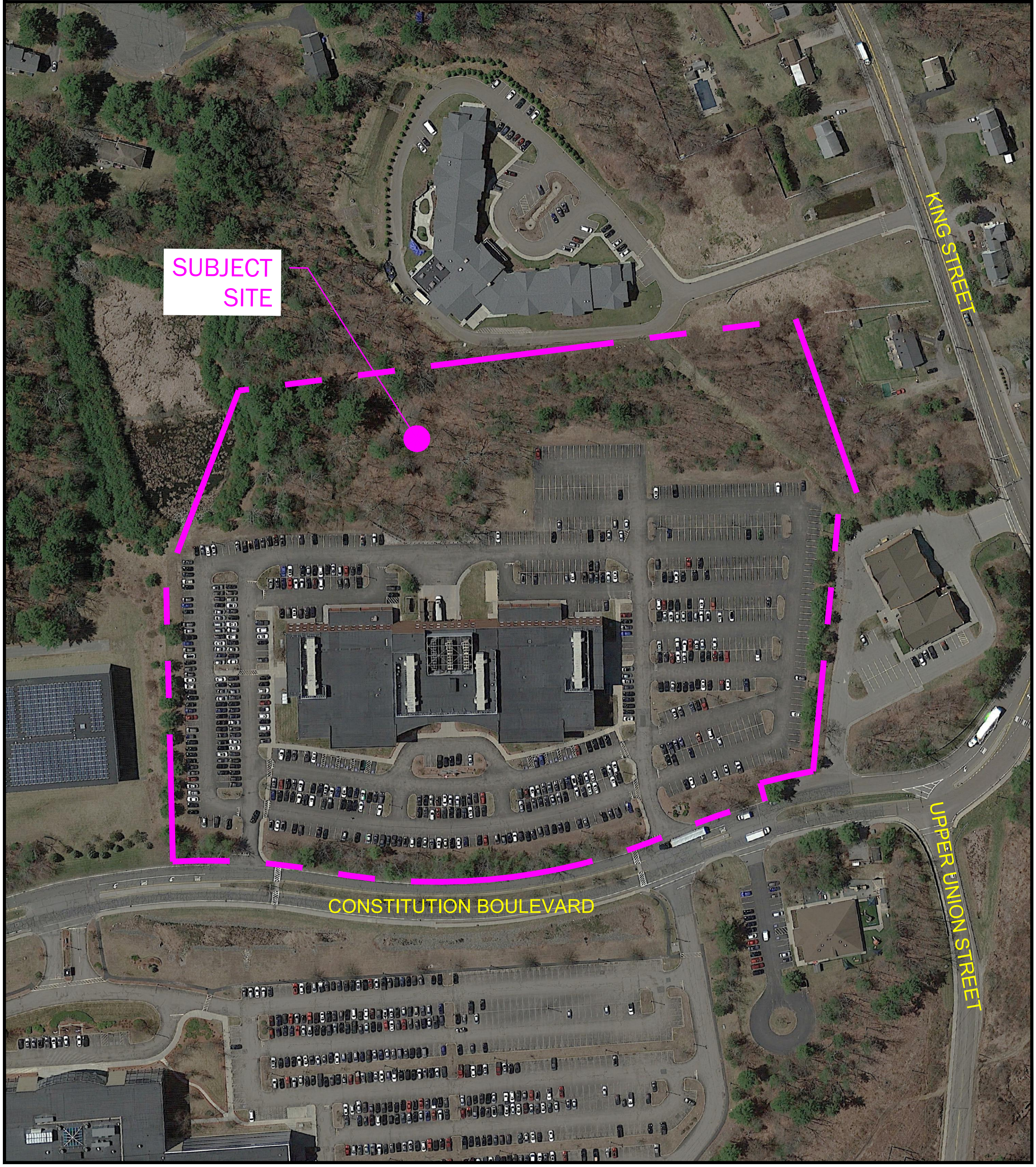
NRCS Legend

Franklin
Massachusetts

Figure 6A
Date: April, 2024

SCALE: N.T.S

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. AERIAL PHOTOGRAPHY OBTAINED FROM GOOGLE IMAGERY. THIS SITE IS NOT LOCATED IN A NATURAL HERITAGE AND ENDANGER SPECIES PROGRAM



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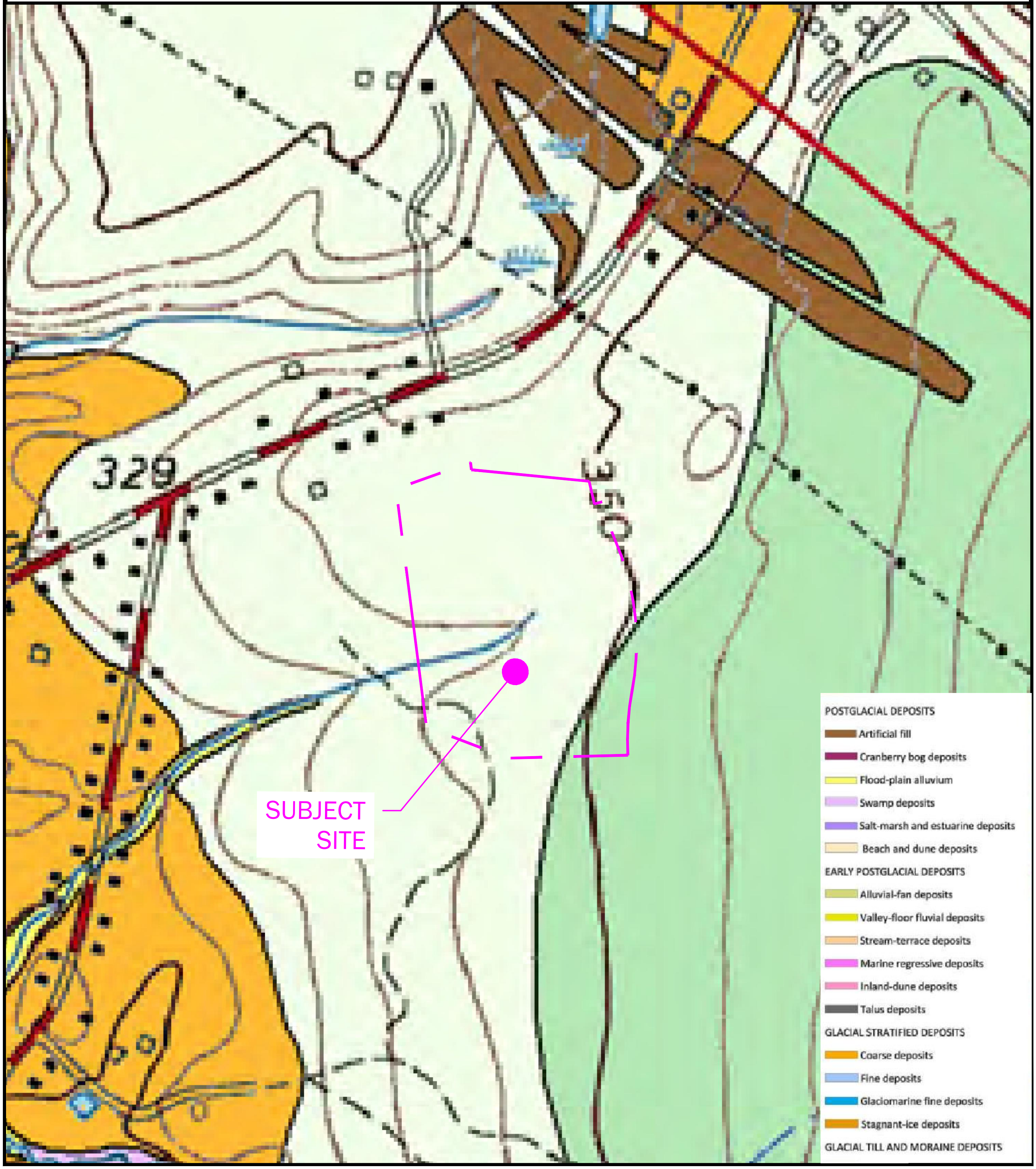
NHESP Map

Franklin
Massachusetts

Figure 7
Date: April, 2024

SCALE: 1"=200'
0 100 200

REFERENCES:
PROPERTY LINE INFORMATION OBTAINED FROM SURVEY. SURFICIAL GEOLOGY INFORMATION OBTAINED FROM SCIENTIFIC INVESTIGATIONS MAP 3402
QUADRANGLE 100 - FRANKLIN



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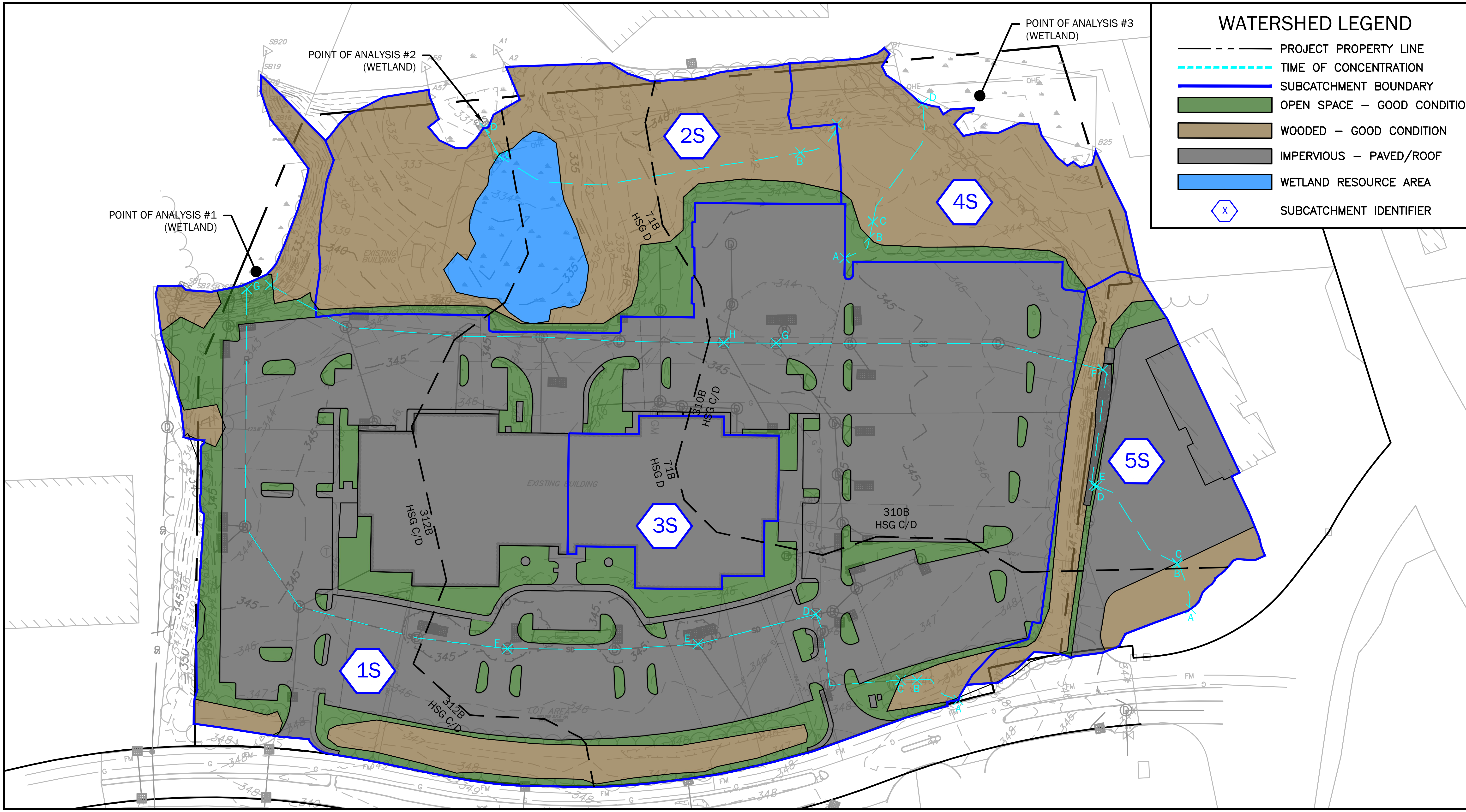
Surficial Geology Map

Franklin
Massachusetts

Figure 8
Date: April, 2024

SCALE: N.T.S

# APPENDIX D: WATERSHED MAPS




PATH:H:\C-1381 Franklin\Autocad\Design Development\Pre Development Watershed Map.dwg



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NORTHBRIDGE

# Warehouse Buildings

55 Constitution Boulevard
Franklin, MA

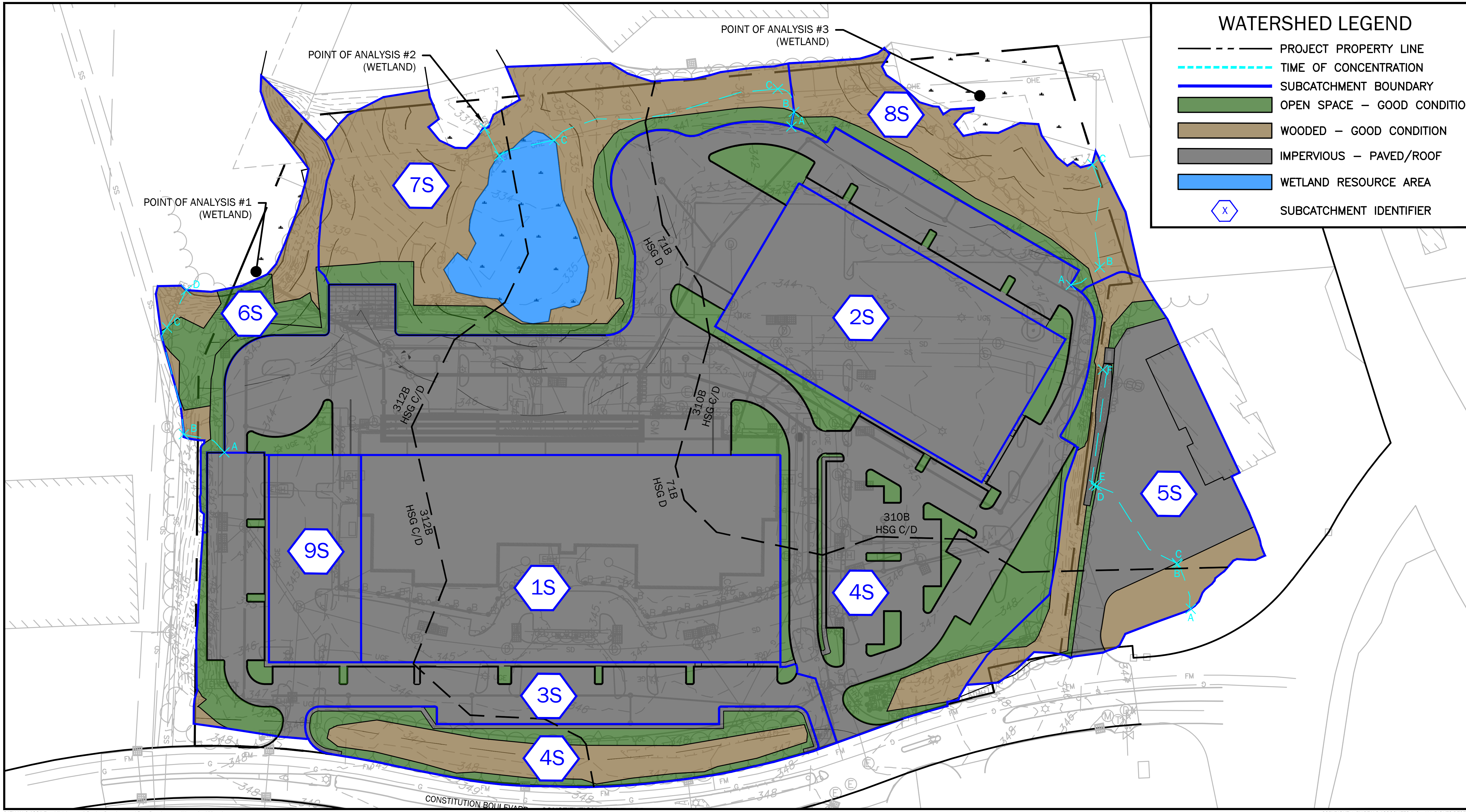
SCALE: 1"=100'

100 0 50 100 200

Sheet Title:
Pre Development Watershed Map

Sheet No:
C.1

Date:
September, 2024




PATH:H:\C-1381 Franklin\Autocad\Design Development\Post Development Watershed Map.dwg



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NORTHBRIDGE

# Warehouse Buildings

55 Constitution Boulevard
Franklin, MA

SCALE: 1"=100'

100 0 50 100 200

Sheet Title:
## Post Development Watershed Map

Sheet No:
C.2

Date:
September, 2024

# APPENDIX E: NRCS SOILS REPORT

United States Department of Agriculture

NRCS

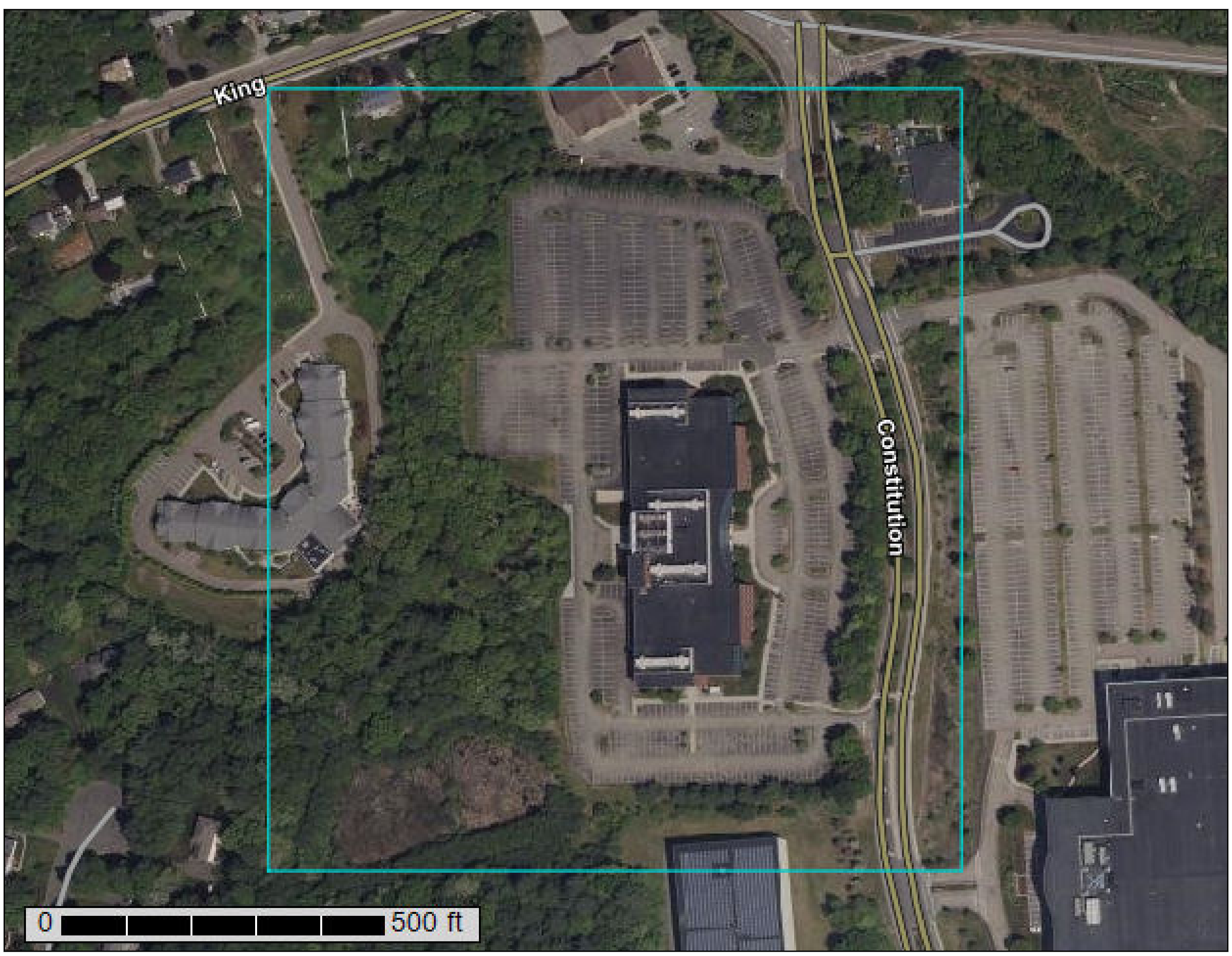
Natural Resources Conservation Service

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

# Custom Soil Resource Report for

# Norfolk and Suffolk Counties, Massachusetts

## 55 Constitution - Franklin MA




February 9, 2024

# Preface

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

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

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

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

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

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

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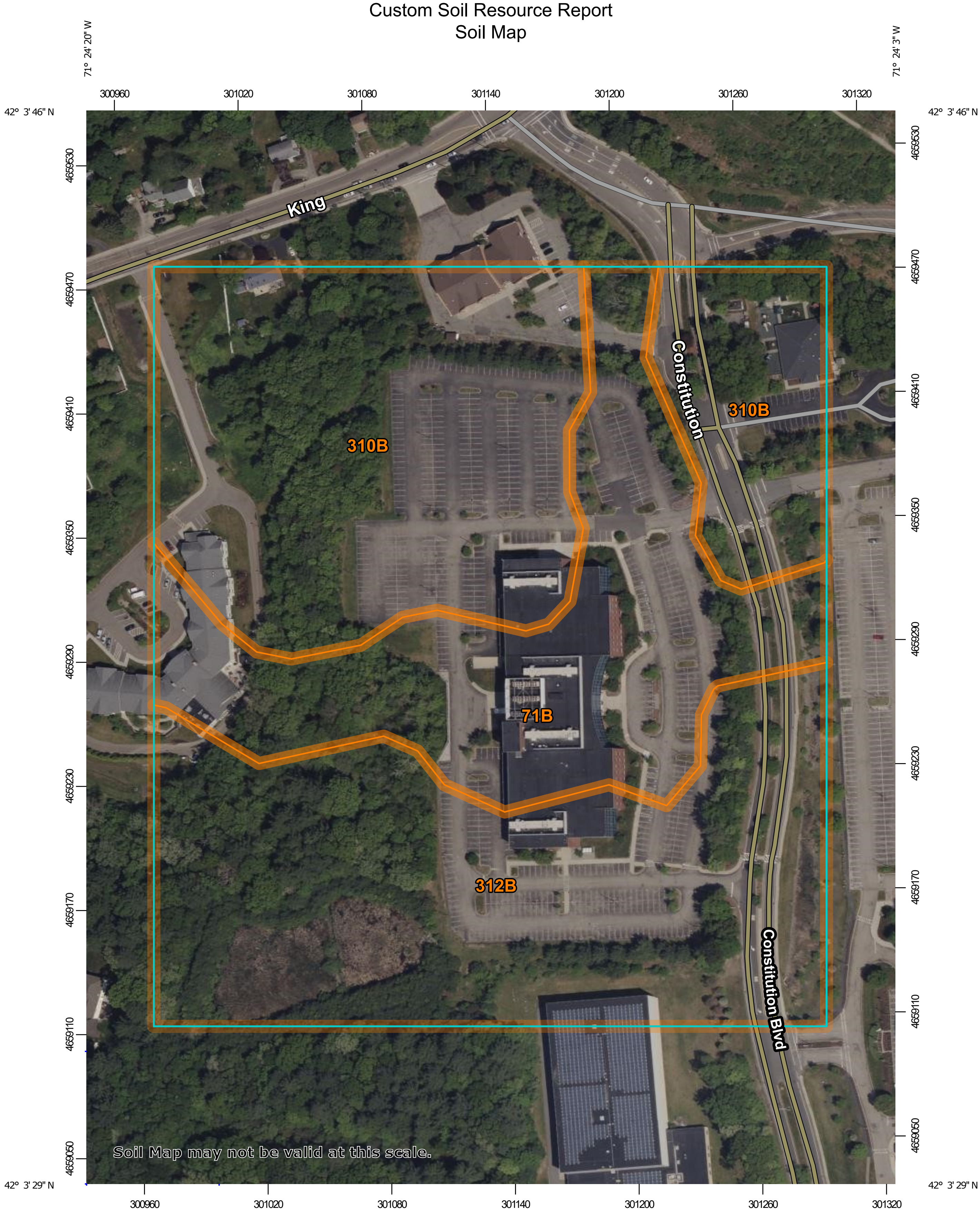
# Soil Map

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.

# Soil Map




Map Scale: 1:2,530 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 35, 70, 140, 210

Feet: 0, 100, 200, 400, 600

N

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

## MAP LEGEND

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

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

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

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 19, Sep 10, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| 71B | Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony | 7.4 | 24.9% |
| 310B | Woodbridge fine sandy loam, 3 to 8 percent slopes | 11.6 | 38.9% |
| 312B | Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony | 10.8 | 36.2% |
| **Totals for Area of Interest** | | **29.7** | **100.0%** |

# Map Unit Descriptions

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

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

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

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

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

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

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

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

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

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

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

# Norfolk and Suffolk Counties, Massachusetts

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

### Map Unit Setting

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

### Map Unit Composition

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

### Description of Ridgebury, Extremely Stony

#### Setting

*Landform:* Drumlins, depressions, ground moraines, hills, drainageways
*Landform position (two-dimensional):* Footslope, toeslope
*Landform position (three-dimensional):* Base slope, head slope
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

#### Typical profile

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

#### Properties and qualities

*Slope:* 3 to 8 percent
*Surface area covered with cobbles, stones or boulders:* 9.0 percent
*Depth to restrictive feature:* 15 to 35 inches to densic material
*Drainage class:* Poorly drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)
*Depth to water table:* About 0 to 6 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water supply, 0 to 60 inches:* Low (about 3.0 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* D
*Ecological site:* F144AY009CT - Wet Till Depressions
*Hydric soil rating:* Yes

**Minor Components**

**Woodbridge, extremely stony**

*Percent of map unit:* 10 percent
*Landform:* Ground moraines, hills, drumlins
*Landform position (two-dimensional):* Summit, backslope, footslope
*Landform position (three-dimensional):* Crest, side slope
*Down-slope shape:* Convex
*Across-slope shape:* Linear
*Hydric soil rating:* No

**Whitman, extremely stony**

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

**Paxton, extremely stony**

*Percent of map unit:* 2 percent
*Landform:* Ground moraines, hills, drumlins
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Crest, side slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Linear, convex
*Hydric soil rating:* No

## 310B—Woodbridge fine sandy loam, 3 to 8 percent slopes

**Map Unit Setting**

*National map unit symbol:* 2t2ql
*Elevation:* 0 to 1,470 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days
*Farmland classification:* All areas are prime farmland

**Map Unit Composition**

*Woodbridge, fine sandy loam, and similar soils:* 82 percent
*Minor components:* 18 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Woodbridge, Fine Sandy Loam**

**Setting**

*Landform:* Ground moraines, drumlins, hills
*Landform position (two-dimensional):* Summit, backslope, footslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Concave
*Across-slope shape:* Linear

*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Ap - 0 to 7 inches:* fine sandy loam
*Bw1 - 7 to 18 inches:* fine sandy loam
*Bw2 - 18 to 30 inches:* fine sandy loam
*Cd - 30 to 65 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 3 to 8 percent
*Depth to restrictive feature:* 20 to 39 inches to densic material
*Drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)
*Depth to water table:* About 18 to 30 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water supply, 0 to 60 inches:* Low (about 3.6 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 2w
*Hydrologic Soil Group:* C/D
*Ecological site:* F144AY037MA - Moist Dense Till Uplands
*Hydric soil rating:* No

**Minor Components**

**Paxton**

*Percent of map unit:* 10 percent
*Landform:* Drumlins, ground moraines, hills
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Side slope, crest, nose slope
*Down-slope shape:* Convex, linear
*Across-slope shape:* Convex
*Hydric soil rating:* No

**Ridgebury**

*Percent of map unit:* 8 percent
*Landform:* Depressions, ground moraines, hills, drainageways
*Landform position (two-dimensional):* Toeslope, backslope, footslope
*Landform position (three-dimensional):* Base slope, head slope, dip
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

## 312B—Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony

**Map Unit Setting**

*National map unit symbol:* 2t2qs
*Elevation:* 0 to 1,580 feet
*Mean annual precipitation:* 36 to 71 inches
*Mean annual air temperature:* 39 to 55 degrees F
*Frost-free period:* 140 to 240 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Woodbridge, extremely stony, and similar soils:* 82 percent
*Minor components:* 18 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Woodbridge, Extremely Stony**

**Setting**

*Landform:* Ground moraines, hills, drumlins
*Landform position (two-dimensional):* Summit, backslope, footslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Concave
*Across-slope shape:* Linear
*Parent material:* Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

**Typical profile**

*Oe - 0 to 2 inches:* moderately decomposed plant material
*A - 2 to 9 inches:* fine sandy loam
*Bw1 - 9 to 20 inches:* fine sandy loam
*Bw2 - 20 to 32 inches:* fine sandy loam
*Cd - 32 to 67 inches:* gravelly fine sandy loam

**Properties and qualities**

*Slope:* 0 to 8 percent
*Surface area covered with cobbles, stones or boulders:* 9.0 percent
*Depth to restrictive feature:* 20 to 43 inches to densic material
*Drainage class:* Moderately well drained
*Runoff class:* Medium
*Capacity of the most limiting layer to transmit water (Ksat):* Very low to moderately low (0.00 to 0.14 in/hr)
*Depth to water table:* About 19 to 27 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline (0.0 to 1.9 mmhos/cm)
*Available water supply, 0 to 60 inches:* Low (about 4.0 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified

*Land capability classification (nonirrigated):* 7s
*Hydrologic Soil Group:* C/D
*Ecological site:* F144AY037MA - Moist Dense Till Uplands
*Hydric soil rating:* No

## Minor Components

### Paxton, extremely stony

*Percent of map unit:* 10 percent
*Landform:* Ground moraines, hills, drumlins
*Landform position (two-dimensional):* Summit, shoulder, backslope
*Landform position (three-dimensional):* Side slope, crest
*Down-slope shape:* Convex, linear
*Across-slope shape:* Linear, convex
*Hydric soil rating:* No

### Ridgebury, extremely stony

*Percent of map unit:* 8 percent
*Landform:* Hills, drainageways, drumlins, depressions, ground moraines
*Landform position (two-dimensional):* Toeslope
*Landform position (three-dimensional):* Base slope, head slope
*Down-slope shape:* Concave
*Across-slope shape:* Concave
*Hydric soil rating:* Yes

# APPENDIX F: GEOTECHNICAL DATA






BEALS·ASSOCIATES Inc.
2 PARK PLAZA SUITE 200 BOSTON, MA 02116
PHONE: 617-242-1120
•PLANNING •ENGINEERING •PERMITTING •MANAGEMENT

Owner/Applicant
NBPIV Constitution II LLC
401 Edgewater Place, Suite 265
Wakefield, MA 01880

NORTHBRIDGE

# 55 Constitution Boulevard
Franklin, MA

| No. | Revision | Date |
| --- | --- | --- |

Not for Construction
Permit Documents

| | |
| --- | --- |
| Designed by: BGJ | Checked by: TPM |
| Proj. No.: C-1381 | Issue Date: 10.17.24 |
| Drawing Scale: 1"=40 | |

Sheet Title
TEST PIT PLAN

Sheet Number
SK-1

Not for Construction

# TEST PIT LOG

| | |
|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #1<br>Ground Elevation: 348+/-<br>ESHGW<br>Depth: 77" Elev: 341.6+/- |

BEALS · ASSOCIATES INC.

| | |
|---|---|
| Contractor: Marinella Construction, Inc. | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | Date: August 22, 2024 |
| Completion Depth: No refusal @ 132" Roots to: | Weather: 57 Degrees and Partly Cloudy |

## DESCRIPTION

| Depth (ft) | ENGINEERING | GEOLOGIC/GENERAL |
|---|---|---|
| | 0"-3" Pavement |  |
| 1 | | |
| 2 | 3"-26" Gravel Fill | |
| 3 | | |
| 4 | 26"-43" Sandy Loam Fill | |
| | 43"-50" A-Horizon Sandy Loam | |
| 5 | | |
| 6 | ESHGW @ 77" ▼ | |
| 7 | 50"-82" B-Horizon Sandy Loam | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | 82"-132" C-Horizon Sandy Loam | |
| | Bottom of Test Pit. No Refusal @ 132"<br>Elev. 337.0+/- | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

# TEST PIT LOG

| | | |
|---|---|---|
| **TEST PIT LOG** | Test Pit #2 | BEALS · ASSOCIATES INC. |
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Ground Elevation: 346+/-<br>ESHGW<br>Depth: 39" Elev: 342.8+/- | |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 111" | Roots to: 67" | Weather: 58 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION — ENGINEERING | DESCRIPTION — GEOLOGIC/GENERAL |
|---|---|---|
| | 0"-3" Pavement |  |
| 1 | | |
| 2 | 3"-28" Gravel Fill | |
| 3 | | |
| 4 | ▼ Weeping from Pit Face & ESHGW @ 39" | |
| 5 | 28"-67" Sandy Loam Fill | |
| 6 | | |
| 7 | 80"-92"- Pocket of A Horizon Sandy Loam | |
| 8 | | |
| 9 | 67"-111" Sandy Loam | |
| 10 | Bottom of Test Pit. No Refusal @ 111"<br>Elev. 336.8+/- | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #3<br>Ground Elevation: 346+/-<br>ESHGW<br>Depth: 36" Elev: 343+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 127" | Roots to: | Weather: 62 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION - ENGINEERING | DESCRIPTION - GEOLOGIC/GENERAL |
|---|---|---|
| | 0"-3" Pavement |  |
| 1 | | |
| 2 | 3"-28" Gravel Fill | |
| 3 | ESHGW @ 36" | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| 10 | 28"-127" Sandy Loam | |
| 11 | Bottom of Test Pit. No Refusal @ 127"<br>Elev. 335.4+/- | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #4<br>Ground Elevation: 341.5+/-<br>ESHGW<br>Depth: N/E Elev: N/E | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 115" | Roots to: | Weather: 64 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION: ENGINEERING | DESCRIPTION: GEOLOGIC/GENERAL |
|---|---|---|
| | 0"-4" A-Horizon Loamy Sand 5% Gravel |  |
| 1 | | |
| 2 | 4"-25" Bw Horizon Sandy Loam 5% Gravel | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | | |
| | 25"-115" C-Horizon Sandy Loam 5% Gravel, Cobbles, Stones | |
| 10 | Bottom of Test Pit. No Refusal @ 115"<br>Elev. 331.9+/- | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #5<br>Ground Elevation: 339.5+/-<br>ESHGW<br>Depth: 38" Elev: 336.3+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 116" | Roots to: | Weather: 67 Degrees and Partly Cloudy |

## DESCRIPTION

| Depth (ft) | ENGINEERING | | GEOLOGIC/GENERAL |
|---|---|---|---|
| | 0"-4" A-Horizon Sandy Loam | 5% Gravel |  |
| 1 | | | |
| 2 | 4"-26" B-Horizon Sandy Loam | 5% Gravel | |
| 3 | ▼ ESHGW @ 38" | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | 26"-116"- C-Horizon Loamy Sand | 5% Gravel, Cobbles & Boulders | |
| 10 | Bottom of Test Pit. No Refusal @ 116"<br>Elev. 329.8+/- | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #6<br>Ground Elevation: 342+/-<br>ESHGW<br>Depth: 29" Elev: 339.6+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 116" | Roots to: 39" | Weather: 67 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION: ENGINEERING | DESCRIPTION: GEOLOGIC/GENERAL |
|---|---|---|
| 1 | 0"-13" A-Horizon Loamy Sand (Fill along Eastern side of Pit) — 5% Gravel |  |
| 2 | 13"-29" B-Horizon Loamy Sand — 5% Gravel; ▼ ESHGW @ 29" | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | 29"-111"- C-Horizon Loamy Sand — 5% Gravel, Cobbles | |
| 10 | Bottom of Test Pit. No Refusal @ 111" Elev. 332.8+/- | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #7<br>Ground Elevation: 343+/-<br>ESHGW<br>Depth: 26" Elev: 340.8+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 109" | Roots to: 61" | Weather: 68 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION — ENGINEERING | DESCRIPTION — GEOLOGIC/GENERAL |
|---|---|---|
| 1 | 0"-12" A-Horizon Loamy Sand 5% Gravel |  |
| 2 | 12"-23" B-Horizon Loamy Sand 5% Gravel | |
| 3 | ESHGW @ 26" | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | 23"-109"- C-Horizon Loamy Sand 5% Gravel, Cobbles | |
| 10 | Bottom of Test Pit. No Refusal @ 106"<br>Elev. 333.9+/- | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

| TEST PIT LOG | Test Pit #8 | BEALS · ASSOCIATES INC. |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Ground Elevation: 344+/-<br>ESHGW<br>Depth: 25" Elev: 341.2+/- | |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 96" | Roots to: 40" | Weather: 69 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION — ENGINEERING | | DESCRIPTION — GEOLOGIC/GENERAL |
|---|---|---|---|
| 1 | 0"-8" A-Horizon Loamy Sand | 5% Gravel |  |
| 2 | ESHGW @ 25" ▼ | | |
| 3 | 8"-31" B-Horizon Loamy Sand | 5% Gravel | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | 31"-96"- C-Horizon Loamy Sand | 5% Gravel, Cobbles, Boulders | |
| 9 | Bottom of Test Pit. No Refusal @ 96"<br>Elev. 333.9+/- | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #9<br>Ground Elevation: 345+/-<br>ESHGW<br>Depth: 40" Elev: 341.7+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 116" | Roots to: 32" | Weather: 70 Degrees and Partly Cloudy |

## DESCRIPTION

| Depth (ft) | ENGINEERING | | GEOLOGIC/GENERAL |
|---|---|---|---|
| | 0"-10" A-Horizon Loamy Sand | 5% Gravel |  |
| 1 | | | |
| 2 | 10"-31" B-Horizon Loamy Sand | 5% Gravel, Cobbles, Stones | |
| 3 | ESHGW @ 40" ▼ | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | 31"-116"- C-Horizon Loamy Sand | 5% Gravel, Cobbles | |
| 10 | Bottom of Test Pit. No Refusal @ 116"<br>Elev. 335.3+/- | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |

# TEST PIT LOG

| | |
|---|---|
| Test Pit #10 | BEALS · ASSOCIATES INC. |
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Ground Elevation: 347+/- |
| ESHGW<br>Depth: 36" Elev: 343+/- | |
| Contractor: Marinella Construction, Inc. | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | Date: August 22, 2024 |
| Completion Depth: No refusal @ 114" Roots to: | Weather: 72 Degrees and Partly Cloudy |

## DESCRIPTION

| Depth (ft) | ENGINEERING | | GEOLOGIC/GENERAL |
|---|---|---|---|
| | 0"-3" Pavement | |  |
| 1 | 3"-18" Gravel Fill | Minor Weeping at Pit Face @ 20" | |
| 2 | 18"-32" Sandy Loam Fill<br>(Pocket of A-Horizon @ 32") | ESHGW @ 36" | |
| 3 | 32"-38" B-Horizon Loamy Sand | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | 38"-114"- C-Horizon Loamy Sand | | |
| 10 | Bottom of Test Pit. No Refusal @ 114"<br>Elev. 337.5+/- | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #11<br>Ground Elevation: 342+/-<br>ESHGW<br>Depth: 18" Elev: 341.5+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 108" | Roots to: 45" | Weather: 72 Degrees and Partly Cloudy |

| Depth (ft) | DESCRIPTION — ENGINEERING | | DESCRIPTION — GEOLOGIC/GENERAL |
|---|---|---|---|
| | 0"-6" A-Horizon Loamy Sand | 5% Gravel |  |
| 1 | 6"-15" B-Horizon Loamy Sand | 5% Gravel | |
| 2 | ESHGW @ 18" | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | 15"-108"- C-Horizon Loamy Sand | 5-10% Gravel, 5% Cobbles | |
| | Bottom of Test Pit. No Refusal @ 108"<br>Elev. 333.0+/- | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |

# TEST PIT LOG

| | | |
|---|---|---|
| Project: C-1381 Franklin<br>55 Constitution Boulevard<br>Franklin, Massachusetts | Test Pit #12<br>Ground Elevation: 345.3+/-<br>ESHGW<br>Depth: 26" Elev: 343.1+/- | BEALS · ASSOCIATES INC. |
| Contractor: Marinella Construction, Inc. | | Logged by: Devin P. Howe, P.E., SE 14814 & Tyler Lapshanski |
| Equipment: | | Date: August 22, 2024 |
| Completion Depth: No refusal @ 106" | Roots to: | Weather: 73 Degrees and Partly Cloudy |

## DESCRIPTION

| Depth (ft) | ENGINEERING | GEOLOGIC/GENERAL |
|---|---|---|
| | 0"-3.5" Pavement |  |
| 1 | | |
| 2 | 3.5"-22" Sand & Gravel Fill<br>22"-25" B-Horizon Sandy Loam<br>(Contains Roots) ESHGW @ 26" | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |
| 8 | | |
| 9 | 25"-106"- C-Horizon Loamy Sand 5% Cobbles, Stones<br>Bottom of Test Pit. No Refusal @ 106"<br>Elev. 336.5+/- | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |
| 15 | | |
| 16 | | |
| 17 | | |

# APPENDIX G: RAINFALL DATA

**NOAA Atlas 14, Volume 10, Version 3**
**Location name: Franklin, Massachusetts, USA***
**Latitude: 42.0603°, Longitude: -71.403°**
**Elevation: 346 ft****
* source: ESRI Maps
** source: USGS

## POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

# PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | 0.322 (0.255-0.401) | 0.392 (0.311-0.489) | 0.507 (0.400-0.635) | 0.603 (0.473-0.760) | 0.734 (0.555-0.967) | 0.833 (0.617-1.12) | 0.936 (0.670-1.31) | 1.05 (0.711-1.51) | 1.21 (0.785-1.80) | 1.34 (0.846-2.04) |
| 10-min | 0.456 (0.362-0.568) | 0.556 (0.440-0.693) | 0.719 (0.568-0.900) | 0.853 (0.670-1.08) | 1.04 (0.787-1.37) | 1.18 (0.873-1.59) | 1.33 (0.949-1.86) | 1.49 (1.01-2.14) | 1.71 (1.11-2.56) | 1.89 (1.20-2.89) |
| 15-min | 0.536 (0.426-0.668) | 0.654 (0.518-0.815) | 0.846 (0.668-1.06) | 1.00 (0.788-1.26) | 1.22 (0.925-1.61) | 1.39 (1.03-1.87) | 1.56 (1.12-2.18) | 1.75 (1.18-2.52) | 2.01 (1.31-3.01) | 2.23 (1.41-3.40) |
| 30-min | 0.736 (0.584-0.916) | 0.896 (0.710-1.12) | 1.16 (0.915-1.45) | 1.38 (1.08-1.73) | 1.68 (1.27-2.21) | 1.90 (1.41-2.57) | 2.14 (1.53-3.00) | 2.40 (1.62-3.45) | 2.77 (1.80-4.13) | 3.06 (1.94-4.67) |
| 60-min | 0.935 (0.742-1.16) | 1.14 (0.903-1.42) | 1.47 (1.16-1.84) | 1.75 (1.37-2.20) | 2.13 (1.61-2.81) | 2.42 (1.79-3.26) | 2.72 (1.95-3.81) | 3.05 (2.06-4.39) | 3.52 (2.28-5.25) | 3.90 (2.47-5.95) |
| 2-hr | 1.20 (0.958-1.48) | 1.47 (1.18-1.82) | 1.92 (1.53-2.39) | 2.30 (1.82-2.87) | 2.81 (2.15-3.70) | 3.20 (2.39-4.31) | 3.61 (2.62-5.08) | 4.10 (2.78-5.86) | 4.84 (3.15-7.17) | 5.46 (3.47-8.27) |
| 3-hr | 1.39 (1.12-1.71) | 1.71 (1.37-2.11) | 2.24 (1.79-2.77) | 2.68 (2.13-3.33) | 3.28 (2.52-4.30) | 3.73 (2.81-5.02) | 4.21 (3.08-5.93) | 4.80 (3.27-6.84) | 5.71 (3.73-8.44) | 6.50 (4.13-9.80) |
| 6-hr | 1.79 (1.45-2.19) | 2.20 (1.78-2.69) | 2.87 (2.32-3.52) | 3.42 (2.75-4.23) | 4.19 (3.25-5.46) | 4.75 (3.61-6.36) | 5.37 (3.96-7.52) | 6.13 (4.19-8.67) | 7.31 (4.79-10.7) | 8.34 (5.32-12.5) |
| 12-hr | 2.29 (1.87-2.77) | 2.79 (2.28-3.38) | 3.61 (2.94-4.39) | 4.29 (3.47-5.25) | 5.23 (4.08-6.75) | 5.92 (4.52-7.84) | 6.67 (4.94-9.25) | 7.59 (5.22-10.7) | 9.00 (5.92-13.1) | 10.2 (6.55-15.2) |
| 24-hr | 2.74 (2.26-3.30) | 3.36 (2.77-4.04) | 4.38 (3.59-5.28) | 5.21 (4.25-6.33) | 6.37 (5.01-8.17) | 7.22 (5.55-9.50) | 8.15 (6.08-11.2) | 9.29 (6.42-13.0) | 11.1 (7.30-16.0) | 12.6 (8.08-18.6) |
| 2-day | 3.09 (2.57-3.68) | 3.84 (3.20-4.58) | 5.09 (4.21-6.09) | 6.12 (5.03-7.37) | 7.53 (5.97-9.61) | 8.57 (6.65-11.2) | 9.71 (7.32-13.4) | 11.2 (7.74-15.5) | 13.4 (8.90-19.3) | 15.4 (9.95-22.6) |
| 3-day | 3.36 (2.81-3.98) | 4.18 (3.49-4.96) | 5.51 (4.58-6.56) | 6.61 (5.46-7.93) | 8.14 (6.48-10.3) | 9.25 (7.21-12.1) | 10.5 (7.93-14.4) | 12.0 (8.37-16.6) | 14.5 (9.62-20.8) | 16.6 (10.8-24.3) |
| 4-day | 3.62 (3.04-4.28) | 4.47 (3.75-5.28) | 5.85 (4.88-6.95) | 7.00 (5.80-8.36) | 8.58 (6.85-10.8) | 9.74 (7.60-12.6) | 11.0 (8.33-15.0) | 12.6 (8.79-17.3) | 15.1 (10.1-21.6) | 17.3 (11.2-25.2) |
| 7-day | 4.37 (3.69-5.12) | 5.26 (4.44-6.19) | 6.73 (5.66-7.94) | 7.95 (6.63-9.43) | 9.62 (7.72-12.0) | 10.9 (8.50-13.9) | 12.2 (9.23-16.4) | 13.8 (9.69-18.9) | 16.3 (10.9-23.1) | 18.4 (11.9-26.7) |
| 10-day | 5.07 (4.31-5.93) | 6.00 (5.09-7.02) | 7.52 (6.35-8.83) | 8.78 (7.36-10.4) | 10.5 (8.46-13.1) | 11.8 (9.25-15.0) | 13.2 (9.96-17.5) | 14.8 (10.4-20.1) | 17.2 (11.5-24.3) | 19.2 (12.5-27.7) |
| 20-day | 7.16 (6.14-8.30) | 8.16 (6.98-9.46) | 9.78 (8.33-11.4) | 11.1 (9.40-13.0) | 13.0 (10.5-15.9) | 14.4 (11.3-18.0) | 15.8 (11.9-20.6) | 17.4 (12.3-23.4) | 19.6 (13.2-27.4) | 21.3 (13.9-30.5) |
| 30-day | 8.90 (7.67-10.3) | 9.94 (8.55-11.5) | 11.6 (9.96-13.5) | 13.0 (11.1-15.2) | 15.0 (12.2-18.2) | 16.5 (13.0-20.4) | 18.0 (13.5-23.1) | 19.5 (13.9-26.1) | 21.5 (14.5-29.9) | 23.0 (15.0-32.9) |
| 45-day | 11.1 (9.60-12.7) | 12.2 (10.5-14.0) | 14.0 (12.0-16.1) | 15.4 (13.2-17.9) | 17.5 (14.2-21.1) | 19.1 (15.1-23.5) | 20.6 (15.5-26.2) | 22.1 (15.8-29.4) | 23.9 (16.2-33.1) | 25.2 (16.5-35.8) |
| 60-day | 12.9 (11.2-14.8) | 14.1 (12.2-16.1) | 15.9 (13.8-18.3) | 17.5 (15.0-20.2) | 19.6 (16.0-23.5) | 21.3 (16.8-26.0) | 22.9 (17.2-28.8) | 24.3 (17.4-32.1) | 25.9 (17.6-35.8) | 27.0 (17.7-38.3) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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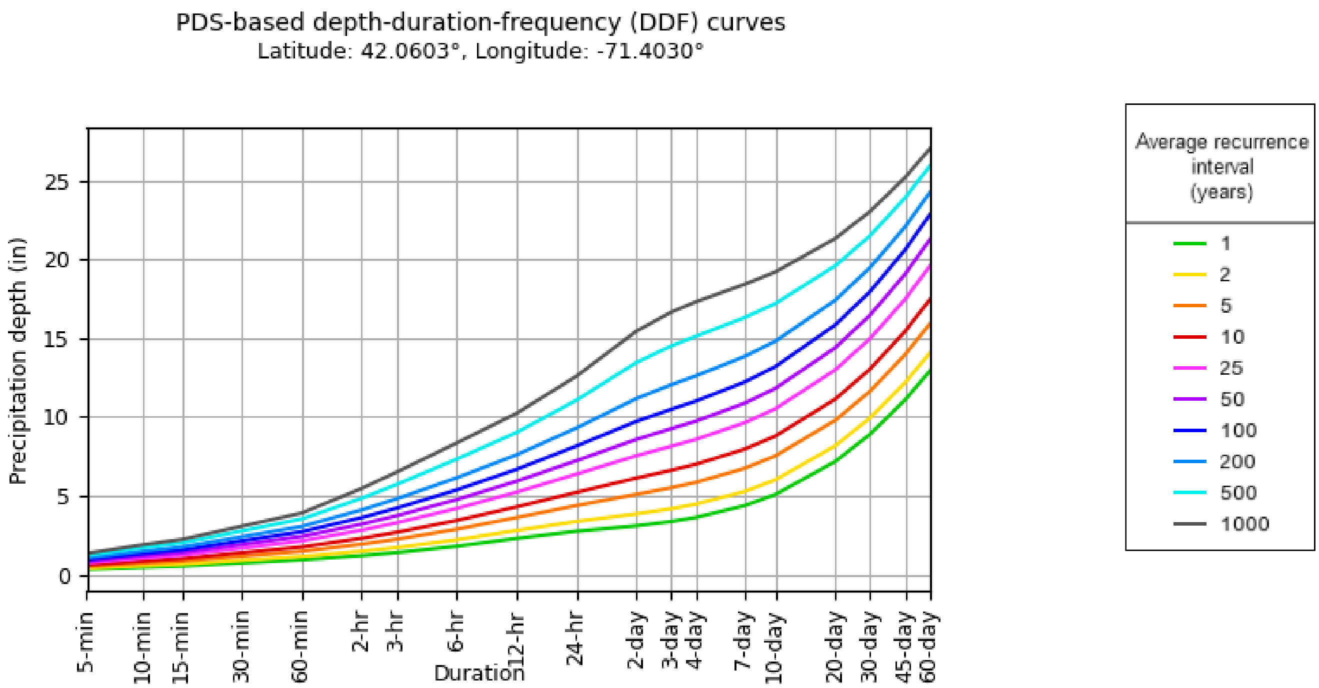
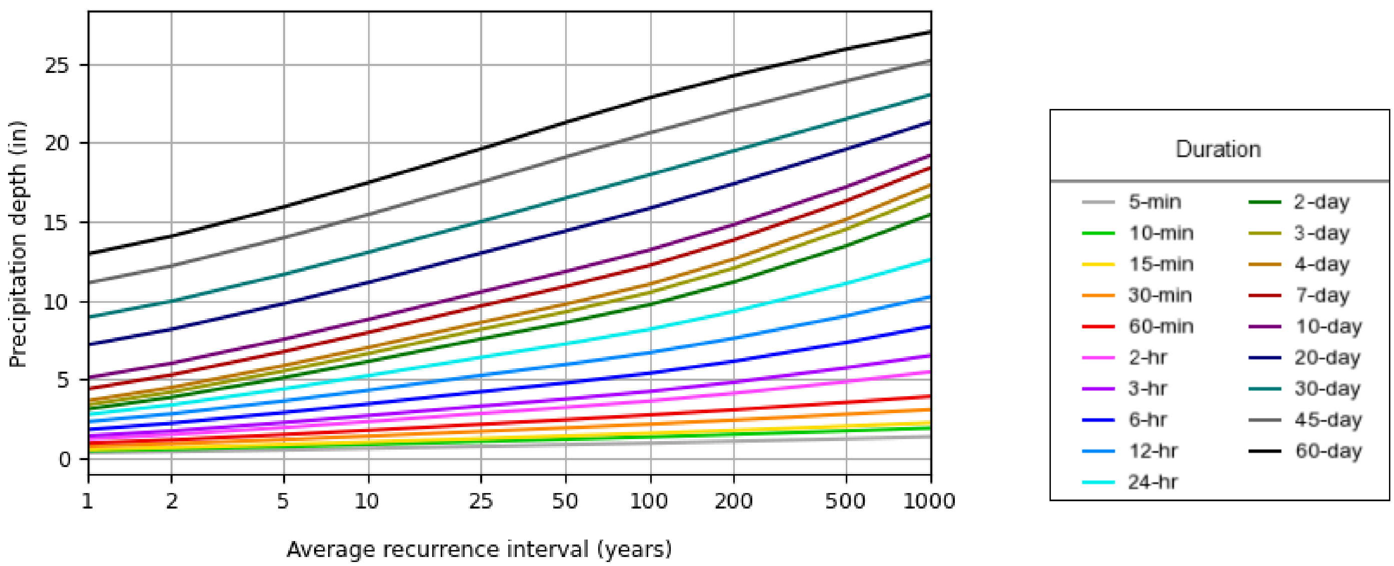
# PF graphical




NOAA Atlas 14, Volume 10, Version 3

Created (GMT): Wed Oct 9 20:42:57 2024

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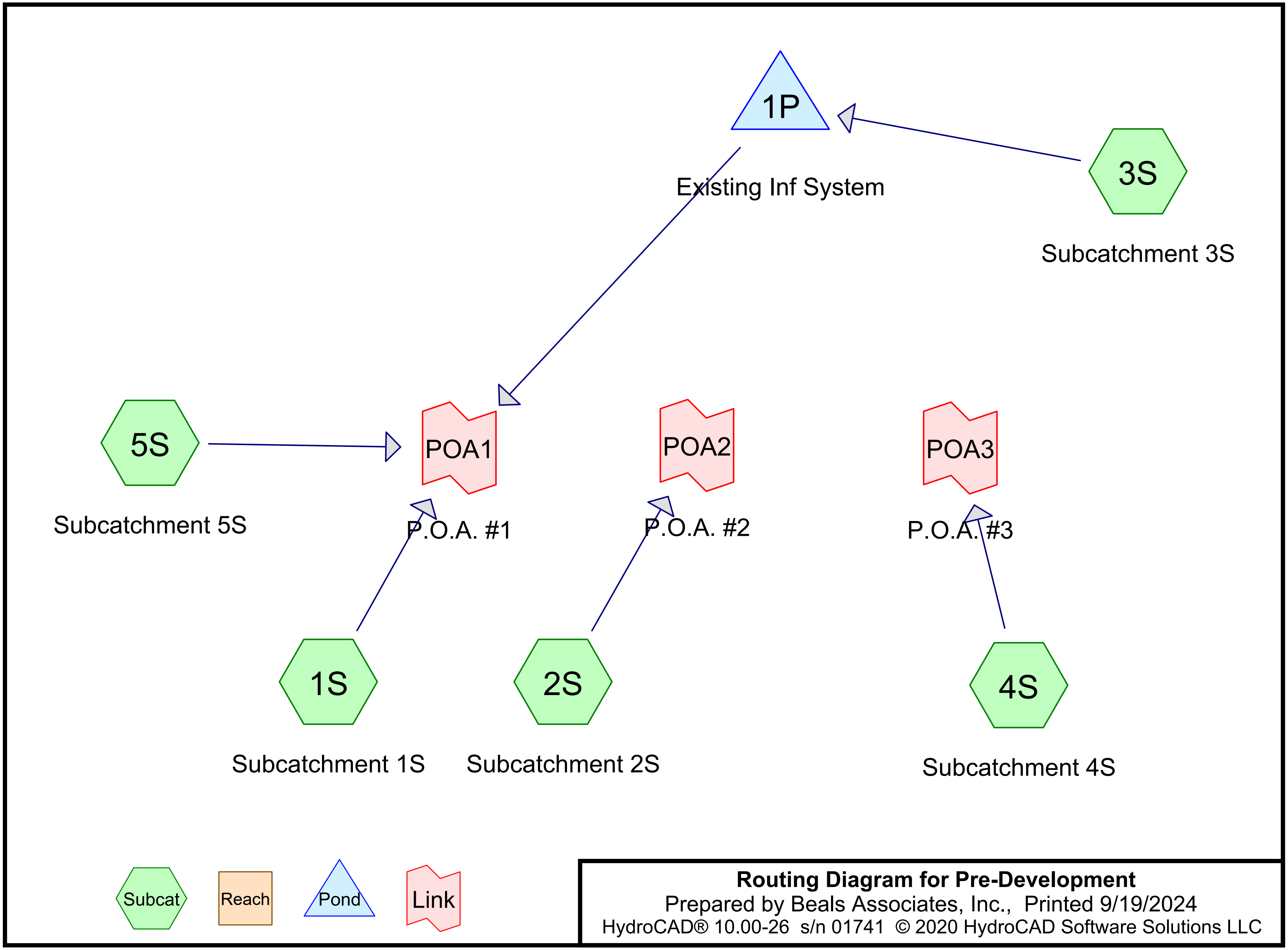
## Maps & aerials

**Small scale terrain**

# APPENDIX H: HYDROCAD




**Routing Diagram for Pre-Development**
Prepared by Beals Associates, Inc., Printed 9/19/2024
HydroCAD® 10.00-26 s/n 01741 © 2020 HydroCAD Software Solutions LLC

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 2.189 | 74 | >75% Grass cover, Good, HSG C (1S, 2S, 4S, 5S) |
| 9.513 | 98 | Impervious (1S, 3S, 5S) |
| 0.454 | 98 | Wetland Resource Area (2S) |
| 4.403 | 70 | Woods, Good, HSG C (1S, 2S, 4S, 5S) |
| **16.559** | **87** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 6.592 | HSG C | 1S, 2S, 4S, 5S |
| 0.000 | HSG D | |
| 9.967 | Other | 1S, 2S, 3S, 5S |
| **16.559** | | **TOTAL AREA** |

## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 2.189 | 0.000 | 0.000 | 2.189 | >75% Grass cover, Good | 1S, 2S, 4S, 5S |
| 0.000 | 0.000 | 0.000 | 0.000 | 9.513 | 9.513 | Impervious | 1S, 3S, 5S |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.454 | 0.454 | Wetland Resource Area | 2S |
| 0.000 | 0.000 | 4.403 | 0.000 | 0.000 | 4.403 | Woods, Good | 1S, 2S, 4S, 5S |
| **0.000** | **0.000** | **6.592** | **0.000** | **9.967** | **16.559** | **TOTAL AREA** | |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1S | 0.00 | 0.00 | 156.0 | 0.0192 | 0.011 | 12.0 | 0.0 | 0.0 |
| 2 | 1S | 0.00 | 0.00 | 132.0 | 0.0049 | 0.011 | 15.0 | 0.0 | 0.0 |
| 3 | 1S | 0.00 | 0.00 | 207.0 | 0.0104 | 0.011 | 18.0 | 0.0 | 0.0 |
| 4 | 1S | 0.00 | 0.00 | 594.0 | 0.0094 | 0.011 | 24.0 | 0.0 | 0.0 |
| 5 | 2S | 0.00 | 0.00 | 34.0 | 0.0271 | 0.011 | 24.0 | 0.0 | 0.0 |
| 6 | 5S | 0.00 | 0.00 | 358.0 | 0.0077 | 0.011 | 24.0 | 0.0 | 0.0 |
| 7 | 5S | 0.00 | 0.00 | 57.0 | 0.0035 | 0.011 | 30.0 | 0.0 | 0.0 |
| 8 | 5S | 0.00 | 0.00 | 504.0 | 0.0052 | 0.011 | 36.0 | 0.0 | 0.0 |
| 9 | 1P | 339.50 | 338.90 | 43.0 | 0.0140 | 0.011 | 12.0 | 0.0 | 0.0 |

Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment1S: Subcatchment1S**
Runoff Area=449,732 sf 75.96% Impervious Runoff Depth=2.63"
Flow Length=1,157' Tc=10.2 min CN=WQ Runoff=24.86 cfs 2.265 af

**Subcatchment2S: Subcatchment2S**
Runoff Area=118,990 sf 16.64% Impervious Runoff Depth=1.31"
Flow Length=422' Tc=15.6 min CN=WQ Runoff=2.82 cfs 0.299 af

**Subcatchment3S: Subcatchment3S**
Runoff Area=35,039 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=2.63 cfs 0.210 af

**Subcatchment4S: Subcatchment4S**
Runoff Area=53,274 sf 0.00% Impervious Runoff Depth=0.94"
Flow Length=198' Tc=8.9 min CN=WQ Runoff=1.12 cfs 0.096 af

**Subcatchment5S: Subcatchment5S**
Runoff Area=64,294 sf 58.66% Impervious Runoff Depth=2.23"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=3.09 cfs 0.275 af

**Pond 1P: Existing Inf System**
Peak Elev=339.32' Storage=4,114 cf Inflow=2.63 cfs 0.210 af
Discarded=0.13 cfs 0.210 af Primary=0.00 cfs 0.000 af Outflow=0.13 cfs 0.210 af

**Link POA1: P.O.A. #1**
Inflow=27.94 cfs 2.540 af
Primary=27.94 cfs 2.540 af

**Link POA2: P.O.A. #2**
Inflow=2.82 cfs 0.299 af
Primary=2.82 cfs 0.299 af

**Link POA3: P.O.A. #3**
Inflow=1.12 cfs 0.096 af
Primary=1.12 cfs 0.096 af

**Total Runoff Area = 16.559 ac Runoff Volume = 3.145 af Average Runoff Depth = 2.28"**
**39.81% Pervious = 6.592 ac 60.19% Impervious = 9.967 ac**

## Summary for Subcatchment 1S: Subcatchment 1S

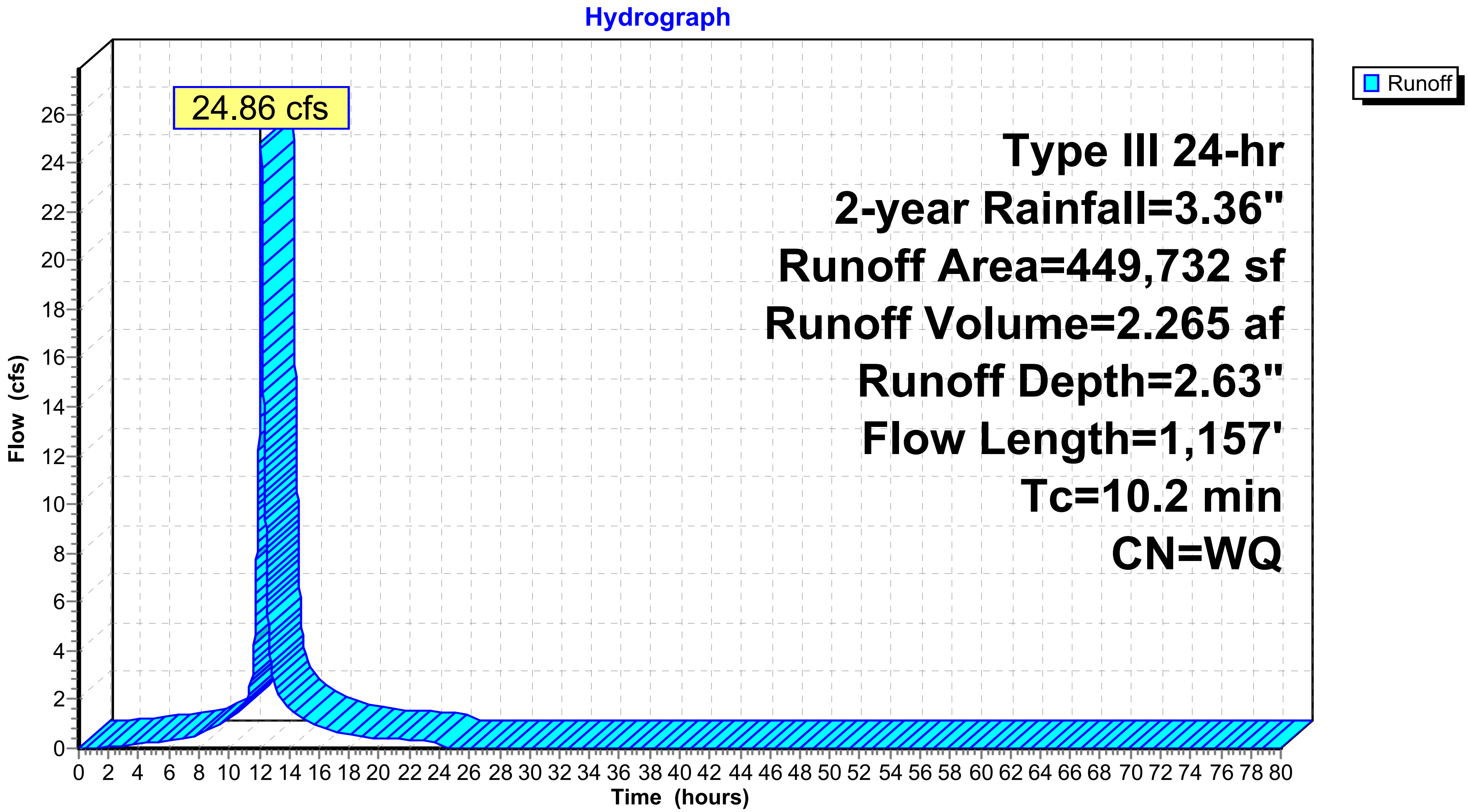
Runoff = 24.86 cfs @ 12.14 hrs, Volume= 2.265 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 341,613 | 98 | Impervious |
| | 72,493 | 74 | >75% Grass cover, Good, HSG C |
| | 35,626 | 70 | Woods, Good, HSG C |
| | 449,732 | | Weighted Average |
| | 108,119 | | 24.04% Pervious Area |
| | 341,613 | | 75.96% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 50 | 0.0780 | 0.12 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.6 | 18 | 0.0094 | 0.48 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.4 | 156 | 0.0192 | 7.43 | 5.83 | **Pipe Channel, C-D**<br>12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 132 | 0.0049 | 4.35 | 5.34 | **Pipe Channel, D-E**<br>15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 207 | 0.0104 | 7.16 | 12.66 | **Pipe Channel, E-F**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.2 | 594 | 0.0094 | 8.25 | 25.92 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 10.2 | 1,157 | Total | | | |

## Subcatchment 1S: Subcatchment 1S



## Summary for Subcatchment 2S: Subcatchment 2S

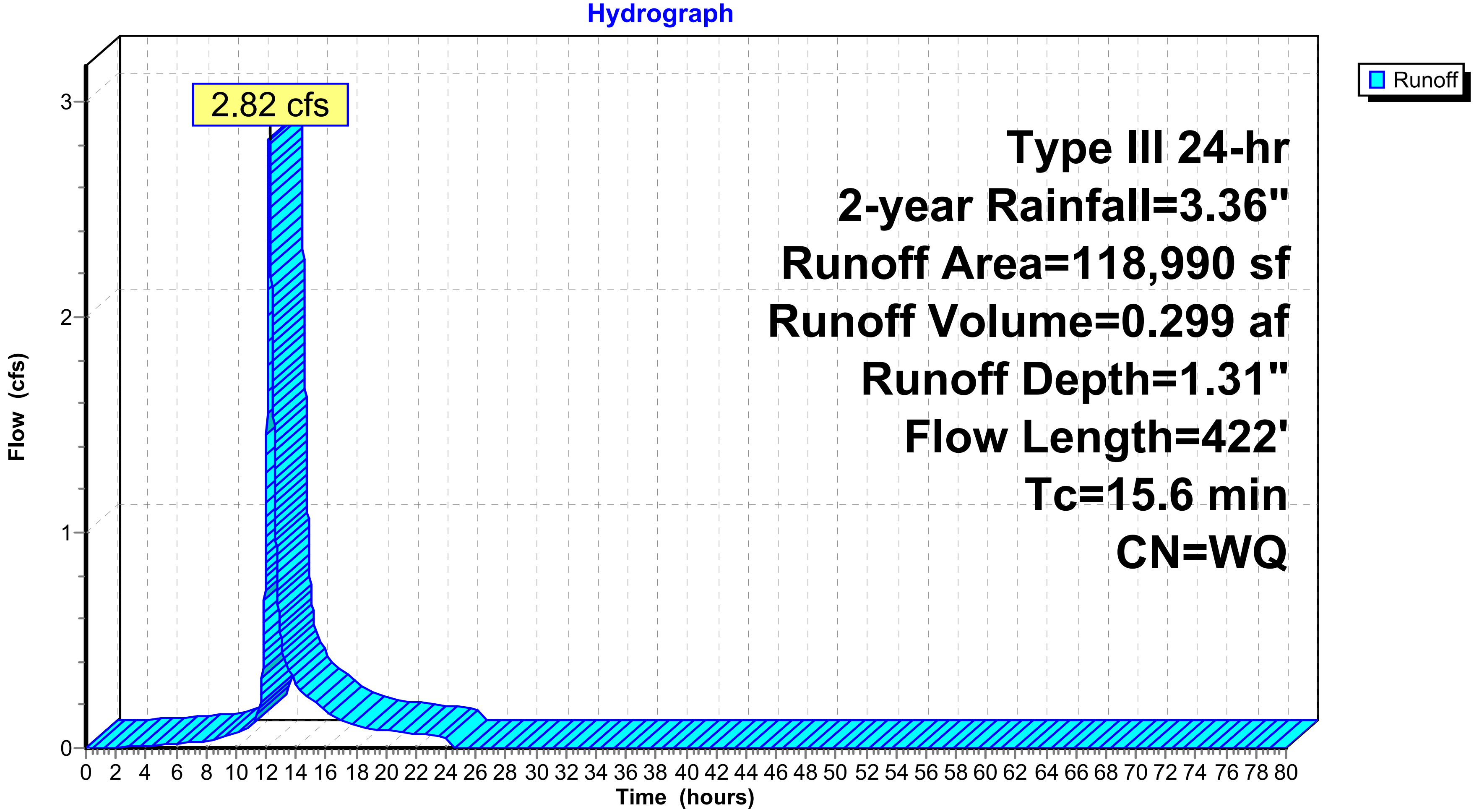
Runoff = 2.82 cfs @ 12.22 hrs, Volume= 0.299 af, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 86,505 | 70 | Woods, Good, HSG C |
| | 12,690 | 74 | >75% Grass cover, Good, HSG C |
| * | 19,795 | 98 | Wetland Resource Area |
| | 118,990 | | Weighted Average |
| | 99,195 | | 83.36% Pervious Area |
| | 19,795 | | 16.64% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.4 | 50 | 0.0374 | 0.09 | | **Sheet Flow, A-B** |
| | | | | | Woods: Light underbrush n= 0.400 P2= 3.36" |
| 6.2 | 338 | 0.0325 | 0.90 | | **Shallow Concentrated Flow, B-C** |
| | | | | | Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, C-D** |
| | | | | | 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' |
| | | | | | n= 0.011 Concrete pipe, straight & clean |
| 15.6 | 422 | Total | | | |

**Subcatchment 2S: Subcatchment 2S**



## Summary for Subcatchment 3S: Subcatchment 3S

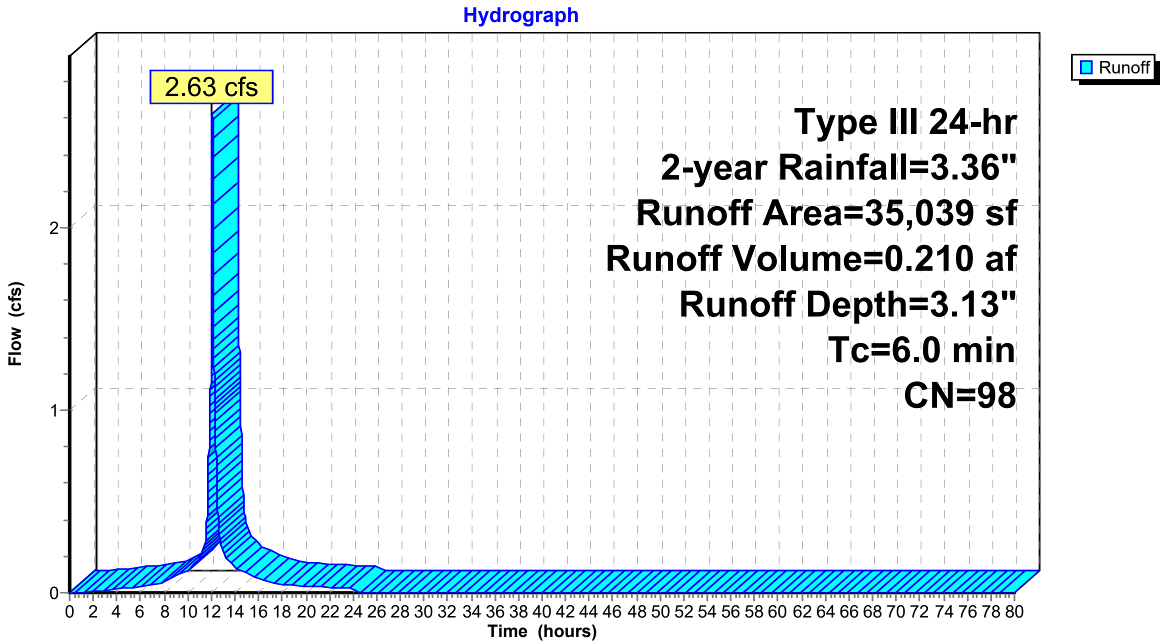
Runoff = 2.63 cfs @ 12.08 hrs, Volume= 0.210 af, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 35,039 | 98 | Impervious |
| | 35,039 | | 100.00% Impervious Area |

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

## Subcatchment 3S: Subcatchment 3S



## Summary for Subcatchment 4S: Subcatchment 4S

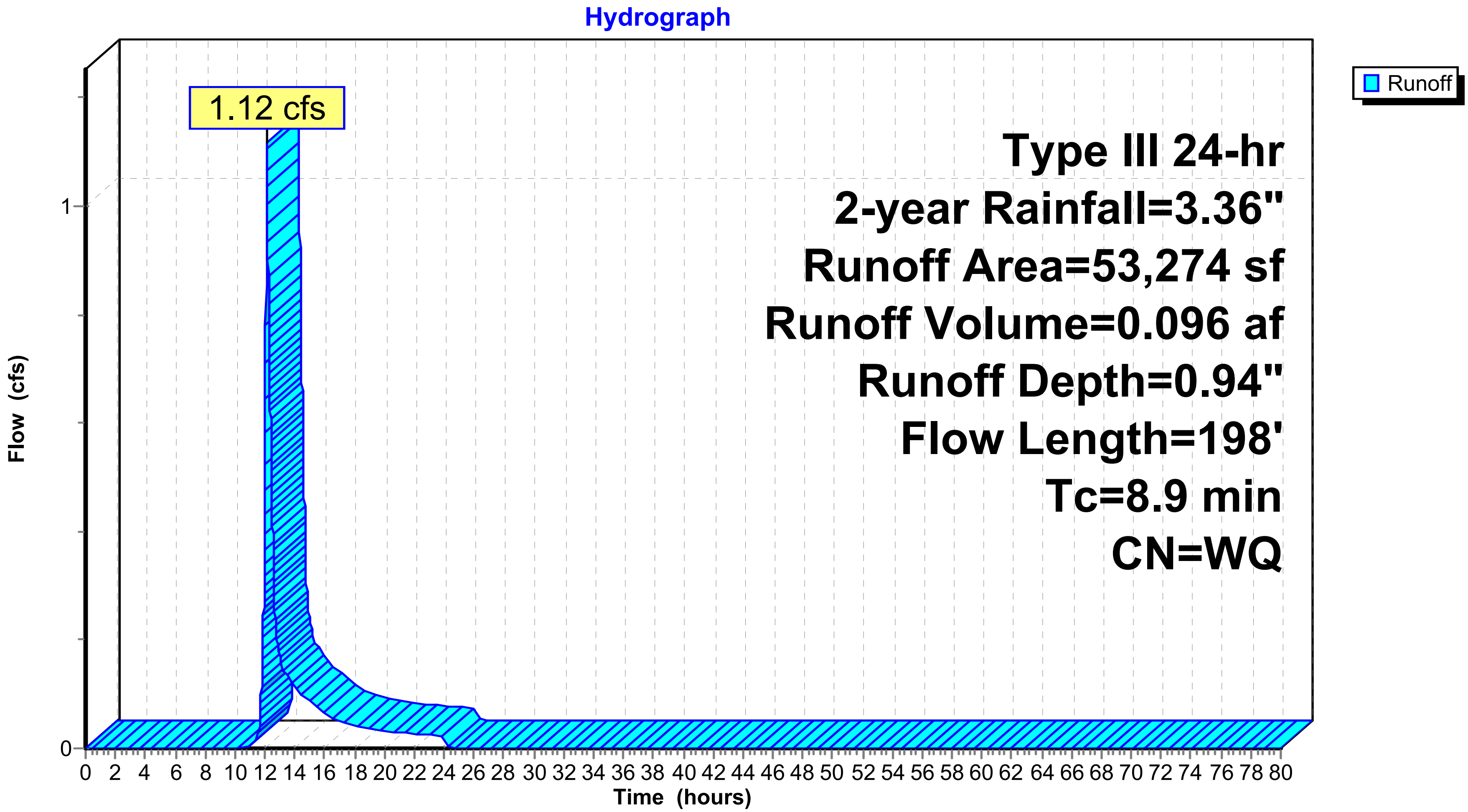
Runoff = 1.12 cfs @ 12.14 hrs, Volume= 0.096 af, Depth= 0.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| Area (sf) | CN | Description |
|---|---|---|
| 47,956 | 70 | Woods, Good, HSG C |
| 5,318 | 74 | >75% Grass cover, Good, HSG C |
| 53,274 | | Weighted Average |
| 53,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.6 | 35 | 0.0286 | 0.16 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 0.5 | 18 | 0.0146 | 0.60 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 4.8 | 145 | 0.0103 | 0.51 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 8.9 | 198 | Total | | | |

### Subcatchment 4S: Subcatchment 4S



## Summary for Subcatchment 5S: Subcatchment 5S

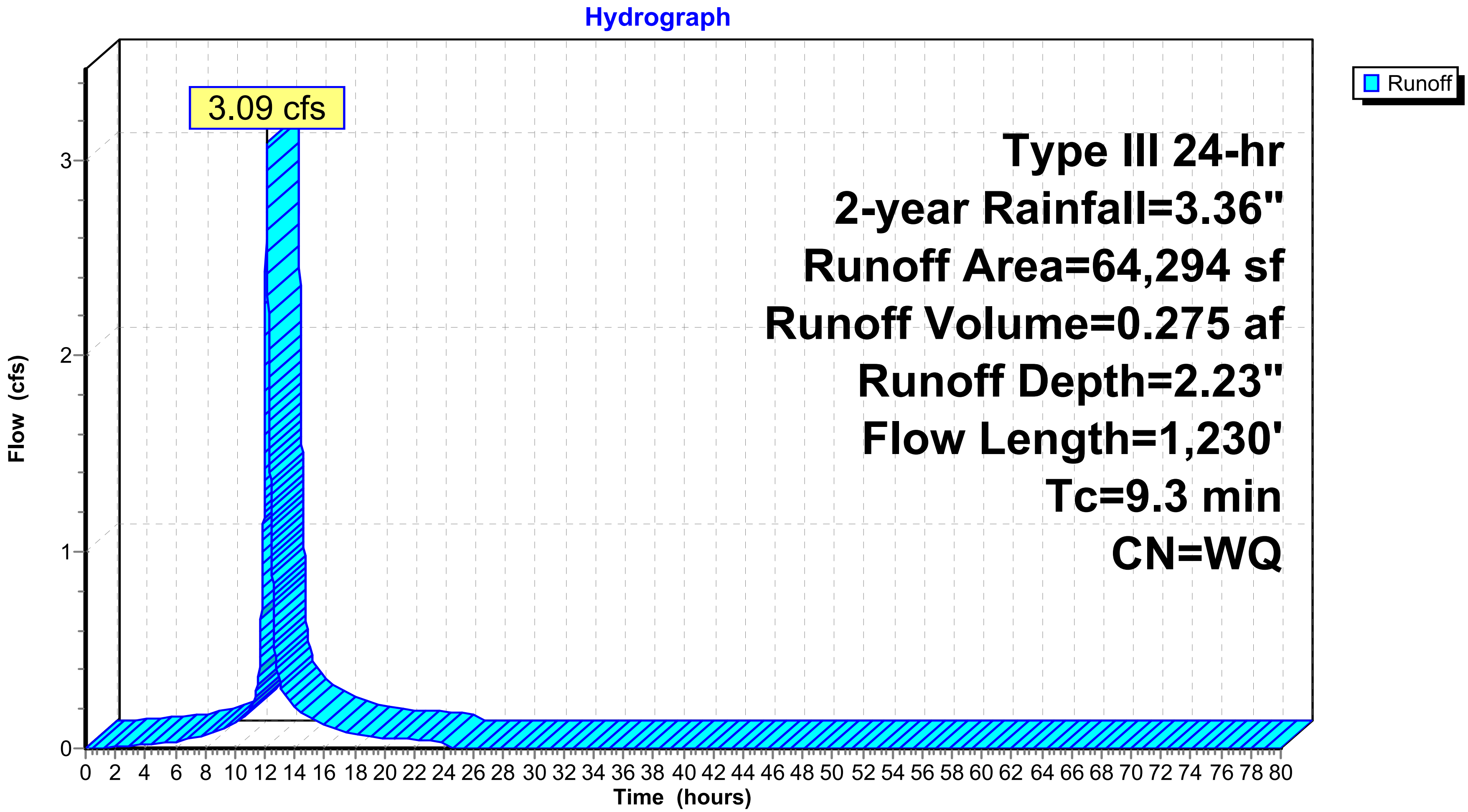
Runoff = 3.09 cfs @ 12.13 hrs, Volume= 0.275 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 21,716 | 70 | Woods, Good, HSG C |
| | 4,863 | 74 | >75% Grass cover, Good, HSG C |
| * | 37,715 | 98 | Impervious |
| | 64,294 | | Weighted Average |
| | 26,579 | | 41.34% Pervious Area |
| | 37,715 | | 58.66% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

## Subcatchment 5S: Subcatchment 5S



## Summary for Pond 1P: Existing Inf System

Inflow Area = 0.804 ac,100.00% Impervious, Inflow Depth = 3.13" for 2-year event
Inflow = 2.63 cfs @ 12.08 hrs, Volume= 0.210 af
Outflow = 0.13 cfs @ 10.90 hrs, Volume= 0.210 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.13 cfs @ 10.90 hrs, Volume= 0.210 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 339.32' @ 14.17 hrs Surf.Area= 5,527 sf Storage= 4,114 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 259.2 min ( 1,014.5 - 755.4 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 338.19' | 3,764 cf | **70.00'W x 78.96'L x 2.71'H Field A** |
| | | | 14,969 cf Overall - 5,559 cf Embedded = 9,411 cf x 40.0% Voids |
| #2A | 338.69' | 5,559 cf | **Cultec R-180** x 252 Inside #1 |
| | | | Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf |
| | | | Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap |
| | | | Row Length Adjustment= +1.00' x 3.44 sf x 21 rows |
| | | 9,323 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.50' | **12.0" Round Culvert** L= 43.0' RCP, rounded edge headwall, Ke= 0.100 |
| | | | Inlet / Outlet Invert= 339.50' / 338.90' S= 0.0140 '/' Cc= 0.900 |
| | | | n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf |
| #2 | Discarded | 338.19' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.13 cfs @ 10.90 hrs HW=338.22' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=338.19' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** ( Controls 0.00 cfs)

## Pond 1P: Existing Inf System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger® 180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 21 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

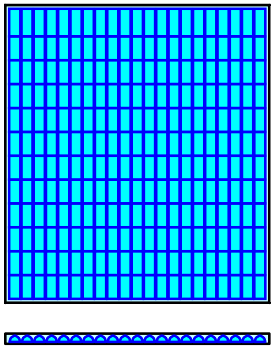
12 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 76.96' Row Length +12.0" End Stone x 2 = 78.96' Base Length
21 Rows x 36.0" Wide + 3.0" Spacing x 20 + 12.0" Side Stone x 2 = 70.00' Base Width
6.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.71' Field Height

252 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 21 Rows = 5,558.8 cf Chamber Storage

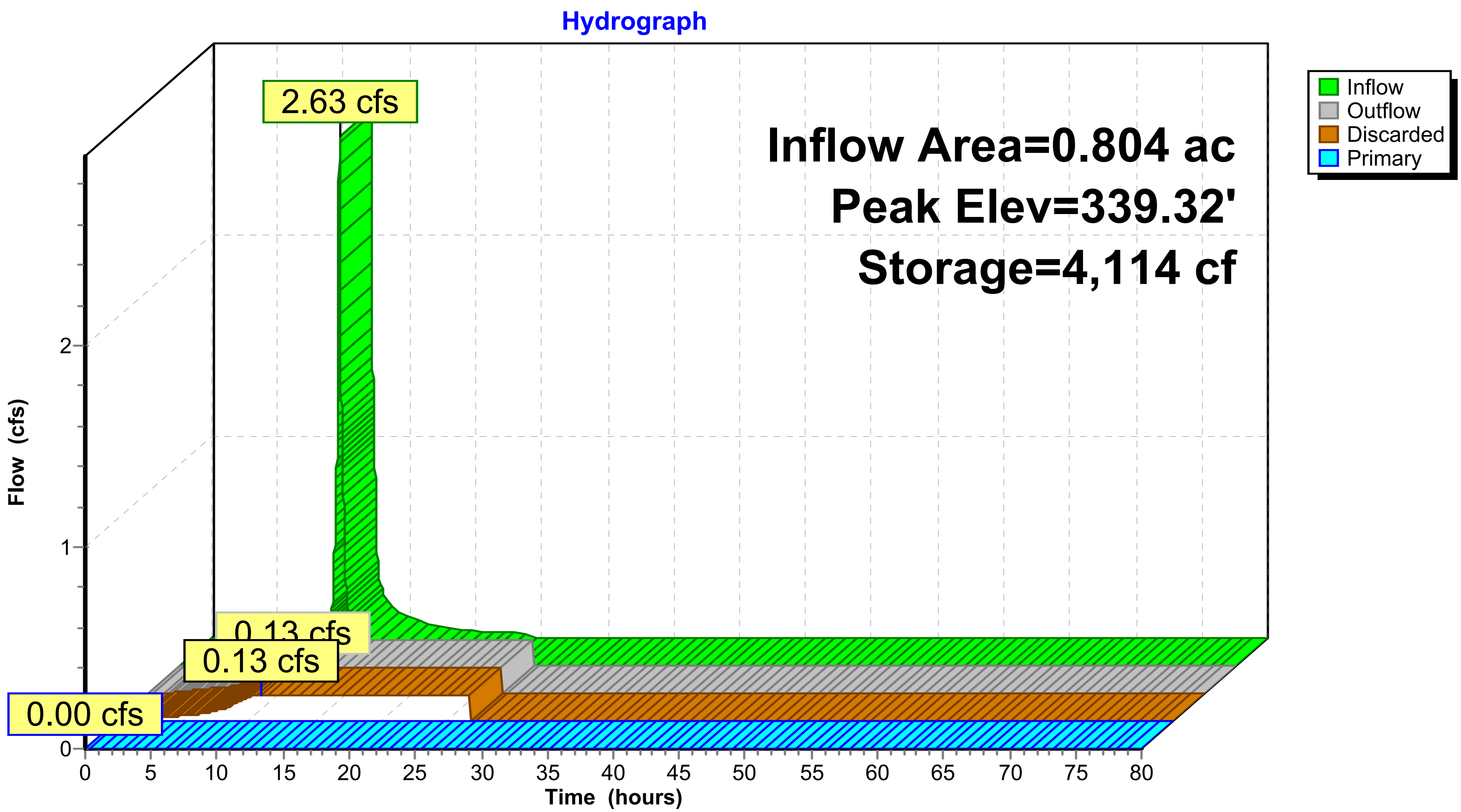
14,969.5 cf Field - 5,558.8 cf Chambers = 9,410.7 cf Stone x 40.0% Voids = 3,764.3 cf Stone Storage

Chamber Storage + Stone Storage = 9,323.1 cf = 0.214 af
Overall Storage Efficiency = 62.3%
Overall System Size = 78.96' x 70.00' x 2.71'

252 Chambers
554.4 cy Field
348.5 cy Stone



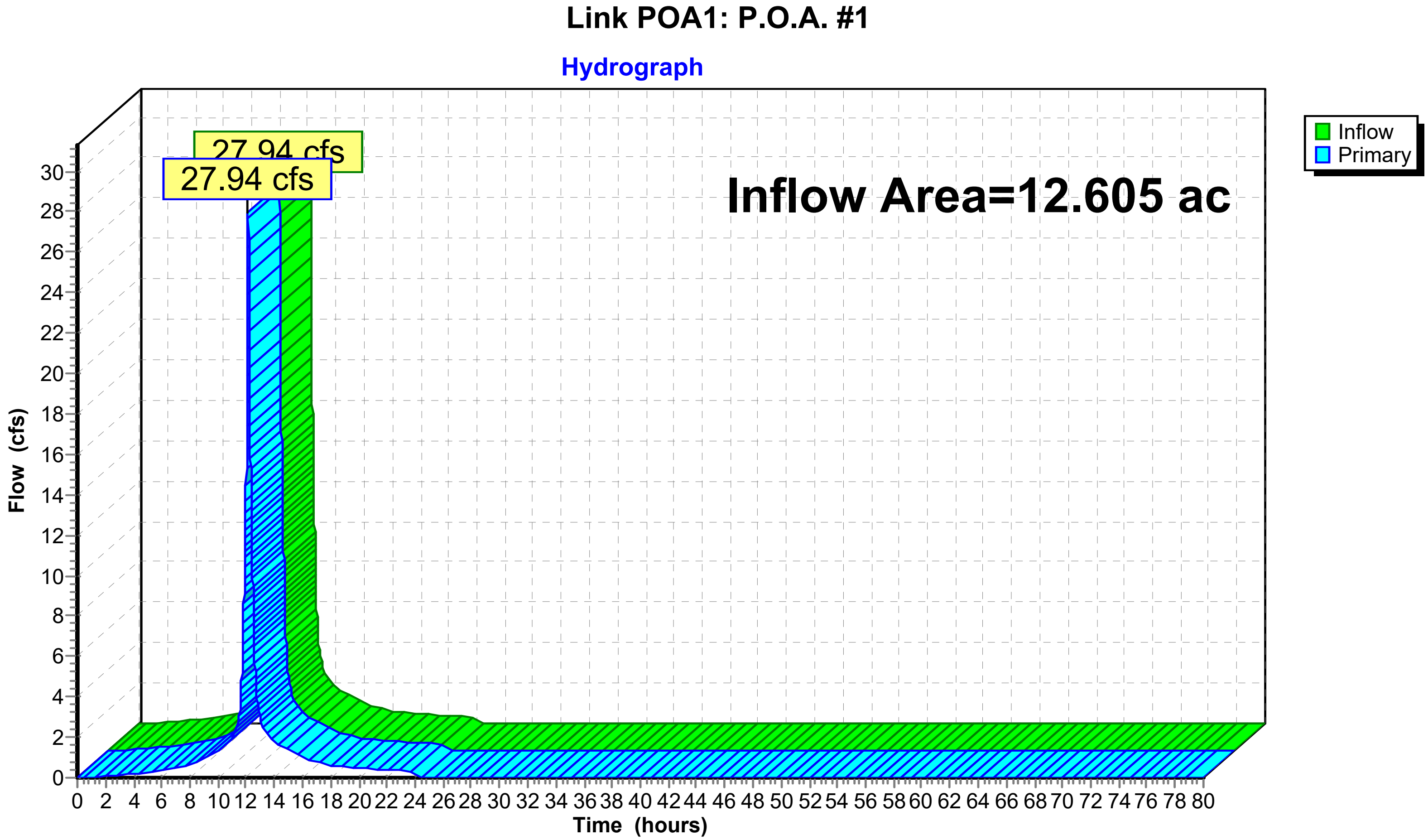
## Pond 1P: Existing Inf System



## Summary for Link POA1: P.O.A. #1

Inflow Area = 12.605 ac, 75.47% Impervious, Inflow Depth = 2.42" for 2-year event
Inflow = 27.94 cfs @ 12.14 hrs, Volume= 2.540 af
Primary = 27.94 cfs @ 12.14 hrs, Volume= 2.540 af, Atten= 0%, Lag= 0.0 min

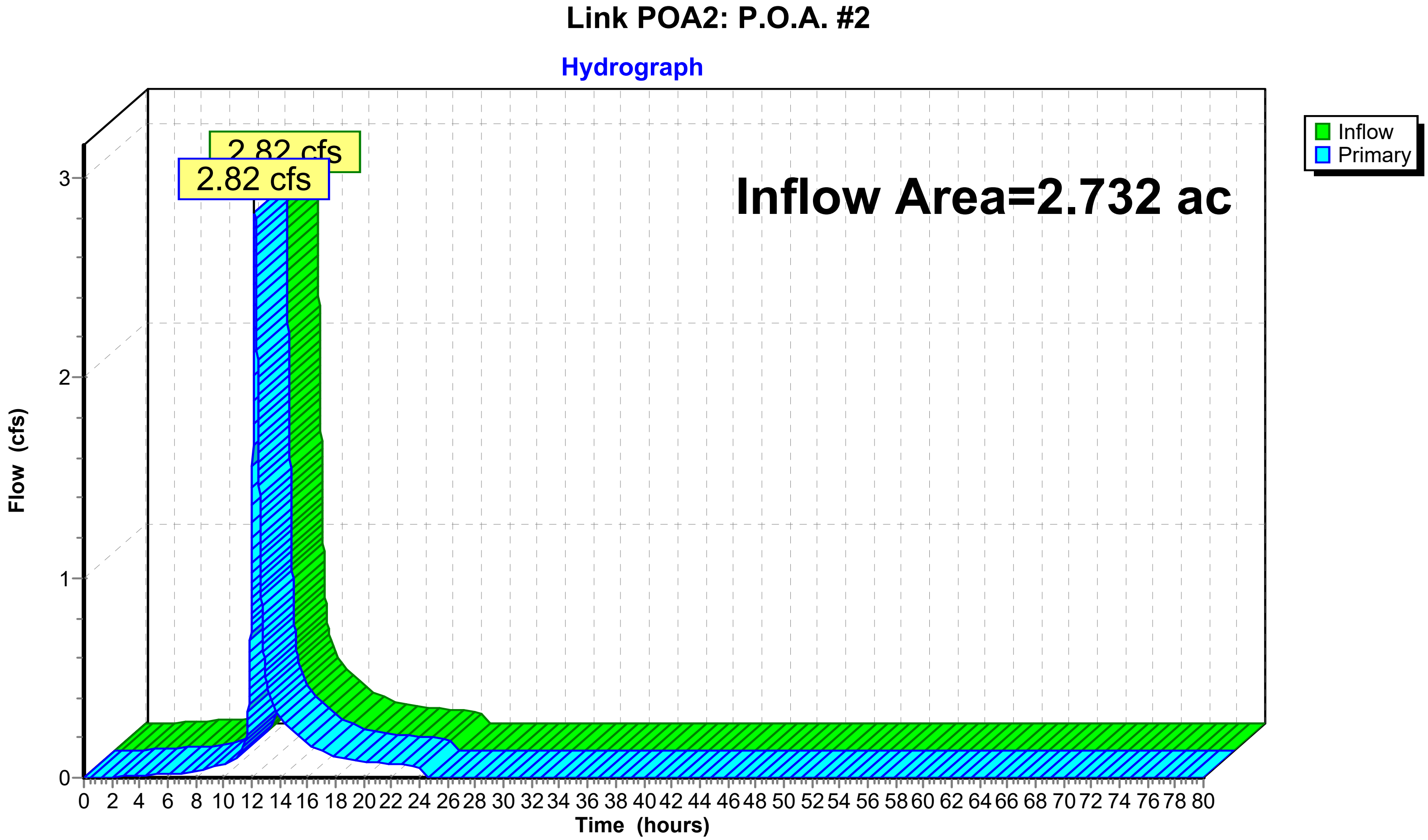
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs



## Summary for Link POA2: P.O.A. #2

Inflow Area = 2.732 ac, 16.64% Impervious, Inflow Depth = 1.31" for 2-year event
Inflow = 2.82 cfs @ 12.22 hrs, Volume= 0.299 af
Primary = 2.82 cfs @ 12.22 hrs, Volume= 0.299 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

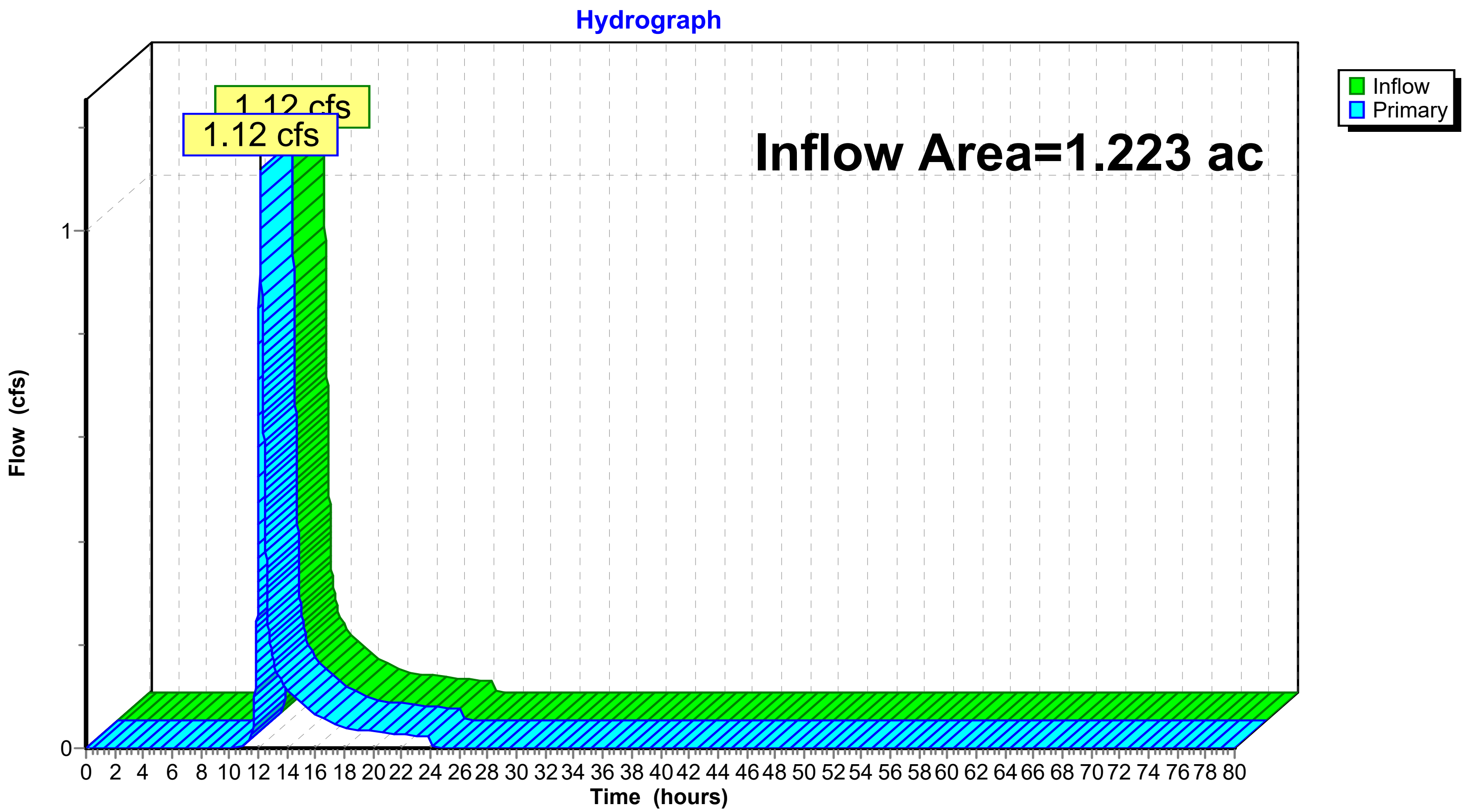


## Summary for Link POA3: P.O.A. #3

Inflow Area = 1.223 ac, 0.00% Impervious, Inflow Depth = 0.94" for 2-year event
Inflow = 1.12 cfs @ 12.14 hrs, Volume= 0.096 af
Primary = 1.12 cfs @ 12.14 hrs, Volume= 0.096 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA3: P.O.A. #3



Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S**
Runoff Area=449,732 sf 75.96% Impervious Runoff Depth=4.36"
Flow Length=1,157' Tc=10.2 min CN=WQ Runoff=40.96 cfs 3.751 af

**Subcatchment 2S: Subcatchment 2S**
Runoff Area=118,990 sf 16.64% Impervious Runoff Depth=2.69"
Flow Length=422' Tc=15.6 min CN=WQ Runoff=6.12 cfs 0.613 af

**Subcatchment 3S: Subcatchment 3S**
Runoff Area=35,039 sf 100.00% Impervious Runoff Depth=4.97"
Tc=6.0 min CN=98 Runoff=4.10 cfs 0.333 af

**Subcatchment 4S: Subcatchment 4S**
Runoff Area=53,274 sf 0.00% Impervious Runoff Depth=2.23"
Flow Length=198' Tc=8.9 min CN=WQ Runoff=2.85 cfs 0.227 af

**Subcatchment 5S: Subcatchment 5S**
Runoff Area=64,294 sf 58.66% Impervious Runoff Depth=3.85"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=5.37 cfs 0.473 af

**Pond 1P: Existing Inf System**
Peak Elev=339.81' Storage=6,265 cf Inflow=4.10 cfs 0.333 af
Discarded=0.13 cfs 0.272 af Primary=0.51 cfs 0.062 af Outflow=0.64 cfs 0.333 af

**Link POA1: P.O.A. #1**
Inflow=46.31 cfs 4.286 af
Primary=46.31 cfs 4.286 af

**Link POA2: P.O.A. #2**
Inflow=6.12 cfs 0.613 af
Primary=6.12 cfs 0.613 af

**Link POA3: P.O.A. #3**
Inflow=2.85 cfs 0.227 af
Primary=2.85 cfs 0.227 af

**Total Runoff Area = 16.559 ac Runoff Volume = 5.397 af Average Runoff Depth = 3.91"**
**39.81% Pervious = 6.592 ac 60.19% Impervious = 9.967 ac**

## Summary for Subcatchment 1S: Subcatchment 1S

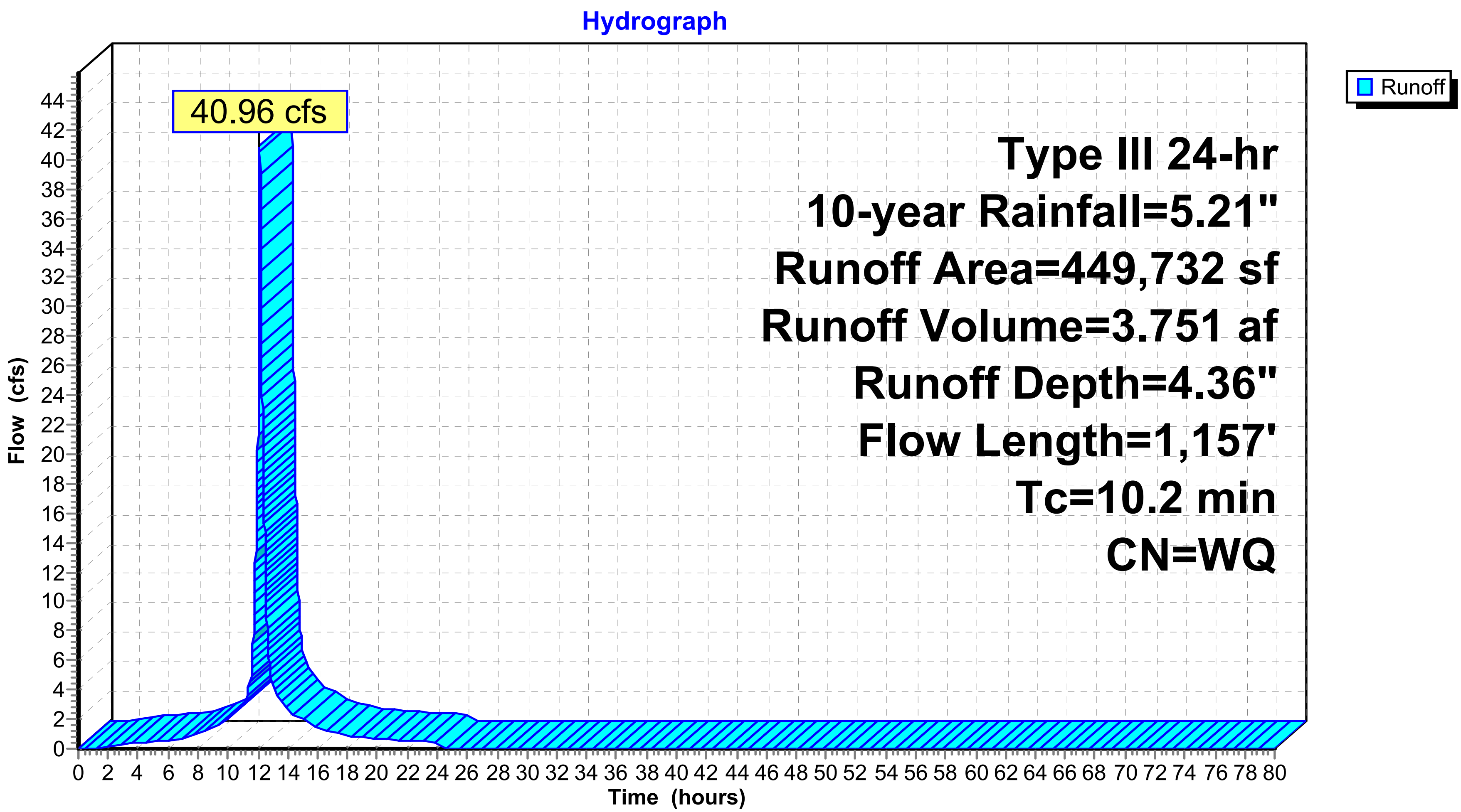
Runoff = 40.96 cfs @ 12.14 hrs, Volume= 3.751 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 341,613 | 98 | Impervious |
| | 72,493 | 74 | >75% Grass cover, Good, HSG C |
| | 35,626 | 70 | Woods, Good, HSG C |
| | 449,732 | | Weighted Average |
| | 108,119 | | 24.04% Pervious Area |
| | 341,613 | | 75.96% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 50 | 0.0780 | 0.12 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.6 | 18 | 0.0094 | 0.48 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.4 | 156 | 0.0192 | 7.43 | 5.83 | **Pipe Channel, C-D**<br>12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 132 | 0.0049 | 4.35 | 5.34 | **Pipe Channel, D-E**<br>15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 207 | 0.0104 | 7.16 | 12.66 | **Pipe Channel, E-F**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.2 | 594 | 0.0094 | 8.25 | 25.92 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 10.2 | 1,157 | Total | | | |

### Subcatchment 1S: Subcatchment 1S



## Summary for Subcatchment 2S: Subcatchment 2S

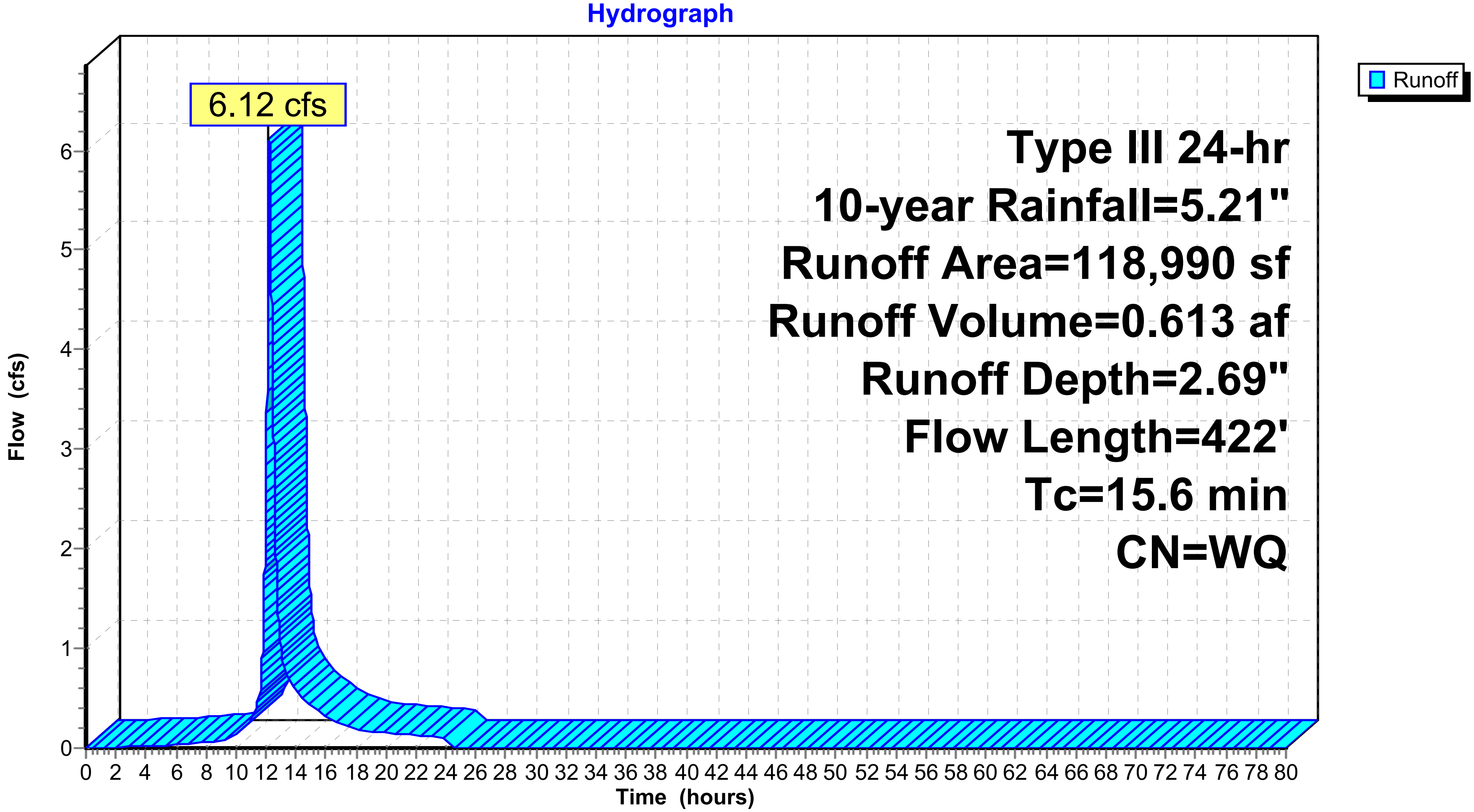
Runoff = 6.12 cfs @ 12.22 hrs, Volume= 0.613 af, Depth= 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 86,505 | 70 | Woods, Good, HSG C |
| | 12,690 | 74 | >75% Grass cover, Good, HSG C |
| * | 19,795 | 98 | Wetland Resource Area |
| | 118,990 | | Weighted Average |
| | 99,195 | | 83.36% Pervious Area |
| | 19,795 | | 16.64% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.4 | 50 | 0.0374 | 0.09 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 6.2 | 338 | 0.0325 | 0.90 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, C-D**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 15.6 | 422 | Total | | | |

### Subcatchment 2S: Subcatchment 2S



## Summary for Subcatchment 3S: Subcatchment 3S

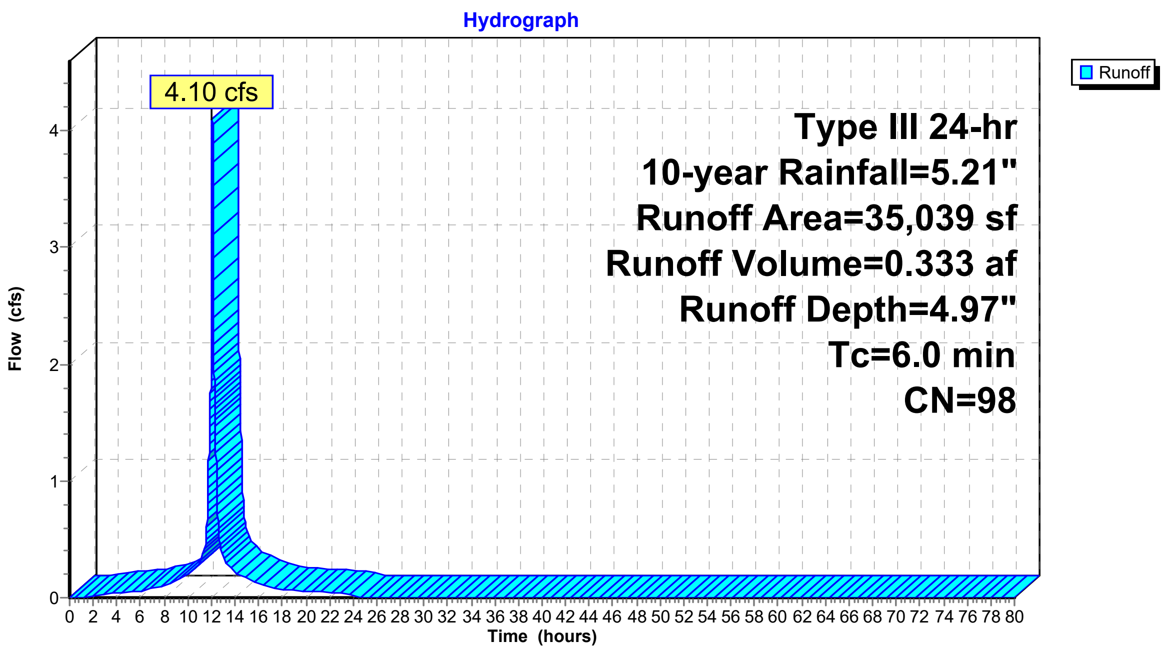
Runoff = 4.10 cfs @ 12.08 hrs, Volume= 0.333 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 35,039 | 98 | Impervious |
| | 35,039 | | 100.00% Impervious Area |

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

## Subcatchment 3S: Subcatchment 3S



## Summary for Subcatchment 4S: Subcatchment 4S

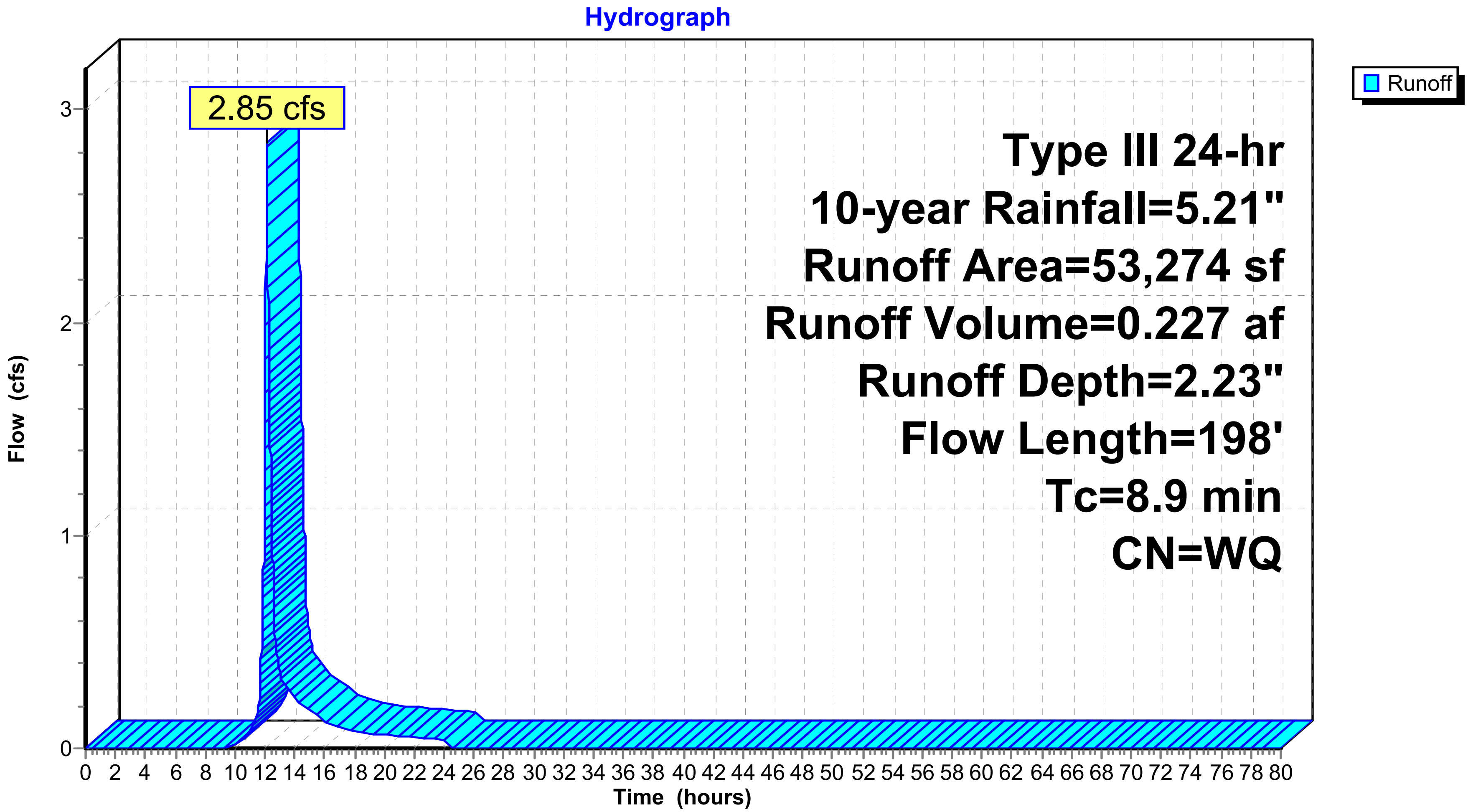
Runoff = 2.85 cfs @ 12.13 hrs, Volume= 0.227 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| Area (sf) | CN | Description |
|---|---|---|
| 47,956 | 70 | Woods, Good, HSG C |
| 5,318 | 74 | >75% Grass cover, Good, HSG C |
| 53,274 | | Weighted Average |
| 53,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.6 | 35 | 0.0286 | 0.16 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 0.5 | 18 | 0.0146 | 0.60 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 4.8 | 145 | 0.0103 | 0.51 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 8.9 | 198 | Total | | | |

## Subcatchment 4S: Subcatchment 4S



## Summary for Subcatchment 5S: Subcatchment 5S

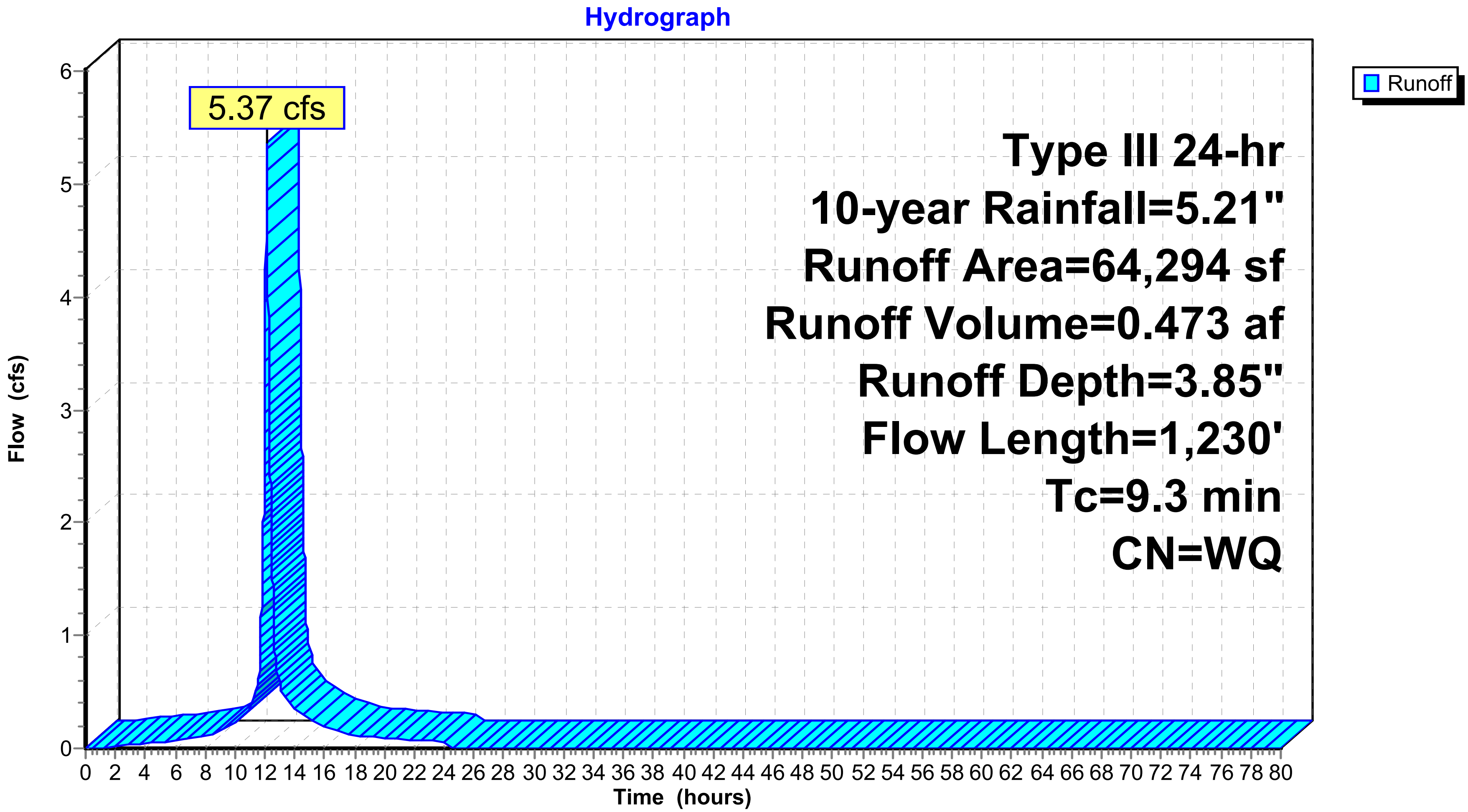
Runoff = 5.37 cfs @ 12.13 hrs, Volume= 0.473 af, Depth= 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 21,716 | 70 | Woods, Good, HSG C |
| | 4,863 | 74 | >75% Grass cover, Good, HSG C |
| * | 37,715 | 98 | Impervious |
| | 64,294 | | Weighted Average |
| | 26,579 | | 41.34% Pervious Area |
| | 37,715 | | 58.66% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

**Subcatchment 5S: Subcatchment 5S**



## Summary for Pond 1P: Existing Inf System

Inflow Area = 0.804 ac,100.00% Impervious, Inflow Depth = 4.97" for 10-year event
Inflow = 4.10 cfs @ 12.08 hrs, Volume= 0.333 af
Outflow = 0.64 cfs @ 12.56 hrs, Volume= 0.333 af, Atten= 84%, Lag= 28.5 min
Discarded = 0.13 cfs @ 9.51 hrs, Volume= 0.272 af
Primary = 0.51 cfs @ 12.56 hrs, Volume= 0.062 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 339.81' @ 12.56 hrs Surf.Area= 5,527 sf Storage= 6,265 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 289.1 min ( 1,036.4 - 747.3 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 338.19' | 3,764 cf | **70.00'W x 78.96'L x 2.71'H Field A** |
| | | | 14,969 cf Overall - 5,559 cf Embedded = 9,411 cf x 40.0% Voids |
| #2A | 338.69' | 5,559 cf | **Cultec R-180** x 252 Inside #1 |
| | | | Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf |
| | | | Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap |
| | | | Row Length Adjustment= +1.00' x 3.44 sf x 21 rows |
| | | 9,323 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.50' | **12.0" Round Culvert** L= 43.0' RCP, rounded edge headwall, Ke= 0.100 |
| | | | Inlet / Outlet Invert= 339.50' / 338.90' S= 0.0140 '/' Cc= 0.900 |
| | | | n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf |
| #2 | Discarded | 338.19' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.13 cfs @ 9.51 hrs HW=338.22' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

**Primary OutFlow** Max=0.51 cfs @ 12.56 hrs HW=339.81' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.51 cfs @ 3.67 fps)

## Pond 1P: Existing Inf System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger® 180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 21 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

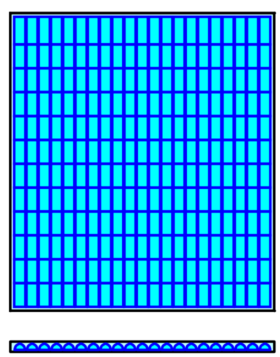
12 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 76.96' Row Length +12.0" End Stone x 2 = 78.96' Base Length
21 Rows x 36.0" Wide + 3.0" Spacing x 20 + 12.0" Side Stone x 2 = 70.00' Base Width
6.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.71' Field Height

252 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 21 Rows = 5,558.8 cf Chamber Storage

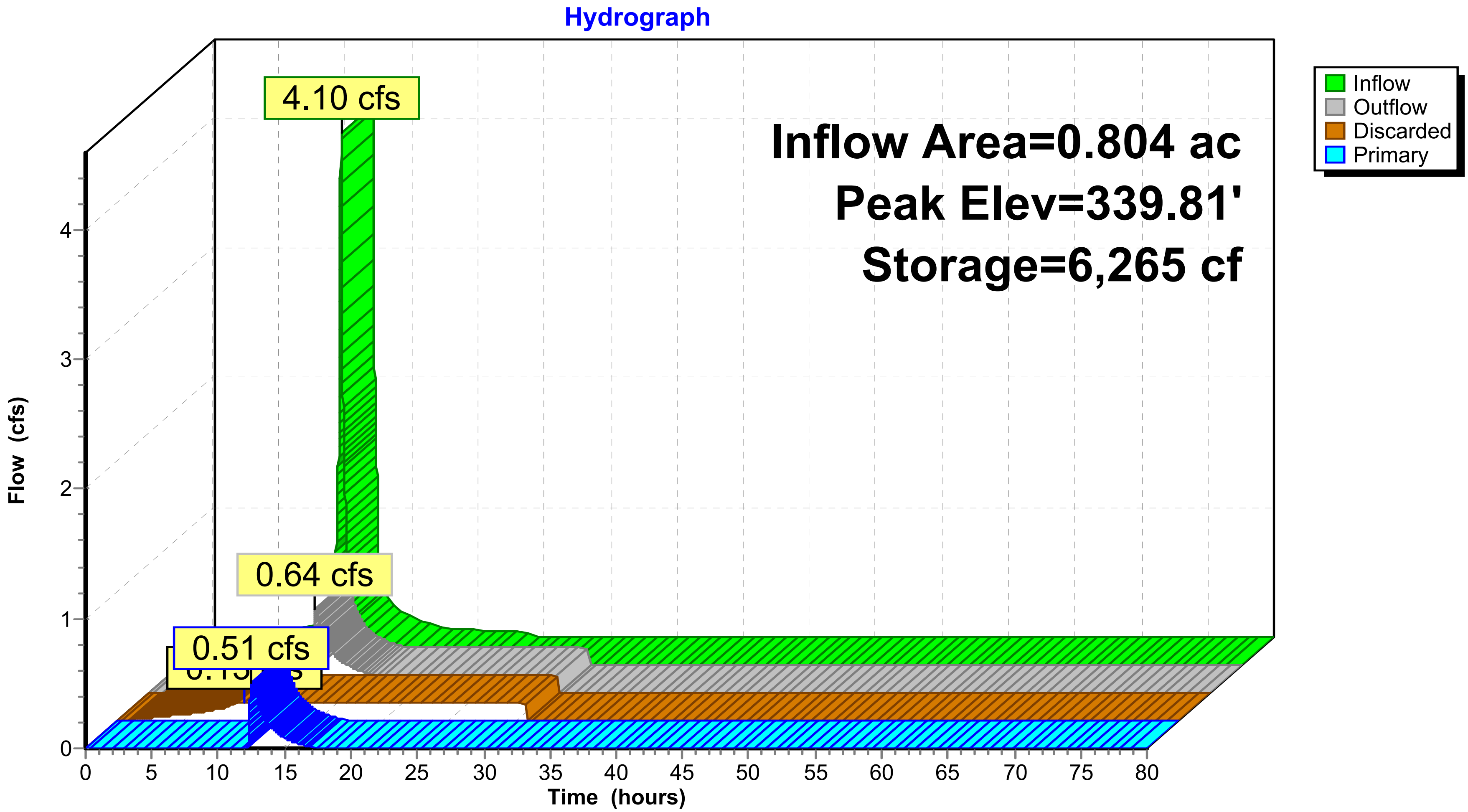
14,969.5 cf Field - 5,558.8 cf Chambers = 9,410.7 cf Stone x 40.0% Voids = 3,764.3 cf Stone Storage

Chamber Storage + Stone Storage = 9,323.1 cf = 0.214 af
Overall Storage Efficiency = 62.3%
Overall System Size = 78.96' x 70.00' x 2.71'

252 Chambers
554.4 cy Field
348.5 cy Stone



## Pond 1P: Existing Inf System

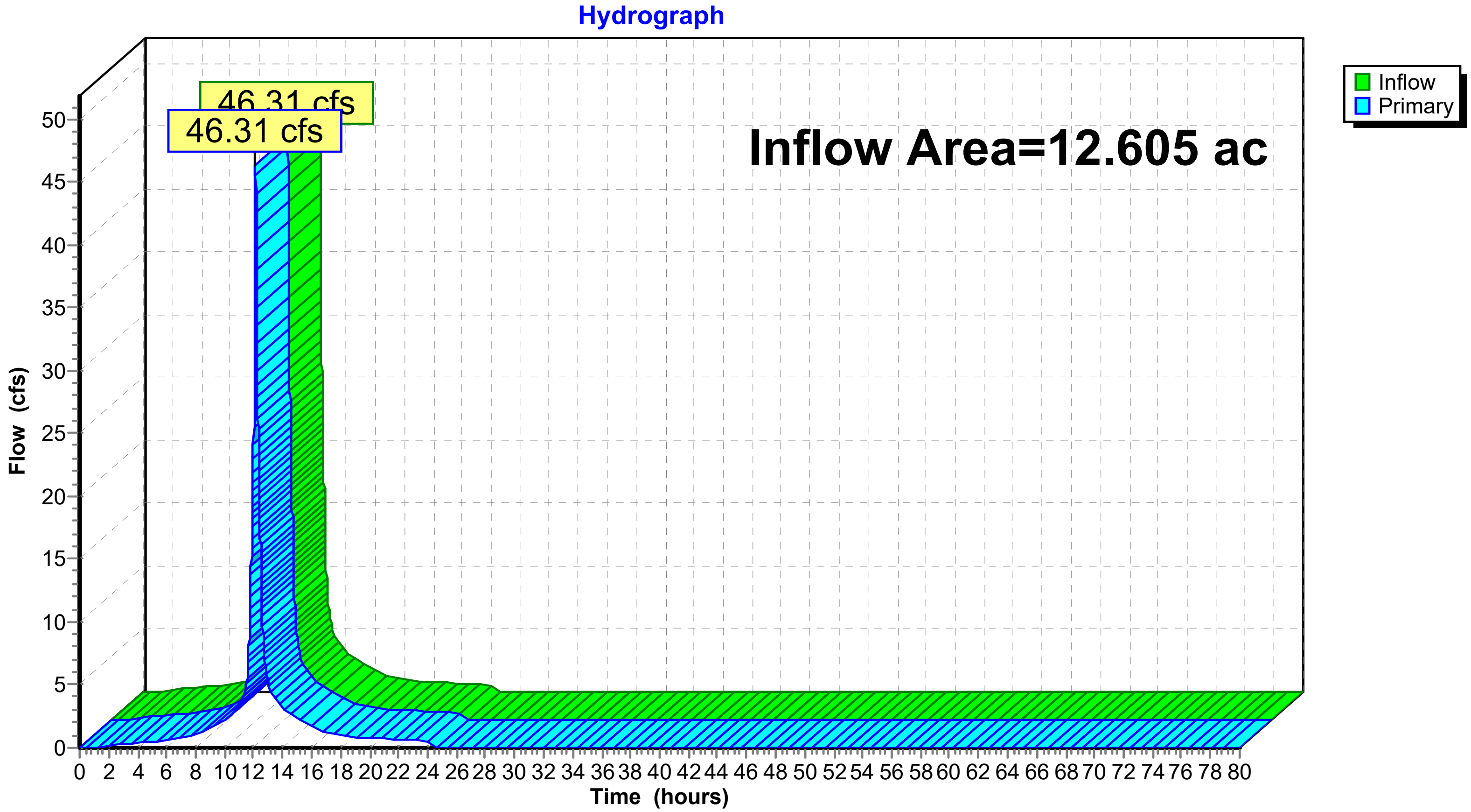


## Summary for Link POA1: P.O.A. #1

Inflow Area = 12.605 ac, 75.47% Impervious, Inflow Depth = 4.08" for 10-year event
Inflow = 46.31 cfs @ 12.14 hrs, Volume= 4.286 af
Primary = 46.31 cfs @ 12.14 hrs, Volume= 4.286 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

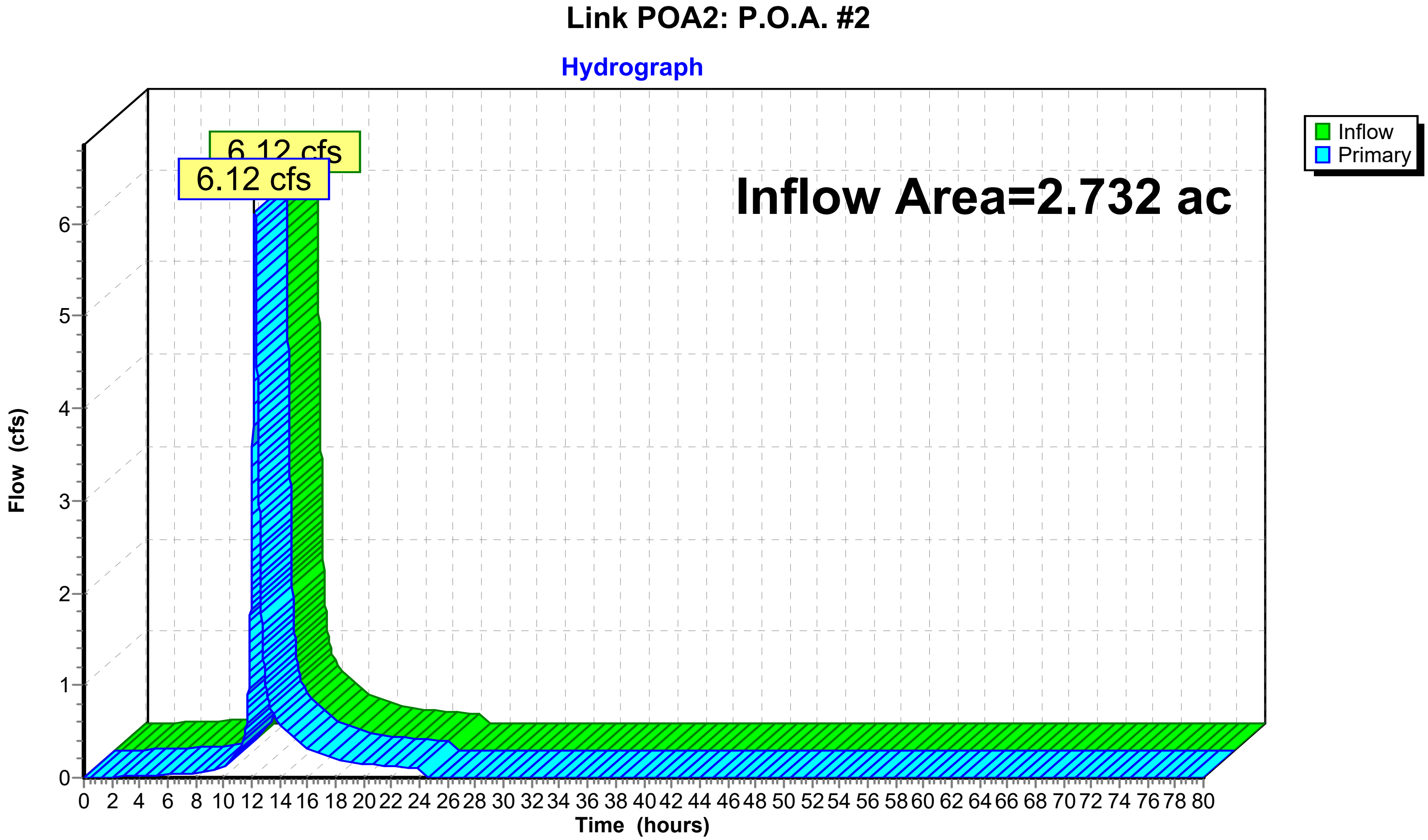
### Link POA1: P.O.A. #1



### Summary for Link POA2: P.O.A. #2

Inflow Area = 2.732 ac, 16.64% Impervious, Inflow Depth = 2.69" for 10-year event
Inflow = 6.12 cfs @ 12.22 hrs, Volume= 0.613 af
Primary = 6.12 cfs @ 12.22 hrs, Volume= 0.613 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

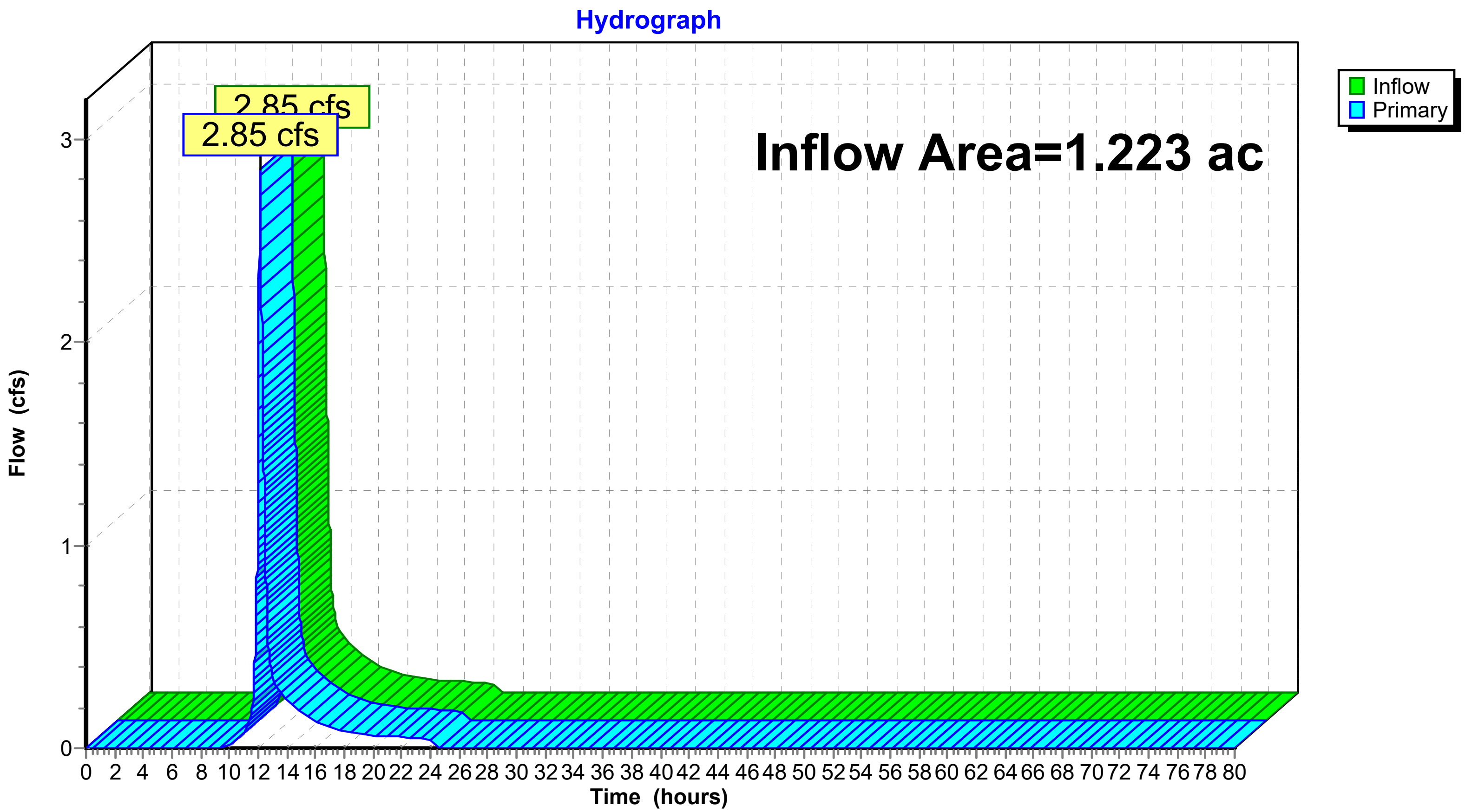


## Summary for Link POA3: P.O.A. #3

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1.223 ac, | 0.00% Impervious, Inflow Depth = 2.23" | for 10-year event | |
| Inflow = | 2.85 cfs @ | 12.13 hrs, Volume= | 0.227 af | |
| Primary = | 2.85 cfs @ | 12.13 hrs, Volume= | 0.227 af, | Atten= 0%, Lag= 0.0 min |

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA3: P.O.A. #3



Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S** Runoff Area=449,732 sf 75.96% Impervious Runoff Depth=5.47"
Flow Length=1,157' Tc=10.2 min CN=WQ Runoff=51.24 cfs 4.704 af

**Subcatchment 2S: Subcatchment 2S** Runoff Area=118,990 sf 16.64% Impervious Runoff Depth=3.65"
Flow Length=422' Tc=15.6 min CN=WQ Runoff=8.38 cfs 0.830 af

**Subcatchment 3S: Subcatchment 3S** Runoff Area=35,039 sf 100.00% Impervious Runoff Depth=6.13"
Tc=6.0 min CN=98 Runoff=5.02 cfs 0.411 af

**Subcatchment 4S: Subcatchment 4S** Runoff Area=53,274 sf 0.00% Impervious Runoff Depth=3.14"
Flow Length=198' Tc=8.9 min CN=WQ Runoff=4.06 cfs 0.320 af

**Subcatchment 5S: Subcatchment 5S** Runoff Area=64,294 sf 58.66% Impervious Runoff Depth=4.91"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=6.87 cfs 0.604 af

**Pond 1P: Existing Inf System** Peak Elev=340.03' Storage=7,107 cf Inflow=5.02 cfs 0.411 af
Discarded=0.13 cfs 0.290 af Primary=1.31 cfs 0.121 af Outflow=1.44 cfs 0.411 af

**Link POA1: P.O.A. #1** Inflow=58.37 cfs 5.429 af
Primary=58.37 cfs 5.429 af

**Link POA2: P.O.A. #2** Inflow=8.38 cfs 0.830 af
Primary=8.38 cfs 0.830 af

**Link POA3: P.O.A. #3** Inflow=4.06 cfs 0.320 af
Primary=4.06 cfs 0.320 af

**Total Runoff Area = 16.559 ac Runoff Volume = 6.869 af Average Runoff Depth = 4.98"**
**39.81% Pervious = 6.592 ac 60.19% Impervious = 9.967 ac**

## Summary for Subcatchment 1S: Subcatchment 1S

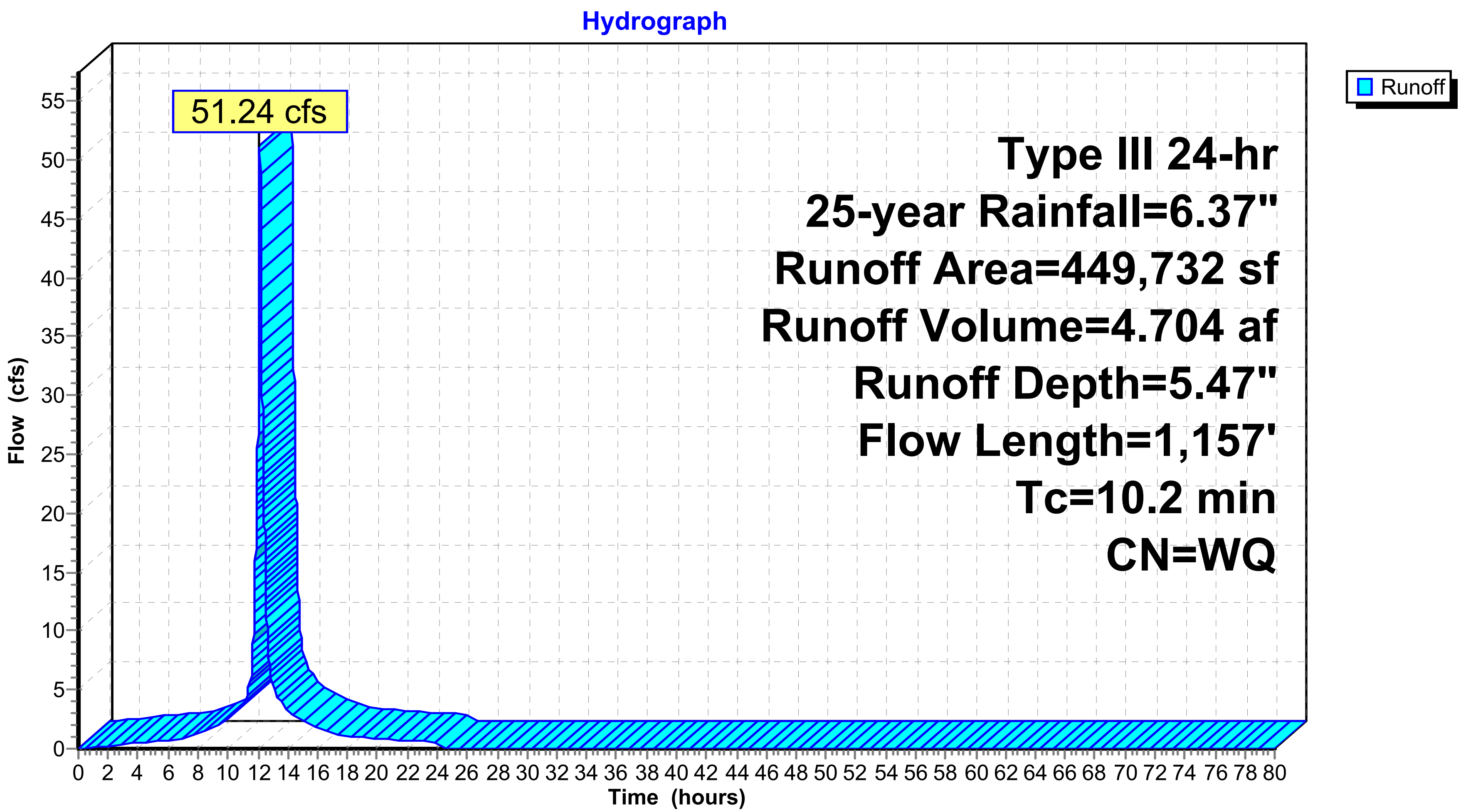
Runoff = 51.24 cfs @ 12.14 hrs, Volume= 4.704 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 341,613 | 98 | Impervious |
| | 72,493 | 74 | >75% Grass cover, Good, HSG C |
| | 35,626 | 70 | Woods, Good, HSG C |
| | 449,732 | | Weighted Average |
| | 108,119 | | 24.04% Pervious Area |
| | 341,613 | | 75.96% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 50 | 0.0780 | 0.12 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.6 | 18 | 0.0094 | 0.48 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.4 | 156 | 0.0192 | 7.43 | 5.83 | **Pipe Channel, C-D**<br>12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 132 | 0.0049 | 4.35 | 5.34 | **Pipe Channel, D-E**<br>15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 207 | 0.0104 | 7.16 | 12.66 | **Pipe Channel, E-F**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.2 | 594 | 0.0094 | 8.25 | 25.92 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 10.2 | 1,157 | Total | | | |

## Subcatchment 1S: Subcatchment 1S



## Summary for Subcatchment 2S: Subcatchment 2S

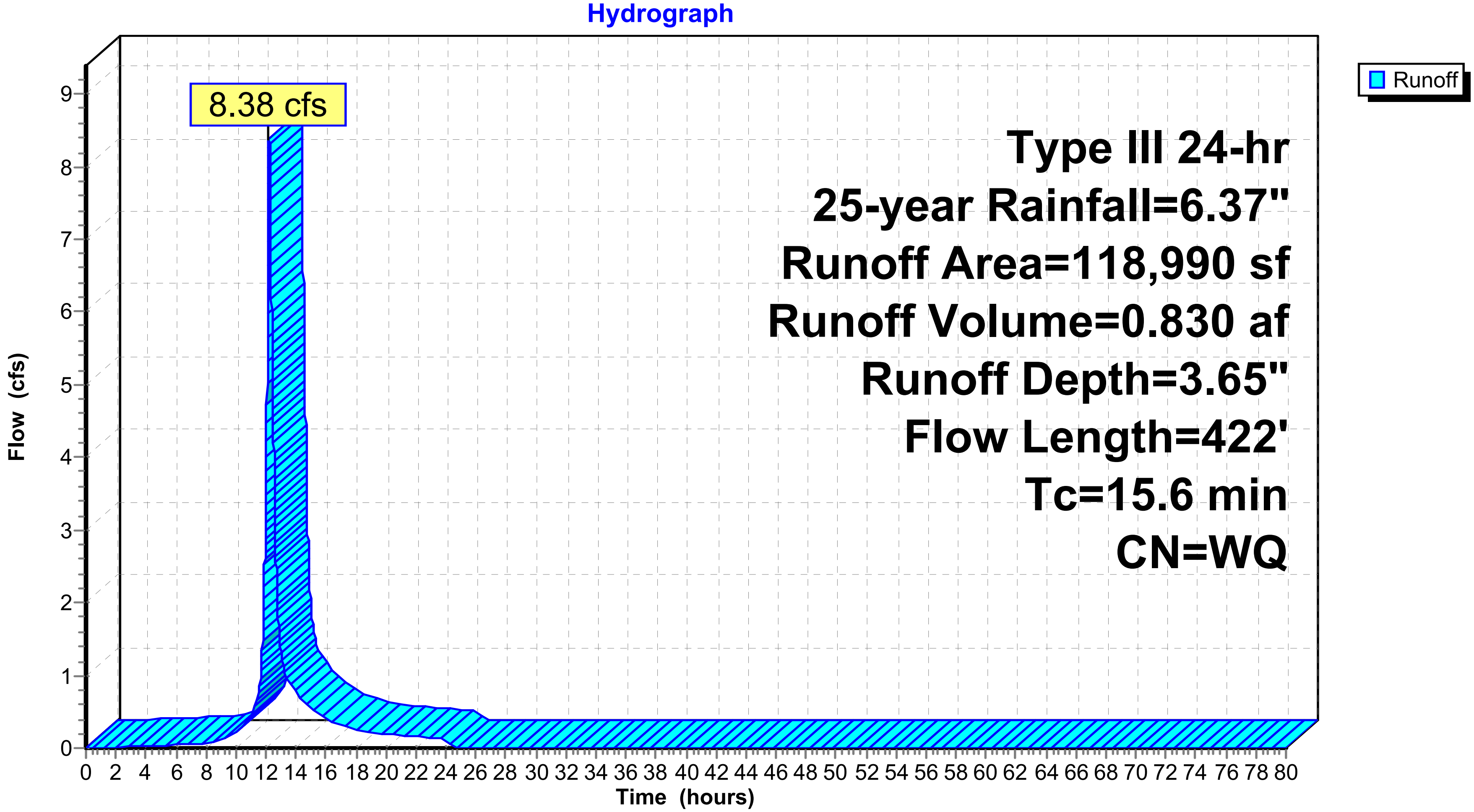
Runoff = 8.38 cfs @ 12.22 hrs, Volume= 0.830 af, Depth= 3.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 86,505 | 70 | Woods, Good, HSG C |
| | 12,690 | 74 | >75% Grass cover, Good, HSG C |
| * | 19,795 | 98 | Wetland Resource Area |
| | 118,990 | | Weighted Average |
| | 99,195 | | 83.36% Pervious Area |
| | 19,795 | | 16.64% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.4 | 50 | 0.0374 | 0.09 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 6.2 | 338 | 0.0325 | 0.90 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, C-D**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 15.6 | 422 | Total | | | |

**Subcatchment 2S: Subcatchment 2S**



## Summary for Subcatchment 3S: Subcatchment 3S

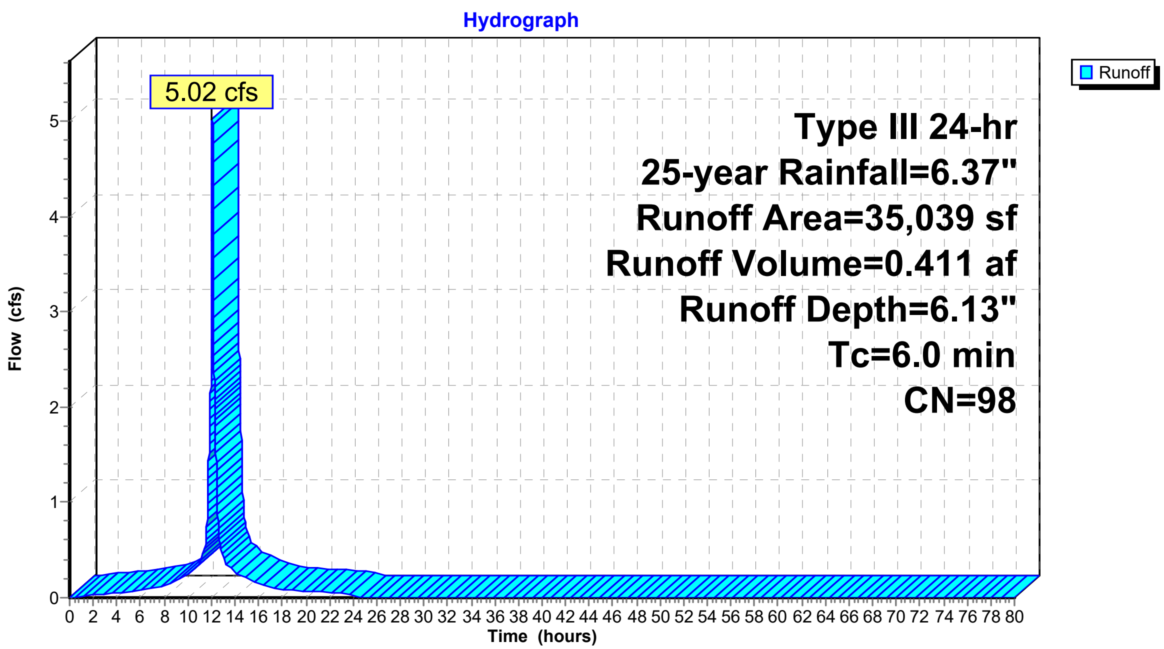
Runoff = 5.02 cfs @ 12.08 hrs, Volume= 0.411 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 35,039 | 98 | Impervious |
| | 35,039 | | 100.00% Impervious Area |

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

### Subcatchment 3S: Subcatchment 3S



## Summary for Subcatchment 4S: Subcatchment 4S

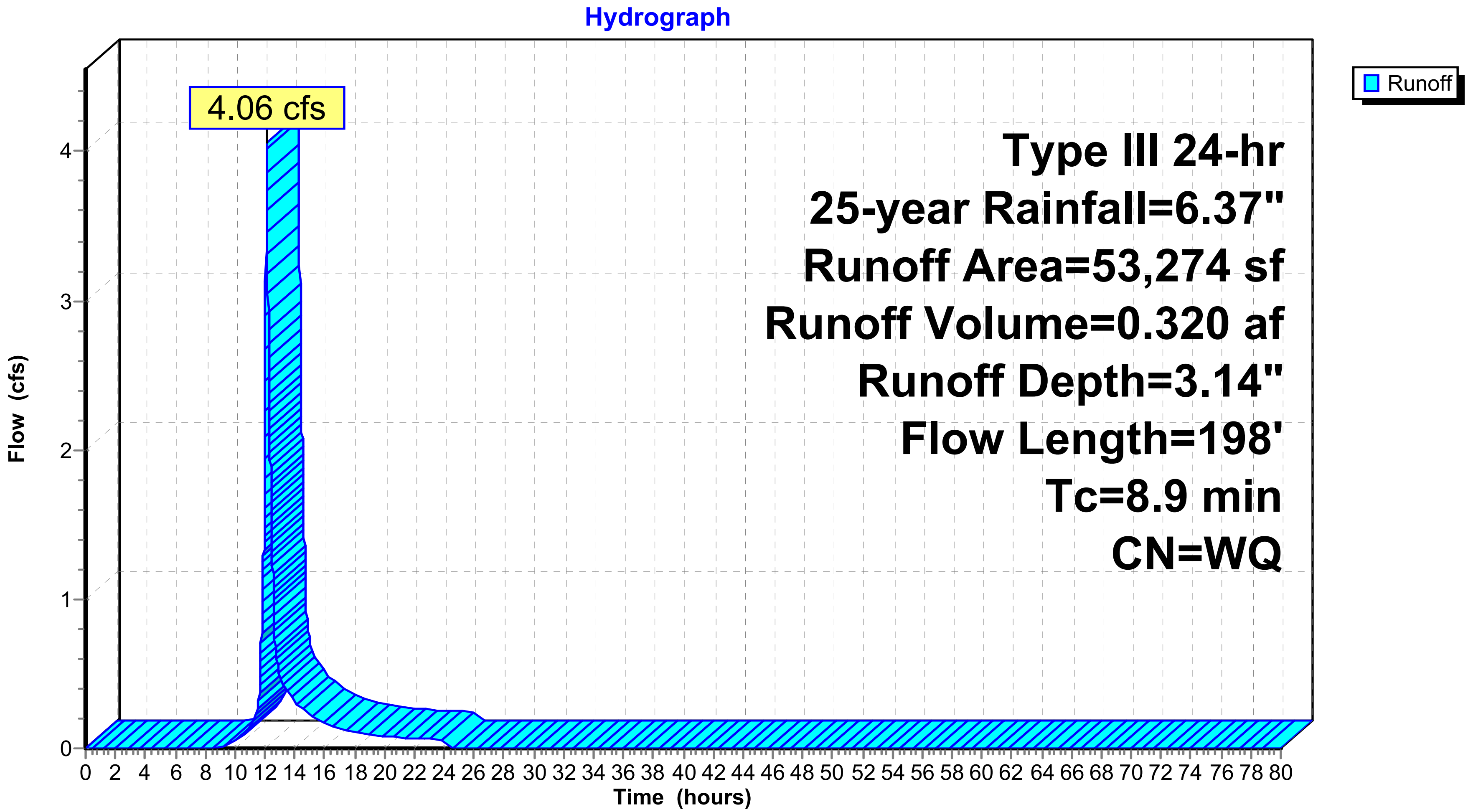
Runoff = 4.06 cfs @ 12.13 hrs, Volume= 0.320 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| Area (sf) | CN | Description |
|---|---|---|
| 47,956 | 70 | Woods, Good, HSG C |
| 5,318 | 74 | >75% Grass cover, Good, HSG C |
| 53,274 | | Weighted Average |
| 53,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.6 | 35 | 0.0286 | 0.16 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 0.5 | 18 | 0.0146 | 0.60 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 4.8 | 145 | 0.0103 | 0.51 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 8.9 | 198 | Total | | | |

## Subcatchment 4S: Subcatchment 4S



## Summary for Subcatchment 5S: Subcatchment 5S

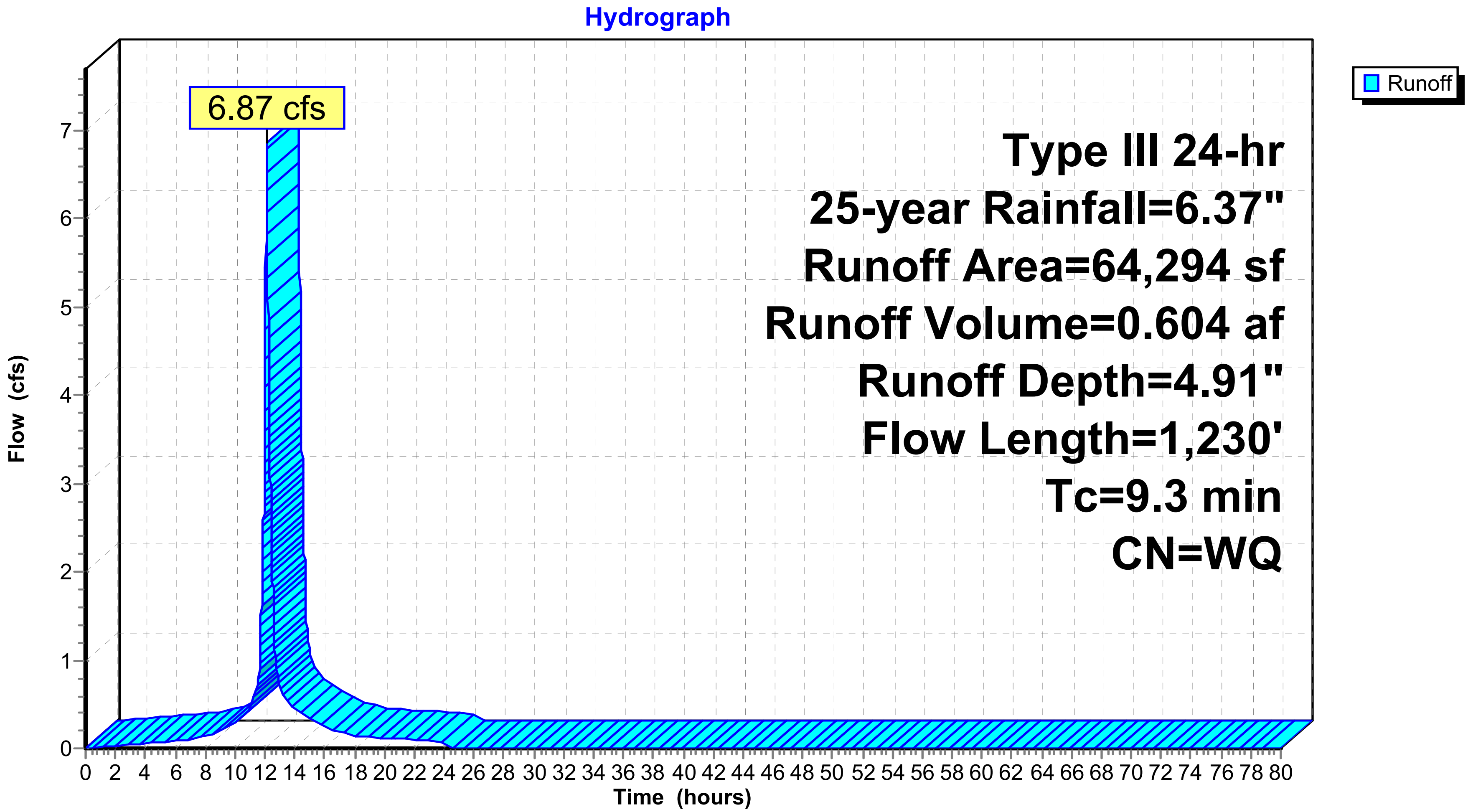
Runoff = 6.87 cfs @ 12.13 hrs, Volume= 0.604 af, Depth= 4.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 21,716 | 70 | Woods, Good, HSG C |
| | 4,863 | 74 | >75% Grass cover, Good, HSG C |
| * | 37,715 | 98 | Impervious |
| | 64,294 | | Weighted Average |
| | 26,579 | | 41.34% Pervious Area |
| | 37,715 | | 58.66% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

**Subcatchment 5S: Subcatchment 5S**



## Summary for Pond 1P: Existing Inf System

Inflow Area = 0.804 ac,100.00% Impervious, Inflow Depth = 6.13" for 25-year event
Inflow = 5.02 cfs @ 12.08 hrs, Volume= 0.411 af
Outflow = 1.44 cfs @ 12.41 hrs, Volume= 0.411 af, Atten= 71%, Lag= 19.7 min
Discarded = 0.13 cfs @ 8.90 hrs, Volume= 0.290 af
Primary = 1.31 cfs @ 12.41 hrs, Volume= 0.121 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.03' @ 12.41 hrs Surf.Area= 5,527 sf Storage= 7,107 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 258.0 min ( 1,002.2 - 744.3 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 338.19' | 3,764 cf | **70.00'W x 78.96'L x 2.71'H Field A** |
| | | | 14,969 cf Overall - 5,559 cf Embedded = 9,411 cf x 40.0% Voids |
| #2A | 338.69' | 5,559 cf | **Cultec R-180** x 252 Inside #1 |
| | | | Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf |
| | | | Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap |
| | | | Row Length Adjustment= +1.00' x 3.44 sf x 21 rows |
| | | 9,323 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.50' | **12.0" Round Culvert** L= 43.0' RCP, rounded edge headwall, Ke= 0.100 |
| | | | Inlet / Outlet Invert= 339.50' / 338.90' S= 0.0140 '/' Cc= 0.900 |
| | | | n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf |
| #2 | Discarded | 338.19' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.13 cfs @ 8.90 hrs HW=338.22' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

**Primary OutFlow** Max=1.31 cfs @ 12.41 hrs HW=340.03' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 1.31 cfs @ 4.52 fps)

## Pond 1P: Existing Inf System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger® 180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 21 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

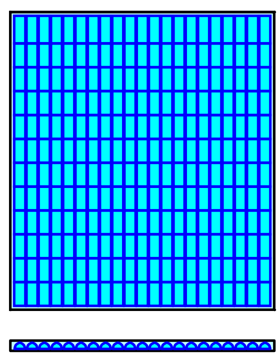
12 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 76.96' Row Length +12.0" End Stone x 2 = 78.96' Base Length
21 Rows x 36.0" Wide + 3.0" Spacing x 20 + 12.0" Side Stone x 2 = 70.00' Base Width
6.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.71' Field Height

252 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 21 Rows = 5,558.8 cf Chamber Storage

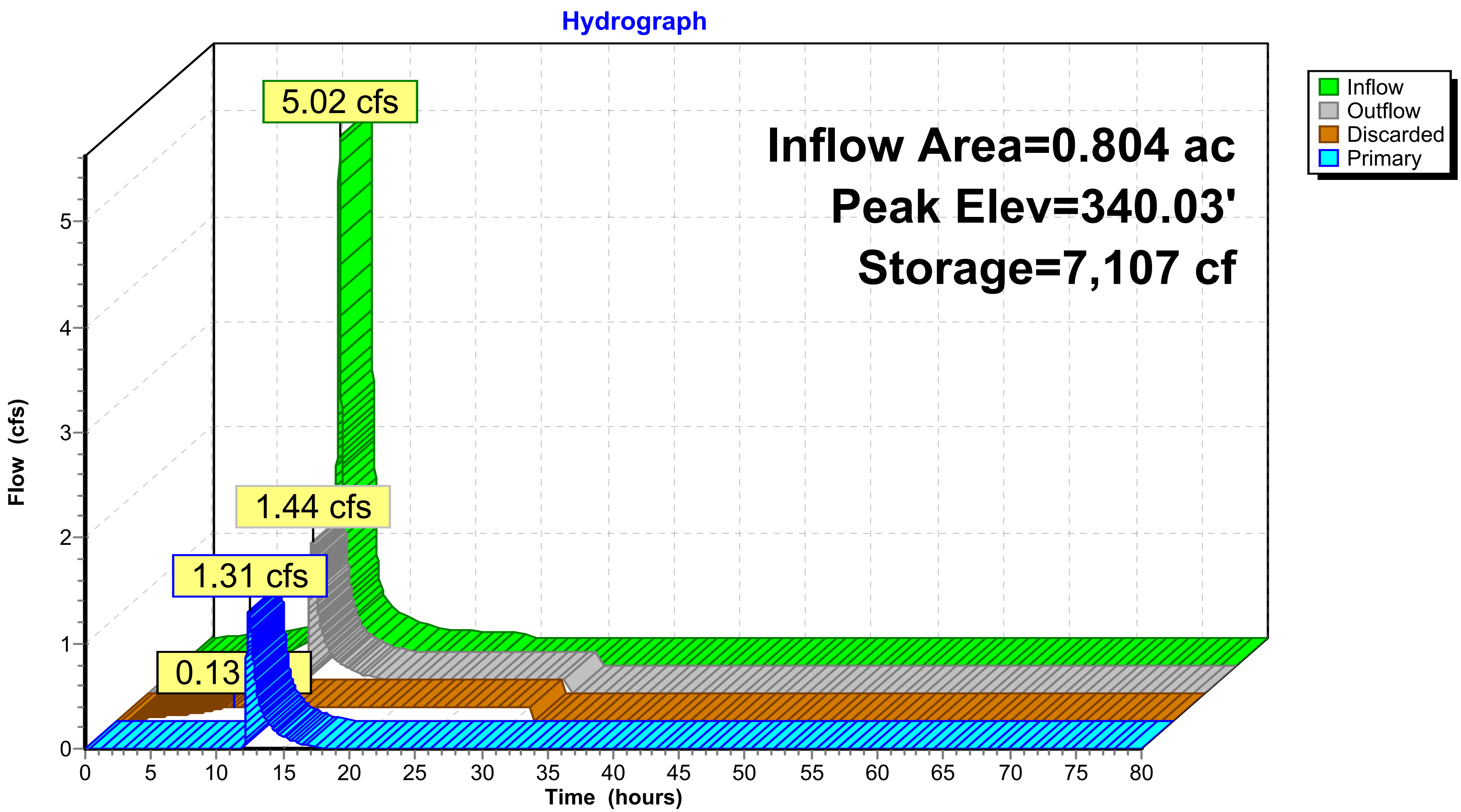
14,969.5 cf Field - 5,558.8 cf Chambers = 9,410.7 cf Stone x 40.0% Voids = 3,764.3 cf Stone Storage

Chamber Storage + Stone Storage = 9,323.1 cf = 0.214 af
Overall Storage Efficiency = 62.3%
Overall System Size = 78.96' x 70.00' x 2.71'

252 Chambers
554.4 cy Field
348.5 cy Stone



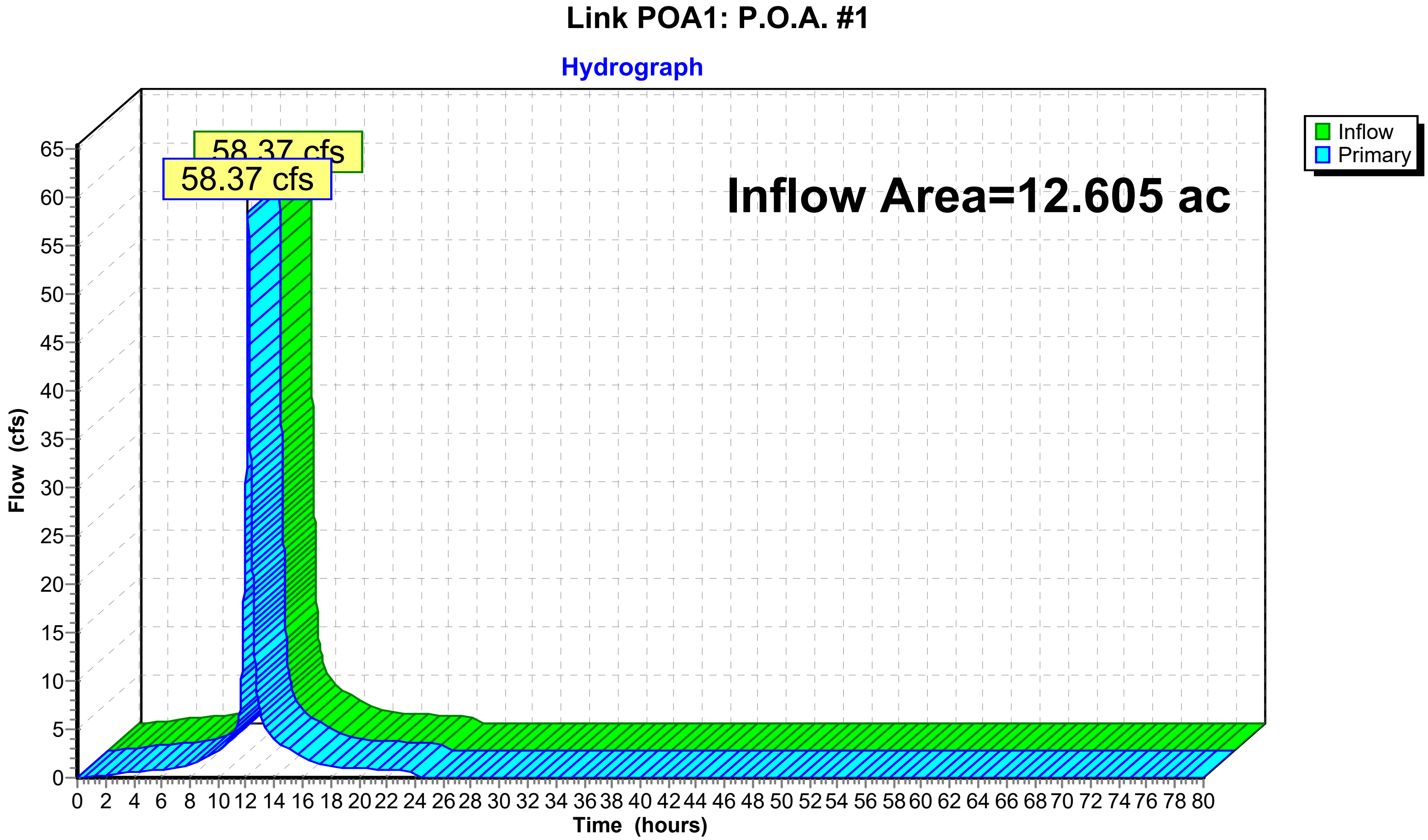
**Pond 1P: Existing Inf System**



## Summary for Link POA1: P.O.A. #1

Inflow Area = 12.605 ac, 75.47% Impervious, Inflow Depth = 5.17" for 25-year event
Inflow = 58.37 cfs @ 12.14 hrs, Volume= 5.429 af
Primary = 58.37 cfs @ 12.14 hrs, Volume= 5.429 af, Atten= 0%, Lag= 0.0 min

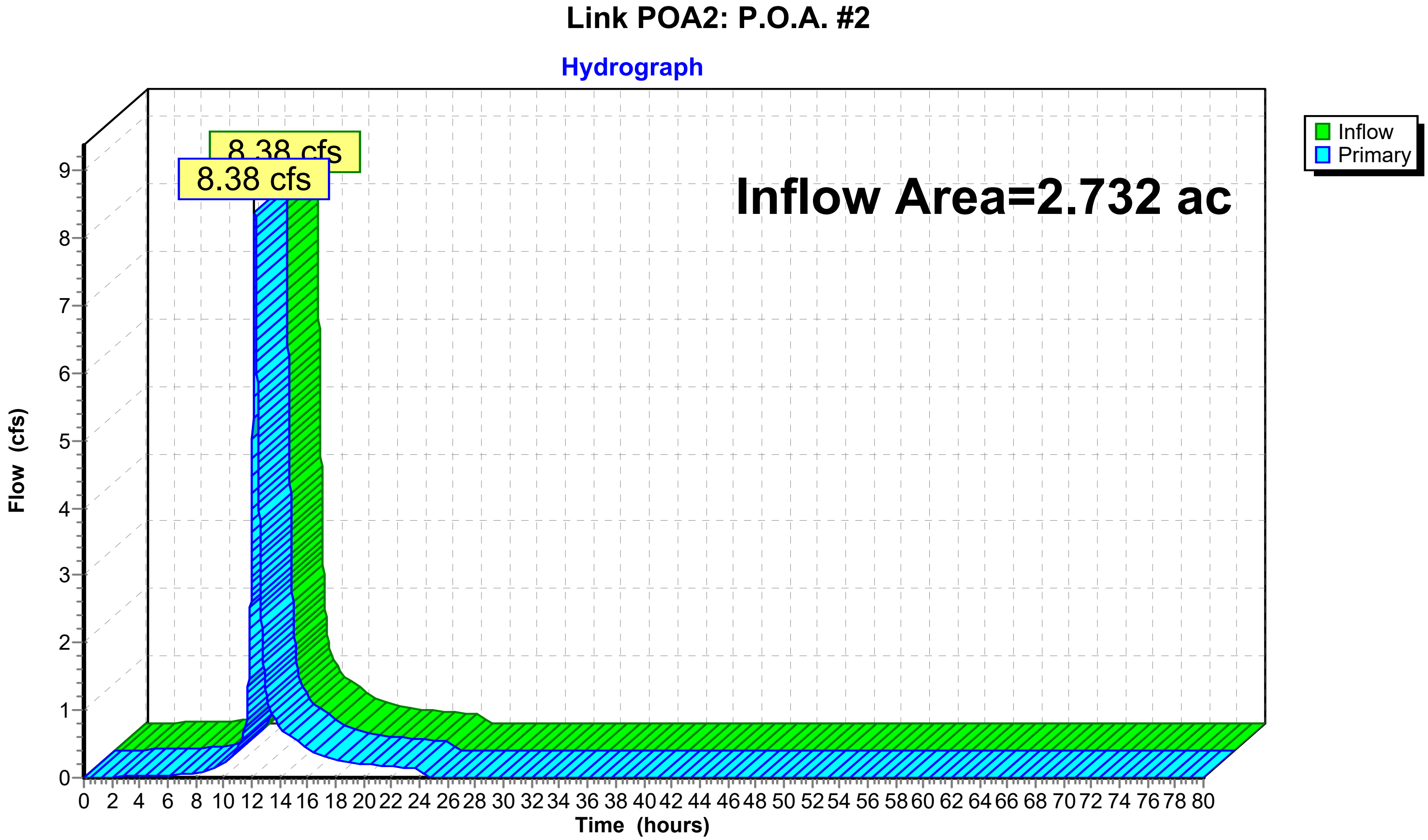
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs



## Summary for Link POA2: P.O.A. #2

Inflow Area = 2.732 ac, 16.64% Impervious, Inflow Depth = 3.65" for 25-year event
Inflow = 8.38 cfs @ 12.22 hrs, Volume= 0.830 af
Primary = 8.38 cfs @ 12.22 hrs, Volume= 0.830 af, Atten= 0%, Lag= 0.0 min

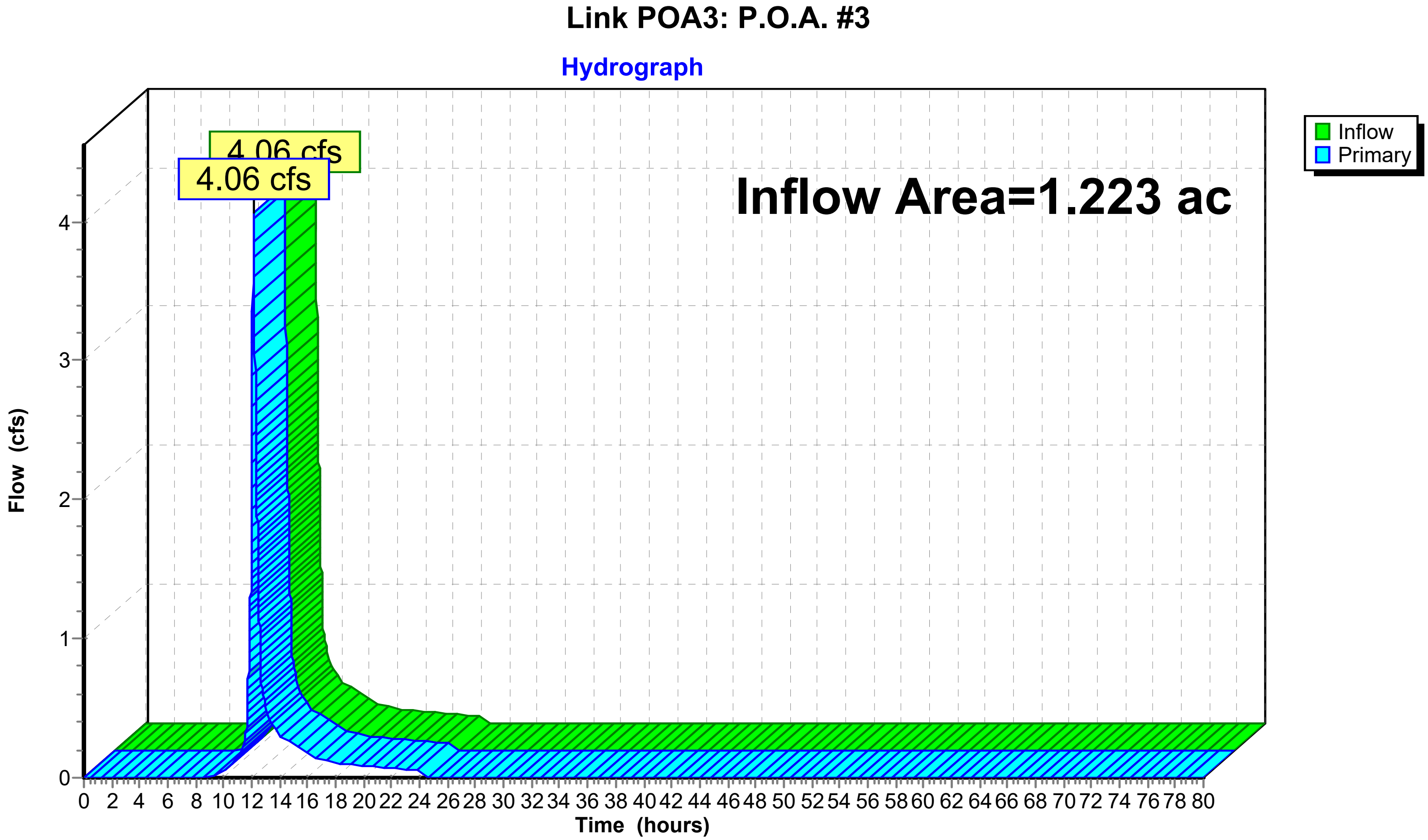
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs



## Summary for Link POA3: P.O.A. #3

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1.223 ac, | 0.00% Impervious, | Inflow Depth = 3.14" | for 25-year event |
| Inflow = | 4.06 cfs @ | 12.13 hrs, | Volume= | 0.320 af |
| Primary = | 4.06 cfs @ | 12.13 hrs, | Volume= | 0.320 af, Atten= 0%, Lag= 0.0 min |

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs



Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S** Runoff Area=449,732 sf 75.96% Impervious Runoff Depth=7.19"
Flow Length=1,157' Tc=10.2 min CN=WQ Runoff=67.16 cfs 6.184 af

**Subcatchment 2S: Subcatchment 2S** Runoff Area=118,990 sf 16.64% Impervious Runoff Depth=5.19"
Flow Length=422' Tc=15.6 min CN=WQ Runoff=12.00 cfs 1.183 af

**Subcatchment 3S: Subcatchment 3S** Runoff Area=35,039 sf 100.00% Impervious Runoff Depth=7.91"
Tc=6.0 min CN=98 Runoff=6.44 cfs 0.530 af

**Subcatchment 4S: Subcatchment 4S** Runoff Area=53,274 sf 0.00% Impervious Runoff Depth=4.64"
Flow Length=198' Tc=8.9 min CN=WQ Runoff=6.02 cfs 0.473 af

**Subcatchment 5S: Subcatchment 5S** Runoff Area=64,294 sf 58.66% Impervious Runoff Depth=6.57"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=9.20 cfs 0.809 af

**Pond 1P: Existing Inf System** Peak Elev=340.38' Storage=8,184 cf Inflow=6.44 cfs 0.530 af
Discarded=0.13 cfs 0.312 af Primary=2.92 cfs 0.218 af Outflow=3.05 cfs 0.530 af

**Link POA1: P.O.A. #1** Inflow=78.52 cfs 7.211 af
Primary=78.52 cfs 7.211 af

**Link POA2: P.O.A. #2** Inflow=12.00 cfs 1.183 af
Primary=12.00 cfs 1.183 af

**Link POA3: P.O.A. #3** Inflow=6.02 cfs 0.473 af
Primary=6.02 cfs 0.473 af

**Total Runoff Area = 16.559 ac Runoff Volume = 9.179 af Average Runoff Depth = 6.65"**
**39.81% Pervious = 6.592 ac 60.19% Impervious = 9.967 ac**

## Summary for Subcatchment 1S: Subcatchment 1S

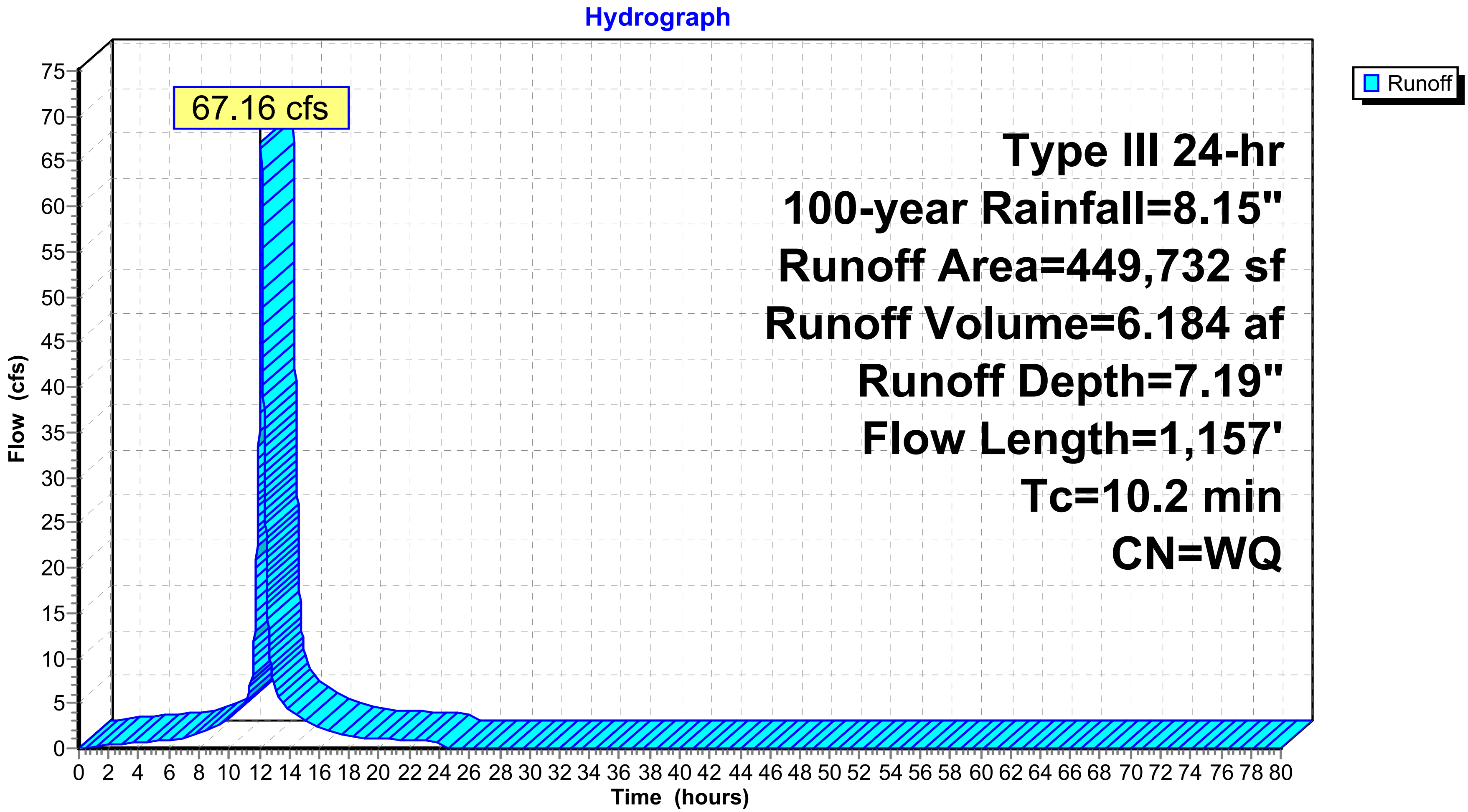
Runoff = 67.16 cfs @ 12.14 hrs, Volume= 6.184 af, Depth= 7.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 341,613 | 98 | Impervious |
| | 72,493 | 74 | >75% Grass cover, Good, HSG C |
| | 35,626 | 70 | Woods, Good, HSG C |
| | 449,732 | | Weighted Average |
| | 108,119 | | 24.04% Pervious Area |
| | 341,613 | | 75.96% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.0 | 50 | 0.0780 | 0.12 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.6 | 18 | 0.0094 | 0.48 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.4 | 156 | 0.0192 | 7.43 | 5.83 | **Pipe Channel, C-D**<br>12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 132 | 0.0049 | 4.35 | 5.34 | **Pipe Channel, D-E**<br>15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.5 | 207 | 0.0104 | 7.16 | 12.66 | **Pipe Channel, E-F**<br>18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.2 | 594 | 0.0094 | 8.25 | 25.92 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 10.2 | 1,157 | Total | | | |

## Subcatchment 1S: Subcatchment 1S



## Summary for Subcatchment 2S: Subcatchment 2S

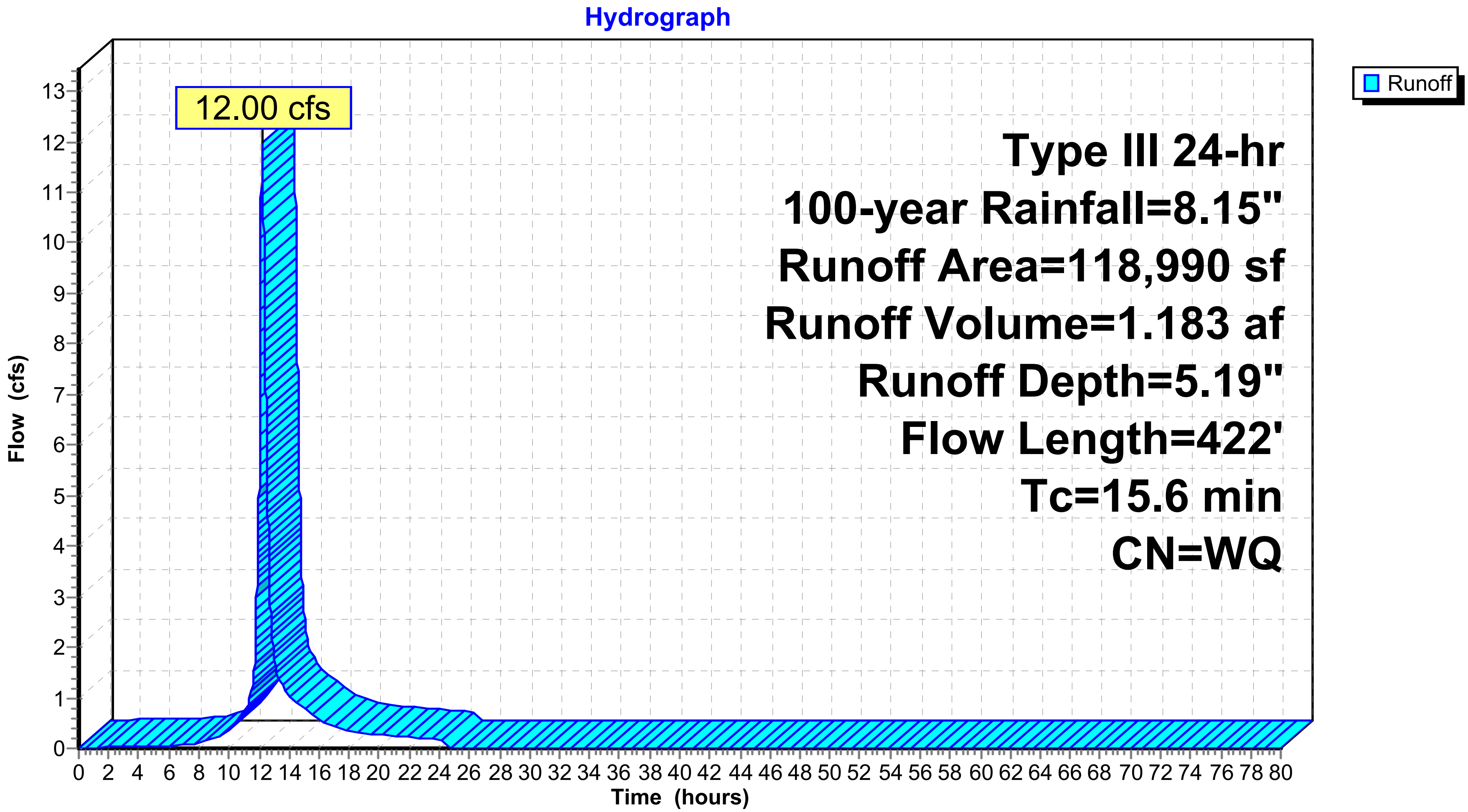
Runoff = 12.00 cfs @ 12.22 hrs, Volume= 1.183 af, Depth= 5.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 86,505 | 70 | Woods, Good, HSG C |
| | 12,690 | 74 | >75% Grass cover, Good, HSG C |
| * | 19,795 | 98 | Wetland Resource Area |
| | 118,990 | | Weighted Average |
| | 99,195 | | 83.36% Pervious Area |
| | 19,795 | | 16.64% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 9.4 | 50 | 0.0374 | 0.09 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 6.2 | 338 | 0.0325 | 0.90 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, C-D**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 15.6 | 422 | Total | | | |

## Subcatchment 2S: Subcatchment 2S



## Summary for Subcatchment 3S: Subcatchment 3S

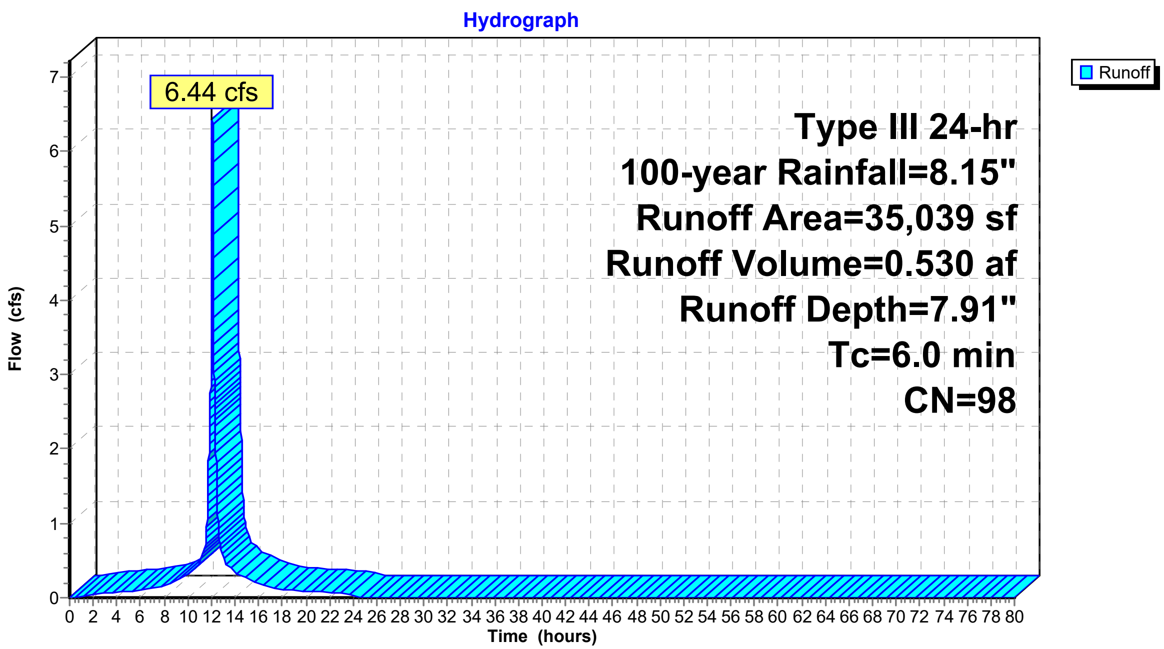
Runoff = 6.44 cfs @ 12.08 hrs, Volume= 0.530 af, Depth= 7.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 35,039 | 98 | Impervious |
| | 35,039 | | 100.00% Impervious Area |

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

### Subcatchment 3S: Subcatchment 3S



## Summary for Subcatchment 4S: Subcatchment 4S

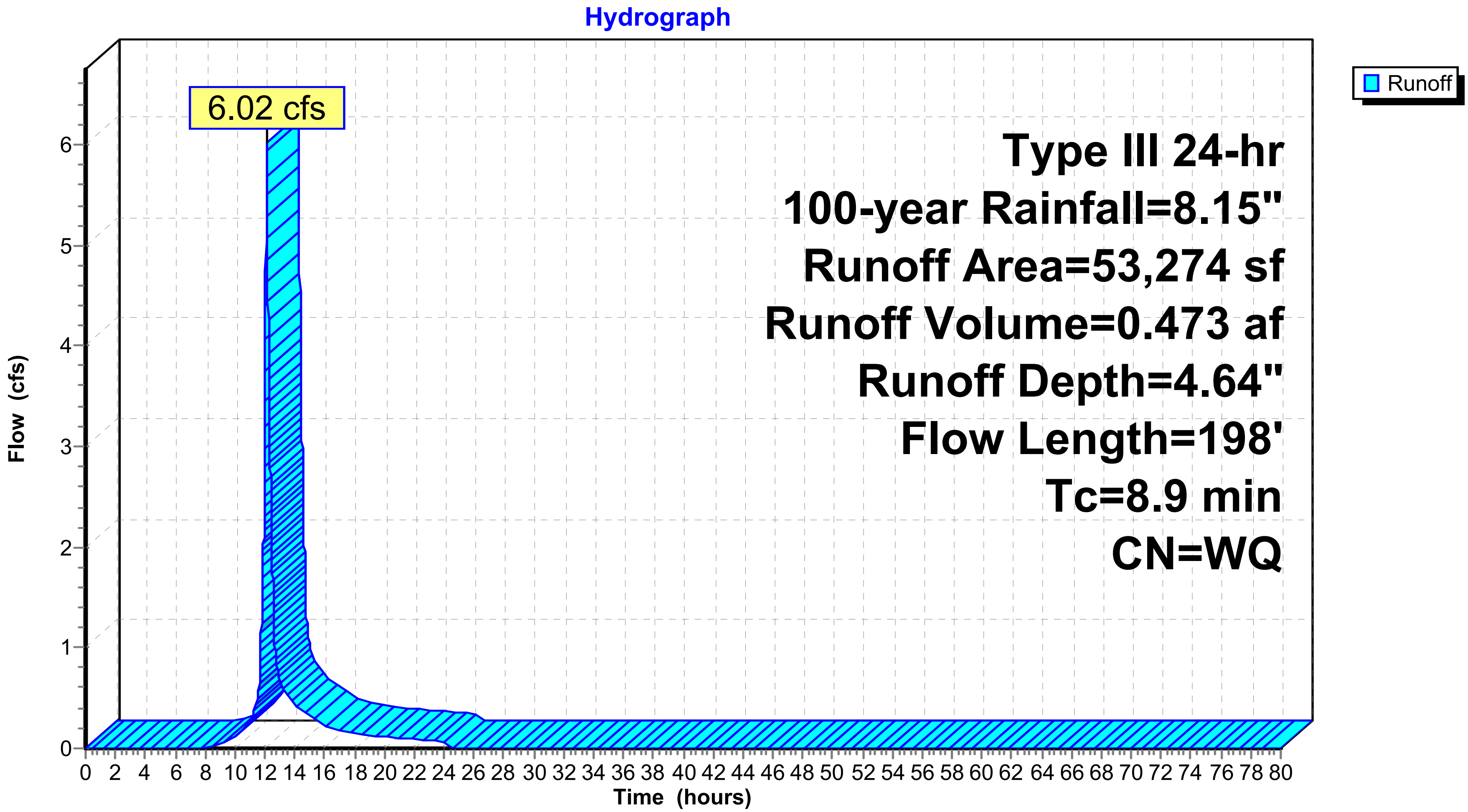
Runoff = 6.02 cfs @ 12.13 hrs, Volume= 0.473 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| Area (sf) | CN | Description |
|---|---|---|
| 47,956 | 70 | Woods, Good, HSG C |
| 5,318 | 74 | >75% Grass cover, Good, HSG C |
| 53,274 | | Weighted Average |
| 53,274 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 3.6 | 35 | 0.0286 | 0.16 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 0.5 | 18 | 0.0146 | 0.60 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 4.8 | 145 | 0.0103 | 0.51 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 8.9 | 198 | Total | | | |

## Subcatchment 4S: Subcatchment 4S



## Summary for Subcatchment 5S: Subcatchment 5S

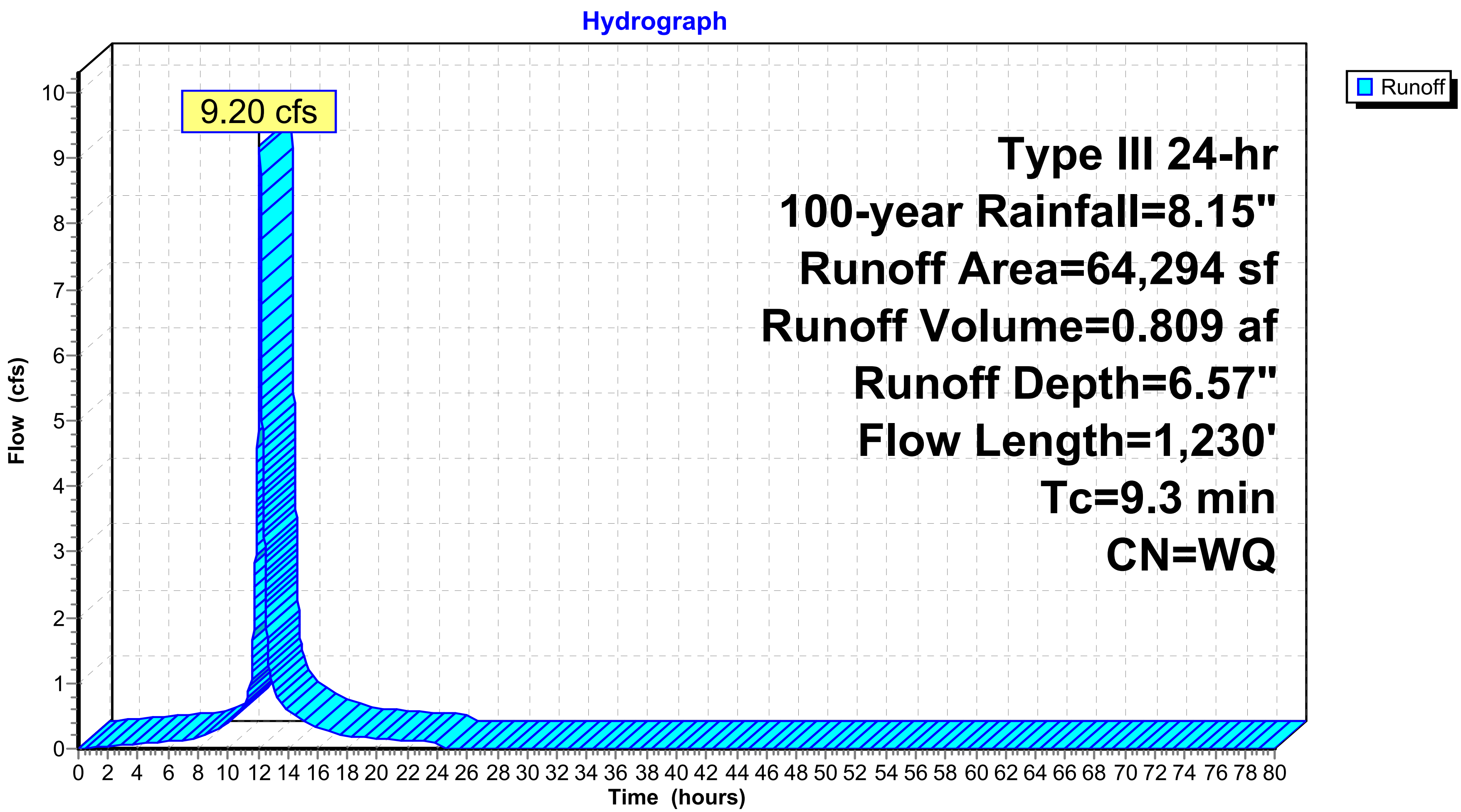
Runoff = 9.20 cfs @ 12.13 hrs, Volume= 0.809 af, Depth= 6.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 21,716 | 70 | Woods, Good, HSG C |
| | 4,863 | 74 | >75% Grass cover, Good, HSG C |
| * | 37,715 | 98 | Impervious |
| | 64,294 | | Weighted Average |
| | 26,579 | | 41.34% Pervious Area |
| | 37,715 | | 58.66% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

**Subcatchment 5S: Subcatchment 5S**



## Summary for Pond 1P: Existing Inf System

Inflow Area = 0.804 ac,100.00% Impervious, Inflow Depth = 7.91" for 100-year event
Inflow = 6.44 cfs @ 12.08 hrs, Volume= 0.530 af
Outflow = 3.05 cfs @ 12.24 hrs, Volume= 0.530 af, Atten= 53%, Lag= 9.3 min
Discarded = 0.13 cfs @ 8.05 hrs, Volume= 0.312 af
Primary = 2.92 cfs @ 12.24 hrs, Volume= 0.218 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.38' @ 12.24 hrs Surf.Area= 5,527 sf Storage= 8,184 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 224.8 min ( 965.8 - 741.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1A | 338.19' | 3,764 cf | **70.00'W x 78.96'L x 2.71'H Field A**<br>14,969 cf Overall - 5,559 cf Embedded = 9,411 cf x 40.0% Voids |
| #2A | 338.69' | 5,559 cf | **Cultec R-180** x 252 Inside #1<br>Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf<br>Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap<br>Row Length Adjustment= +1.00' x 3.44 sf x 21 rows |
| | | 9,323 cf | Total Available Storage |

Storage Group A created with Chamber Wizard

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.50' | **12.0" Round Culvert** L= 43.0' RCP, rounded edge headwall, Ke= 0.100<br>Inlet / Outlet Invert= 339.50' / 338.90' S= 0.0140 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf |
| #2 | Discarded | 338.19' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.13 cfs @ 8.05 hrs HW=338.22' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.13 cfs)

**Primary OutFlow** Max=2.92 cfs @ 12.24 hrs HW=340.38' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 2.92 cfs @ 5.29 fps)

## Pond 1P: Existing Inf System - Chamber Wizard Field A

**Chamber Model = Cultec R-180 (Cultec Recharger® 180HD)**
Effective Size= 33.6"W x 20.0"H => 3.44 sf x 6.33'L = 21.8 cf
Overall Size= 36.0"W x 20.5"H x 7.33'L with 1.00' Overlap
Row Length Adjustment= +1.00' x 3.44 sf x 21 rows

36.0" Wide + 3.0" Spacing = 39.0" C-C Row Spacing

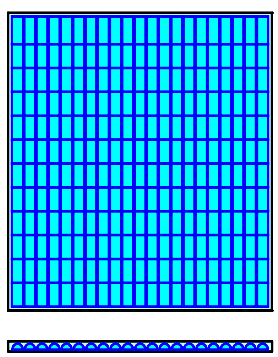
12 Chambers/Row x 6.33' Long +1.00' Row Adjustment = 76.96' Row Length +12.0" End Stone x 2 = 78.96' Base Length
21 Rows x 36.0" Wide + 3.0" Spacing x 20 + 12.0" Side Stone x 2 = 70.00' Base Width
6.0" Base + 20.5" Chamber Height + 6.0" Cover = 2.71' Field Height

252 Chambers x 21.8 cf +1.00' Row Adjustment x 3.44 sf x 21 Rows = 5,558.8 cf Chamber Storage

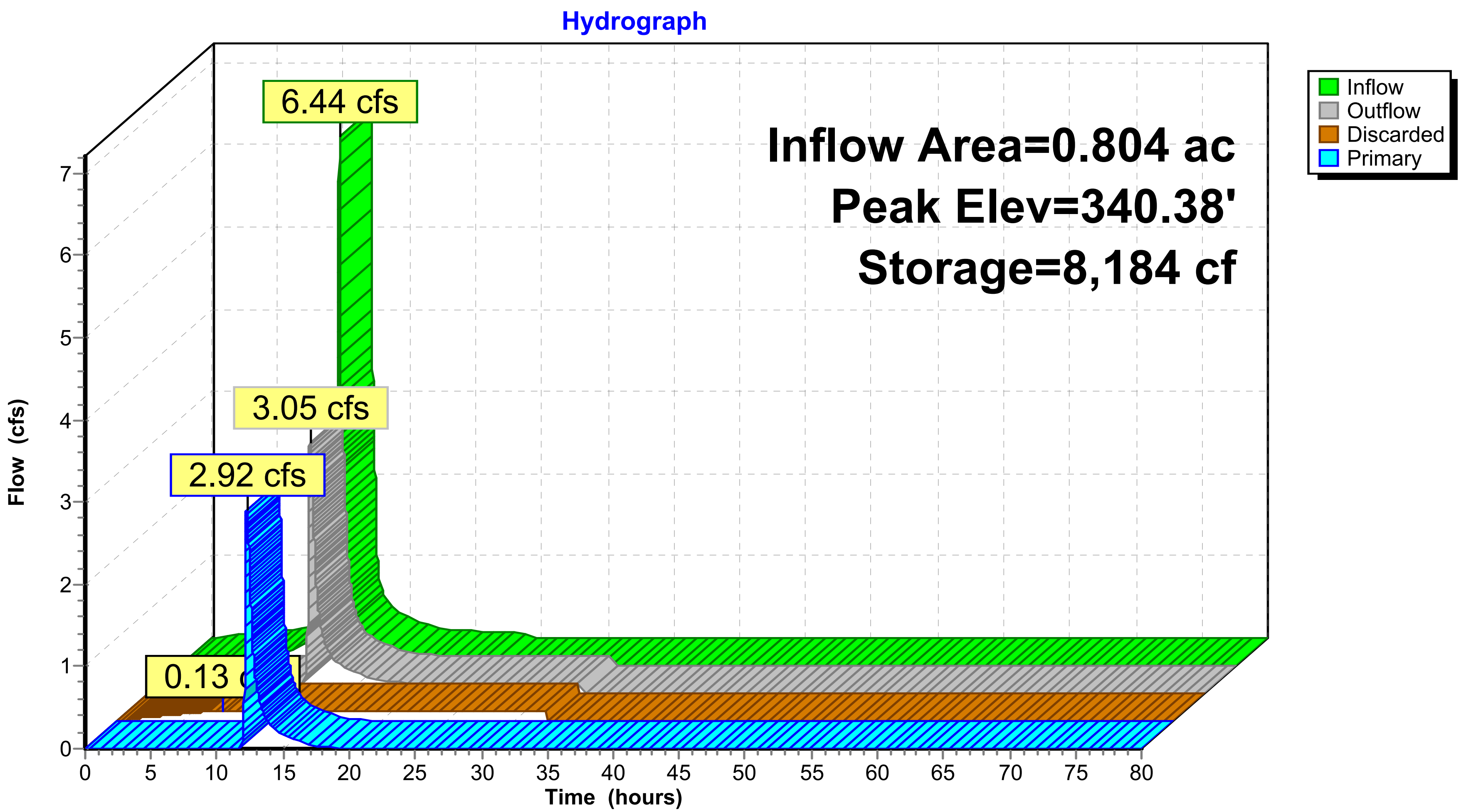
14,969.5 cf Field - 5,558.8 cf Chambers = 9,410.7 cf Stone x 40.0% Voids = 3,764.3 cf Stone Storage

Chamber Storage + Stone Storage = 9,323.1 cf = 0.214 af
Overall Storage Efficiency = 62.3%
Overall System Size = 78.96' x 70.00' x 2.71'

252 Chambers
554.4 cy Field
348.5 cy Stone



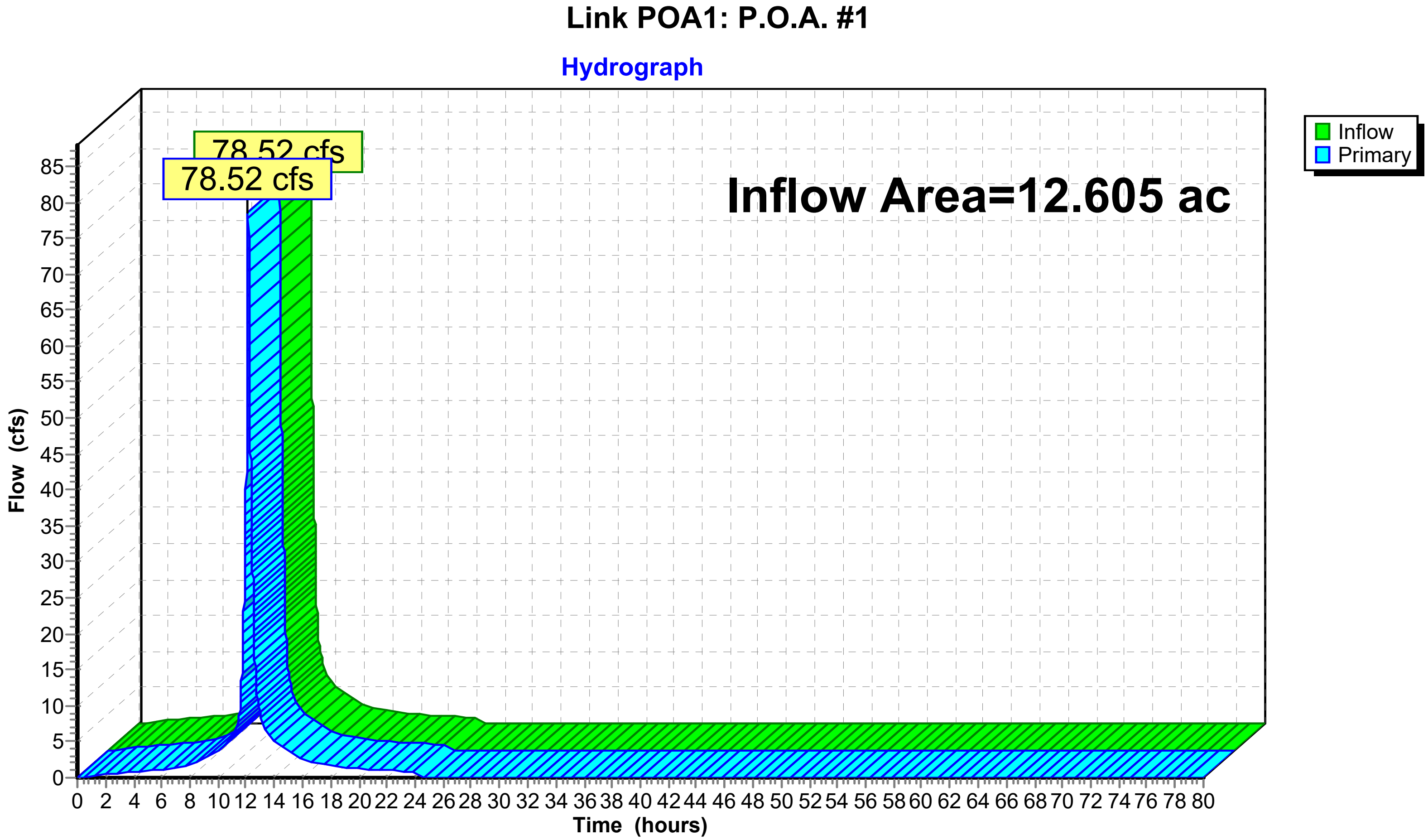
**Pond 1P: Existing Inf System**



## Summary for Link POA1: P.O.A. #1

Inflow Area = 12.605 ac, 75.47% Impervious, Inflow Depth = 6.86" for 100-year event
Inflow = 78.52 cfs @ 12.14 hrs, Volume= 7.211 af
Primary = 78.52 cfs @ 12.14 hrs, Volume= 7.211 af, Atten= 0%, Lag= 0.0 min

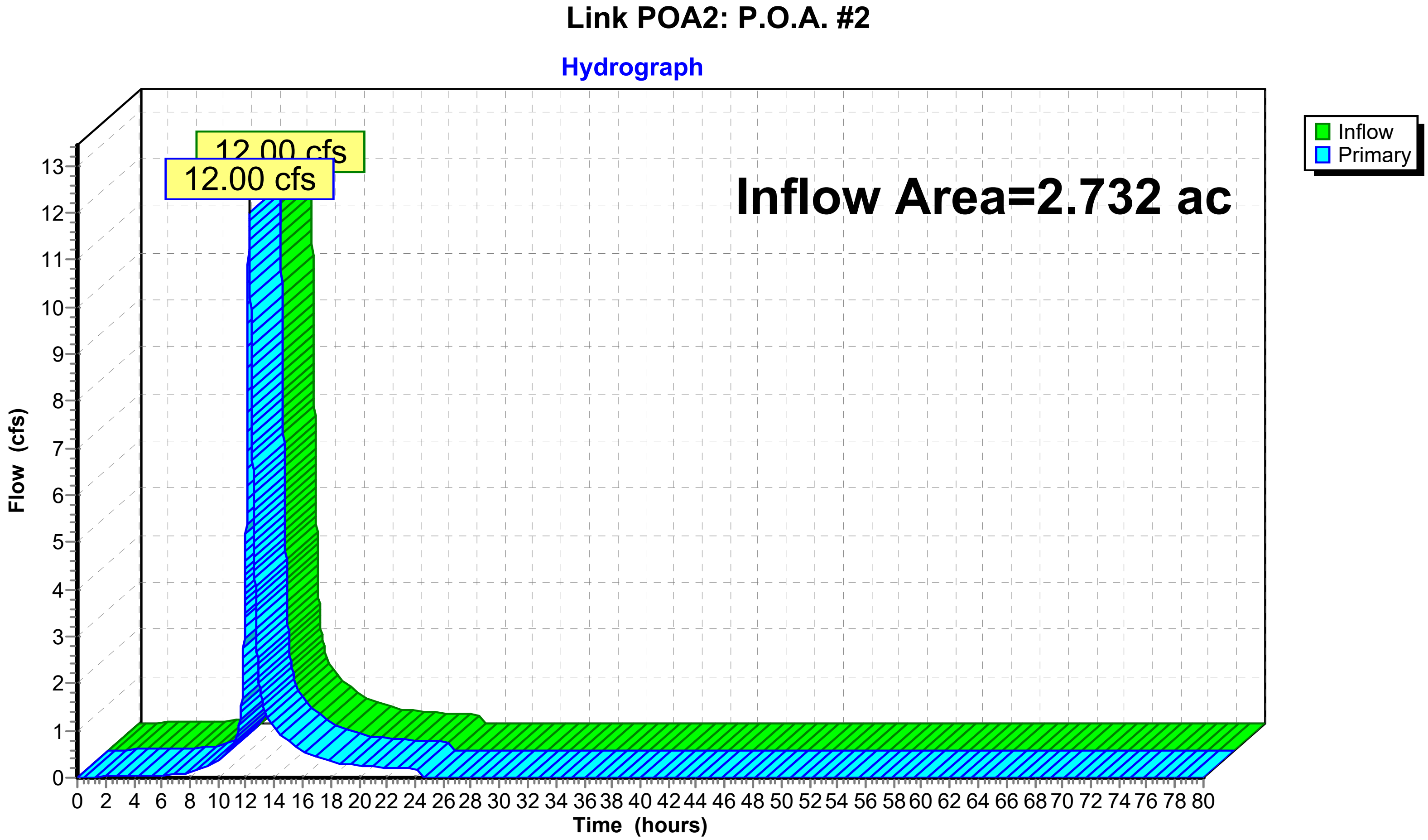
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs



## Summary for Link POA2: P.O.A. #2

Inflow Area = 2.732 ac, 16.64% Impervious, Inflow Depth = 5.19" for 100-year event
Inflow = 12.00 cfs @ 12.22 hrs, Volume= 1.183 af
Primary = 12.00 cfs @ 12.22 hrs, Volume= 1.183 af, Atten= 0%, Lag= 0.0 min

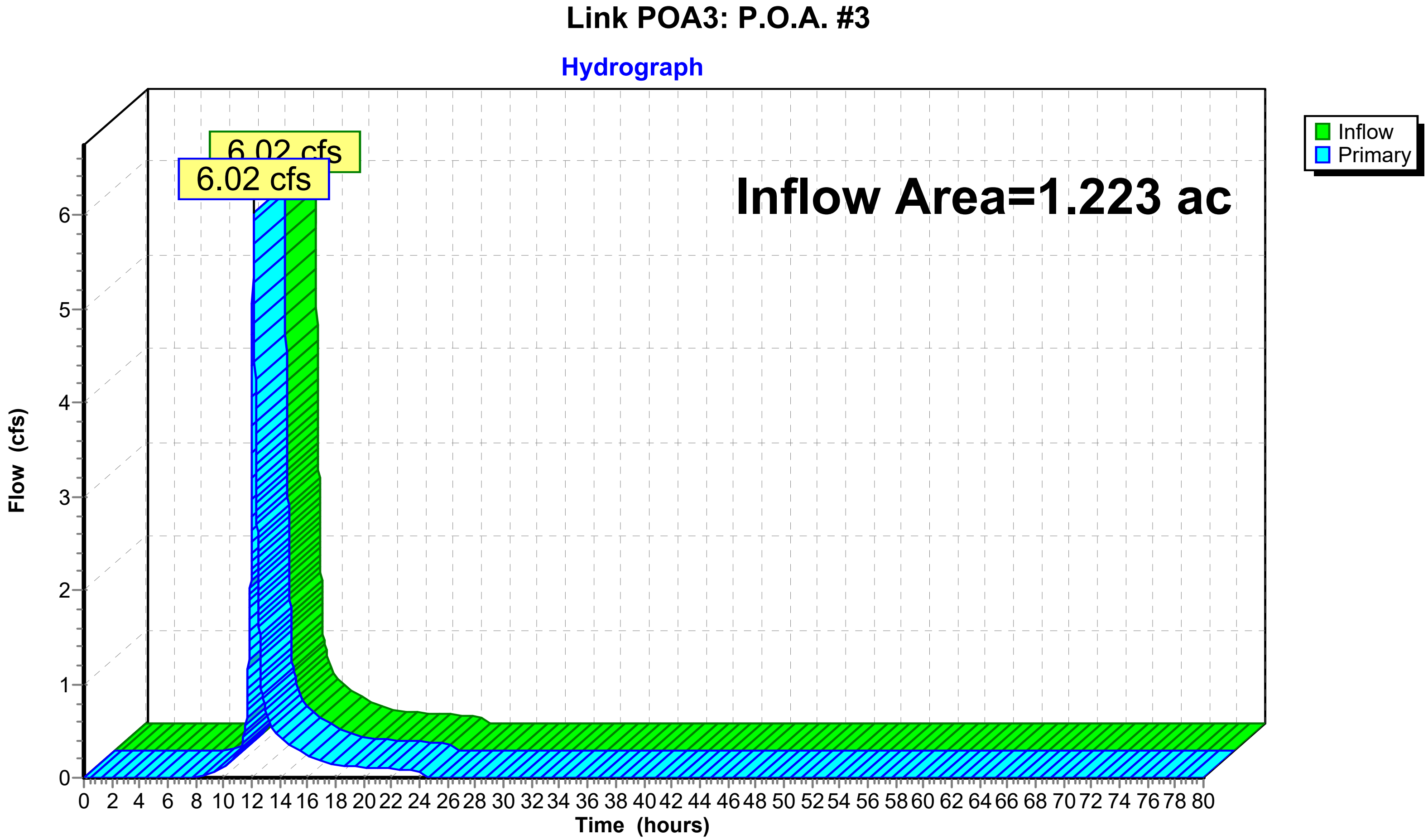
Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

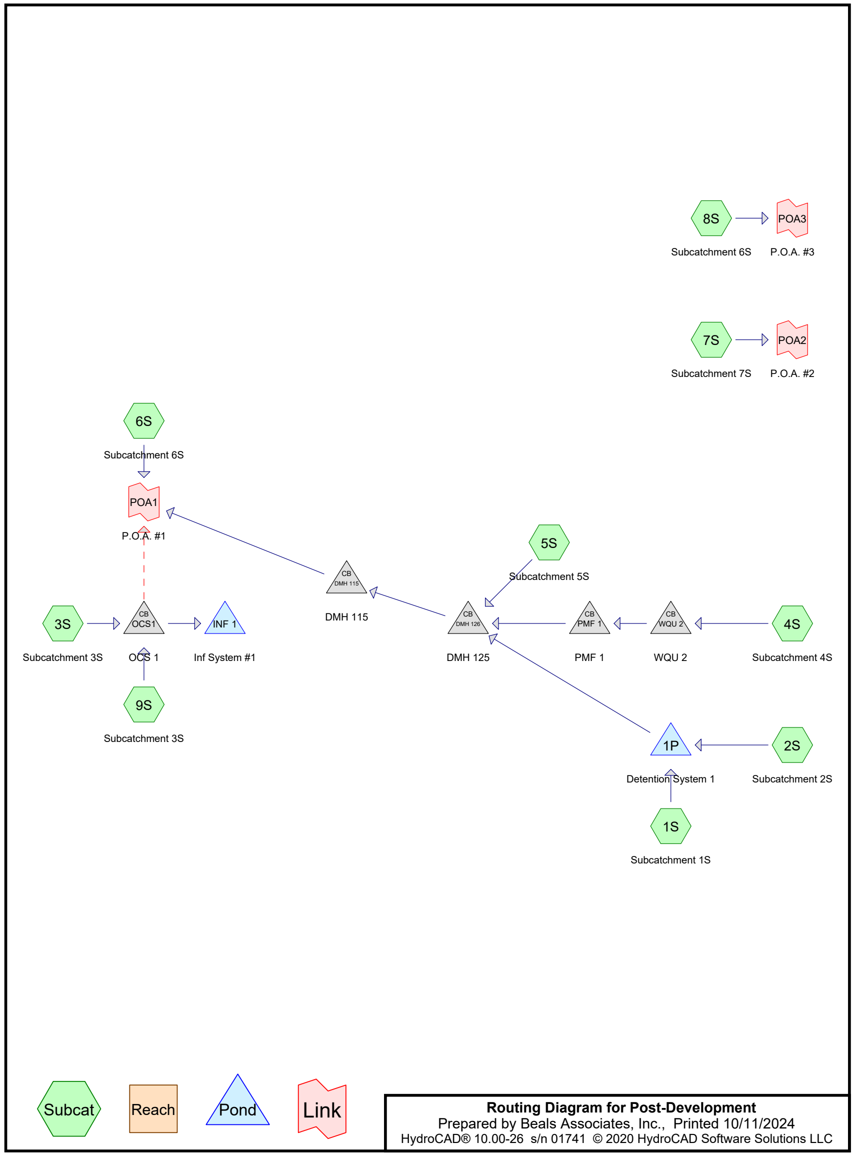


## Summary for Link POA3: P.O.A. #3

Inflow Area = 1.223 ac, 0.00% Impervious, Inflow Depth = 4.64" for 100-year event
Inflow = 6.02 cfs @ 12.13 hrs, Volume= 0.473 af
Primary = 6.02 cfs @ 12.13 hrs, Volume= 0.473 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs








## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 2.317 | 74 | >75% Grass cover, Good, HSG C (3S, 4S, 5S, 6S, 7S, 8S) |
| 2.350 | 98 | Building/Impervious (1S) |
| 8.268 | 98 | Impervious (2S, 3S, 4S, 5S, 9S) |
| 0.454 | 98 | Wetland (7S) |
| 3.172 | 70 | Woods, Good, HSG C (3S, 4S, 5S, 6S, 7S, 8S) |
| **16.561** | **89** | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| 5.489 | HSG C | 3S, 4S, 5S, 6S, 7S, 8S |
| 0.000 | HSG D | |
| 11.072 | Other | 1S, 2S, 3S, 4S, 5S, 7S, 9S |
| **16.561** | | **TOTAL AREA** |



## Ground Covers (all nodes)

| HSG-A (acres) | HSG-B (acres) | HSG-C (acres) | HSG-D (acres) | Other (acres) | Total (acres) | Ground Cover | Subcatchment Numbers |
|---|---|---|---|---|---|---|---|
| 0.000 | 0.000 | 2.317 | 0.000 | 0.000 | 2.317 | >75% Grass cover, Good | 3S, 4S, 5S, 6S, 7S, 8S |
| 0.000 | 0.000 | 0.000 | 0.000 | 2.350 | 2.350 | Building/Impervious | 1S |
| 0.000 | 0.000 | 0.000 | 0.000 | 8.268 | 8.268 | Impervious | 2S, 3S, 4S, 5S, 9S |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.454 | 0.454 | Wetland | 7S |
| 0.000 | 0.000 | 3.172 | 0.000 | 0.000 | 3.172 | Woods, Good | 3S, 4S, 5S, 6S, 7S, 8S |
| **0.000** | **0.000** | **5.489** | **0.000** | **11.072** | **16.561** | **TOTAL AREA** | |

### Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Inside-Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 5S | 0.00 | 0.00 | 358.0 | 0.0077 | 0.011 | 24.0 | 0.0 | 0.0 |
| 2 | 5S | 0.00 | 0.00 | 57.0 | 0.0035 | 0.011 | 30.0 | 0.0 | 0.0 |
| 3 | 5S | 0.00 | 0.00 | 504.0 | 0.0052 | 0.011 | 36.0 | 0.0 | 0.0 |
| 4 | 7S | 0.00 | 0.00 | 34.0 | 0.0271 | 0.011 | 24.0 | 0.0 | 0.0 |
| 5 | 1P | 336.50 | 334.70 | 52.0 | 0.0346 | 0.011 | 30.0 | 0.0 | 0.0 |
| 6 | DMH 115 | 331.68 | 331.66 | 47.7 | 0.0004 | 0.011 | 36.0 | 0.0 | 0.0 |
| 7 | DMH 126 | 332.00 | 331.78 | 83.0 | 0.0027 | 0.011 | 36.0 | 0.0 | 0.0 |
| 8 | OCS1 | 339.69 | 338.50 | 81.0 | 0.0147 | 0.011 | 12.0 | 0.0 | 0.0 |
| 9 | OCS1 | 331.44 | 330.94 | 50.7 | 0.0099 | 0.011 | 24.0 | 0.0 | 0.0 |
| 10 | PMF 1 | 333.40 | 332.10 | 14.7 | 0.0884 | 0.011 | 36.0 | 0.0 | 0.0 |
| 11 | WQU 2 | 334.30 | 333.50 | 10.4 | 0.0769 | 0.011 | 36.0 | 0.0 | 0.0 |



Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S** Runoff Area=102,375 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=7.67 cfs 0.612 af

**Subcatchment 2S: Subcatchment 2S** Runoff Area=60,300 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=4.52 cfs 0.361 af

**Subcatchment 3S: Subcatchment 3S** Runoff Area=58,760 sf 86.68% Impervious Runoff Depth=2.86"
Tc=6.0 min CN=WQ Runoff=4.04 cfs 0.322 af

**Subcatchment 4S: Subcatchment 4S** Runoff Area=263,351 sf 71.70% Impervious Runoff Depth=2.55"
Tc=6.0 min CN=WQ Runoff=16.19 cfs 1.284 af

**Subcatchment 5S: Subcatchment 5S** Runoff Area=62,236 sf 60.40% Impervious Runoff Depth=2.28"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=3.05 cfs 0.271 af

**Subcatchment 6S: Subcatchment 6S** Runoff Area=25,017 sf 0.00% Impervious Runoff Depth=1.04"
Flow Length=216' Tc=7.8 min CN=WQ Runoff=0.61 cfs 0.050 af

**Subcatchment 7S: Subcatchment 7S** Runoff Area=90,963 sf 21.76% Impervious Runoff Depth=1.44"
Flow Length=400' Tc=15.9 min CN=WQ Runoff=2.35 cfs 0.250 af

**Subcatchment 8S: Subcatchment 6S** Runoff Area=35,912 sf 0.00% Impervious Runoff Depth=0.96"
Flow Length=152' Tc=10.5 min CN=WQ Runoff=0.72 cfs 0.066 af

**Subcatchment 9S: Subcatchment 3S** Runoff Area=22,500 sf 100.00% Impervious Runoff Depth=3.13"
Tc=6.0 min CN=98 Runoff=1.69 cfs 0.135 af

**Pond 1P: Detention System 1** Peak Elev=338.85' Storage=10,605 cf Inflow=12.19 cfs 0.973 af
Outflow=3.65 cfs 0.973 af

**Pond DMH 115: DMH 115** Peak Elev=334.12' Inflow=22.03 cfs 2.528 af
36.0" Round Culvert n=0.011 L=47.7' S=0.0004 '/' Outflow=22.03 cfs 2.528 af

**Pond DMH 126: DMH 125** Peak Elev=334.67' Inflow=22.03 cfs 2.528 af
36.0" Round Culvert n=0.011 L=83.0' S=0.0027 '/' Outflow=22.03 cfs 2.528 af

**Pond INF 1: Inf System #1** Peak Elev=340.69' Storage=4,931 cf Inflow=1.29 cfs 0.206 af
Outflow=0.07 cfs 0.206 af

**Pond OCS1: OCS 1** Peak Elev=340.73' Inflow=5.73 cfs 0.456 af
Primary=1.29 cfs 0.206 af Secondary=4.57 cfs 0.250 af Outflow=5.73 cfs 0.456 af

**Pond PMF 1: PMF 1** Peak Elev=335.26' Inflow=16.19 cfs 1.284 af
36.0" Round Culvert n=0.011 L=14.7' S=0.0884 '/' Outflow=16.19 cfs 1.284 af

**Pond WQU 2: WQU 2** Peak Elev=336.01' Inflow=16.19 cfs 1.284 af
36.0" Round Culvert n=0.011 L=10.4' S=0.0769 '/' Outflow=16.19 cfs 1.284 af

**Link POA1: P.O.A. #1** Inflow=27.18 cfs 2.828 af
Primary=27.18 cfs 2.828 af

**Link POA2: P.O.A. #2** Inflow=2.35 cfs 0.250 af
Primary=2.35 cfs 0.250 af

**Link POA3: P.O.A. #3** Inflow=0.72 cfs 0.066 af
Primary=0.72 cfs 0.066 af

**Total Runoff Area = 16.561 ac Runoff Volume = 3.350 af Average Runoff Depth = 2.43"**
**33.14% Pervious = 5.489 ac 66.86% Impervious = 11.072 ac**



## Summary for Subcatchment 1S: Subcatchment 1S

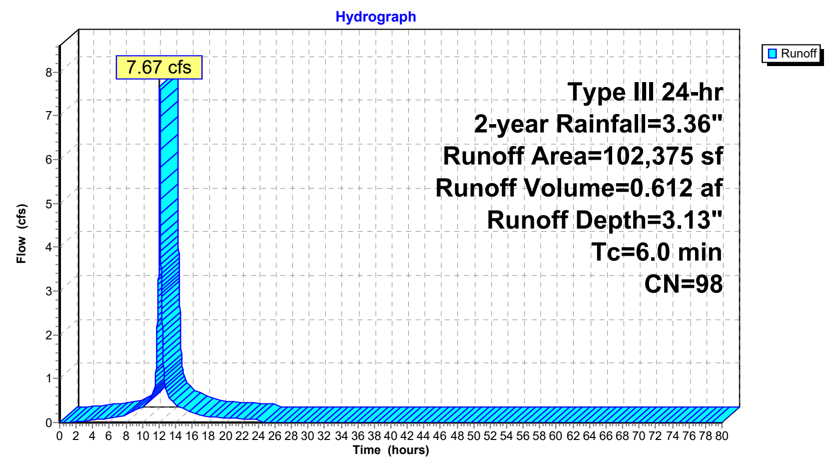
Runoff = 7.67 cfs @ 12.08 hrs, Volume= 0.612 af, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 102,375 | 98 | Building/Impervious |
| | 102,375 | | 100.00% Impervious Area |

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

### Subcatchment 1S: Subcatchment 1S



### Summary for Subcatchment 2S: Subcatchment 2S

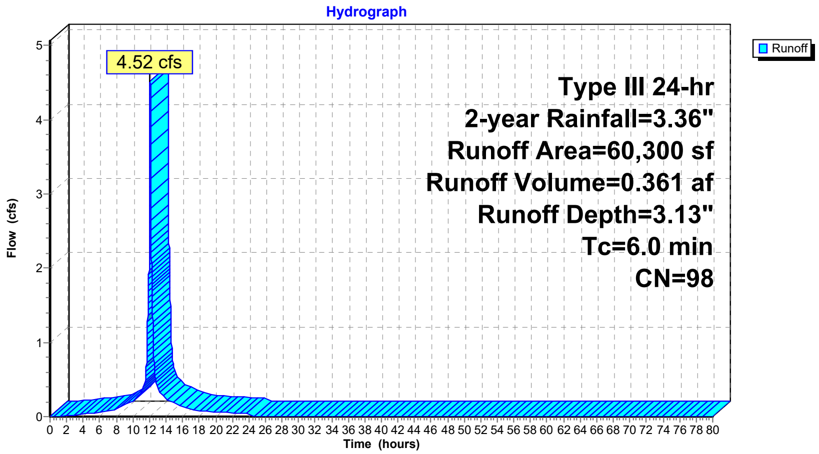
Runoff = 4.52 cfs @ 12.08 hrs, Volume= 0.361 af, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 60,300 | 98 | Impervious |
| | 60,300 | | 100.00% Impervious Area |

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

### Subcatchment 2S: Subcatchment 2S






### Summary for Subcatchment 3S: Subcatchment 3S

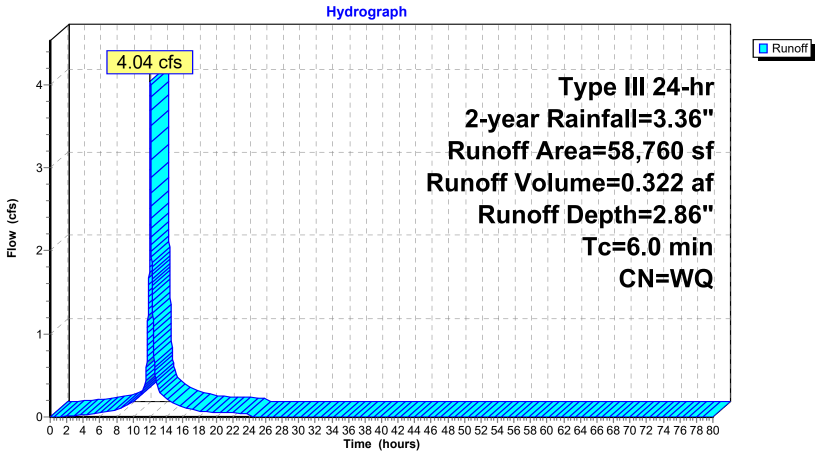
Runoff = 4.04 cfs @ 12.08 hrs, Volume= 0.322 af, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 50,932 | 98 | Impervious |
| | 7,322 | 74 | >75% Grass cover, Good, HSG C |
| | 506 | 70 | Woods, Good, HSG C |
| | 58,760 | | Weighted Average |
| | 7,828 | | 13.32% Pervious Area |
| | 50,932 | | 86.68% Impervious Area |

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

### Subcatchment 3S: Subcatchment 3S



### Summary for Subcatchment 4S: Subcatchment 4S

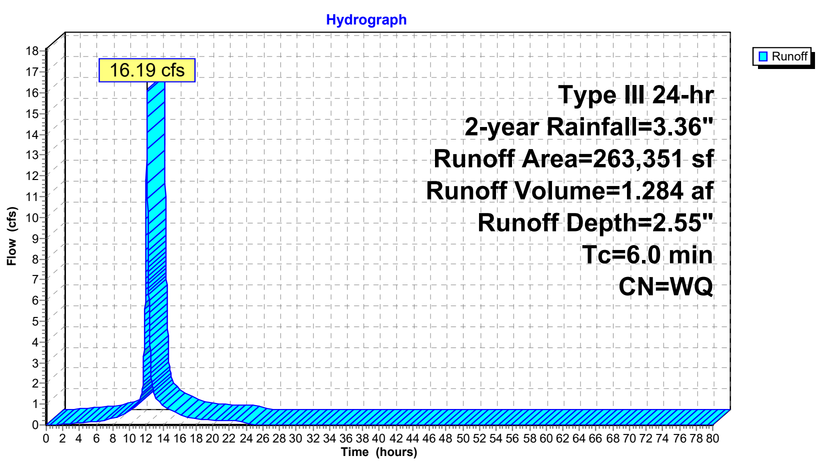
Runoff = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af, Depth= 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 188,818 | 98 | Impervious |
| | 53,700 | 74 | >75% Grass cover, Good, HSG C |
| | 20,833 | 70 | Woods, Good, HSG C |
| | 263,351 | | Weighted Average |
| | 74,533 | | 28.30% Pervious Area |
| | 188,818 | | 71.70% Impervious Area |

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

### Subcatchment 4S: Subcatchment 4S






### Summary for Subcatchment 5S: Subcatchment 5S

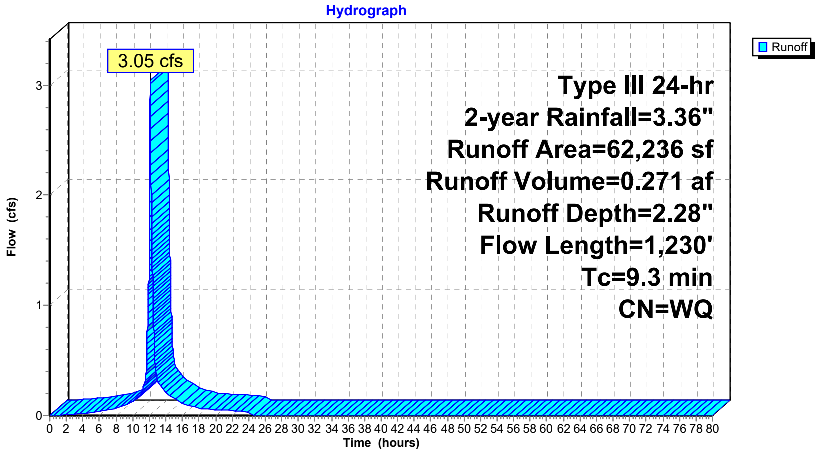
Runoff = 3.05 cfs @ 12.13 hrs, Volume= 0.271 af, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 37,592 | 98 | Impervious |
| | 6,102 | 74 | >75% Grass cover, Good, HSG C |
| | 18,542 | 70 | Woods, Good, HSG C |
| | 62,236 | | Weighted Average |
| | 24,644 | | 39.60% Pervious Area |
| | 37,592 | | 60.40% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

### Subcatchment 5S: Subcatchment 5S






### Summary for Subcatchment 6S: Subcatchment 6S

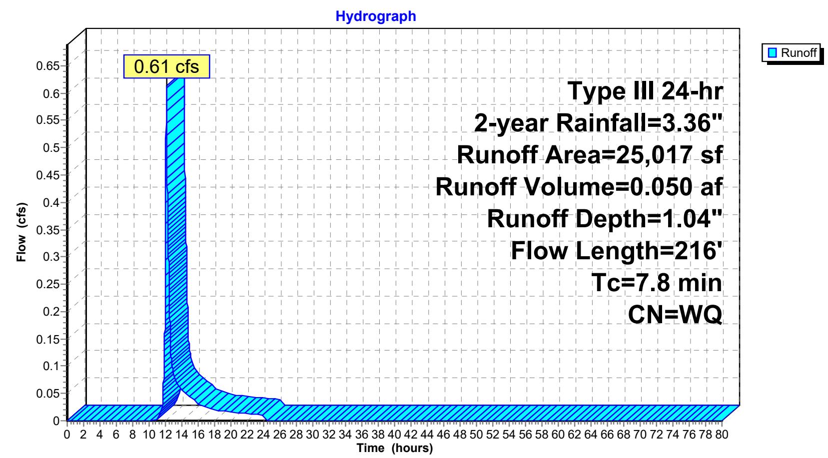
Runoff = 0.61 cfs @ 12.12 hrs, Volume= 0.050 af, Depth= 1.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| Area (sf) | CN | Description |
|---|---|---|
| 13,156 | 74 | >75% Grass cover, Good, HSG C |
| 11,861 | 70 | Woods, Good, HSG C |
| 25,017 | | Weighted Average |
| 25,017 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.8 | 20 | 0.0486 | 0.18 | | **Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36" |
| 3.7 | 30 | 0.1333 | 0.13 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.3 | 166 | 0.0602 | 1.23 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 7.8 | 216 | Total | | | |

### Subcatchment 6S: Subcatchment 6S



## Summary for Subcatchment 7S: Subcatchment 7S

Runoff = 2.35 cfs @ 12.22 hrs, Volume= 0.250 af, Depth= 1.44"

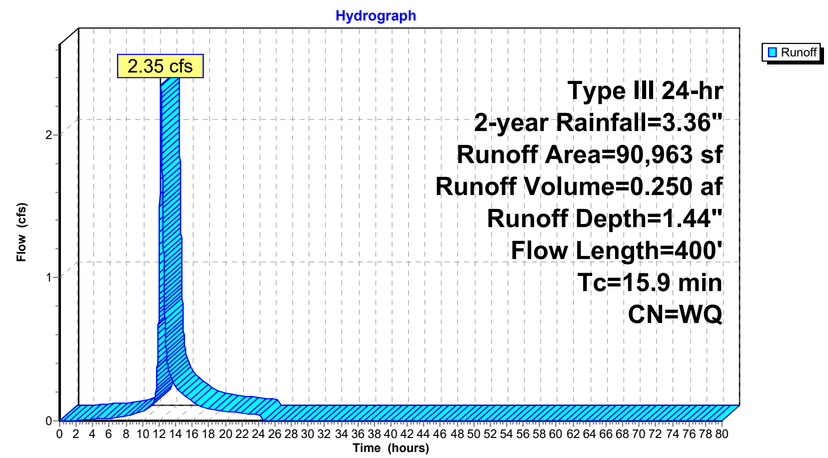
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 15,149 | 74 | >75% Grass cover, Good, HSG C |
| | 56,019 | 70 | Woods, Good, HSG C |
| * | 19,795 | 98 | Wetland |
| | 90,963 | | Weighted Average |
| | 71,168 | | 78.24% Pervious Area |
| | 19,795 | | 21.76% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.3 | 17 | 0.0788 | 0.21 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 8.7 | 33 | 0.0194 | 0.06 | | **Sheet Flow, B-C**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 5.9 | 316 | 0.0315 | 0.89 | | **Shallow Concentrated Flow, C-D**<br>Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, RCP_Round 24"**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, finished |
| 15.9 | 400 | Total | | | |



## Subcatchment 7S: Subcatchment 7S



### Summary for Subcatchment 8S: Subcatchment 6S

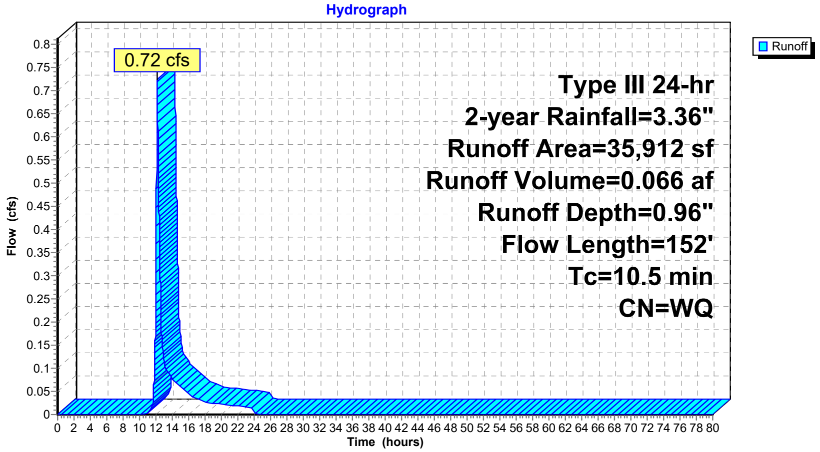
Runoff = 0.72 cfs @ 12.16 hrs, Volume= 0.066 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| Area (sf) | CN | Description |
|---|---|---|
| 5,512 | 74 | >75% Grass cover, Good, HSG C |
| 30,400 | 70 | Woods, Good, HSG C |
| 35,912 | | Weighted Average |
| 35,912 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.3 | 50 | 0.0500 | 0.10 | | **Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.2 | 102 | 0.0245 | 0.78 | | **Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps |
| 10.5 | 152 | Total | | | |

### Subcatchment 8S: Subcatchment 6S






### Summary for Subcatchment 9S: Subcatchment 3S

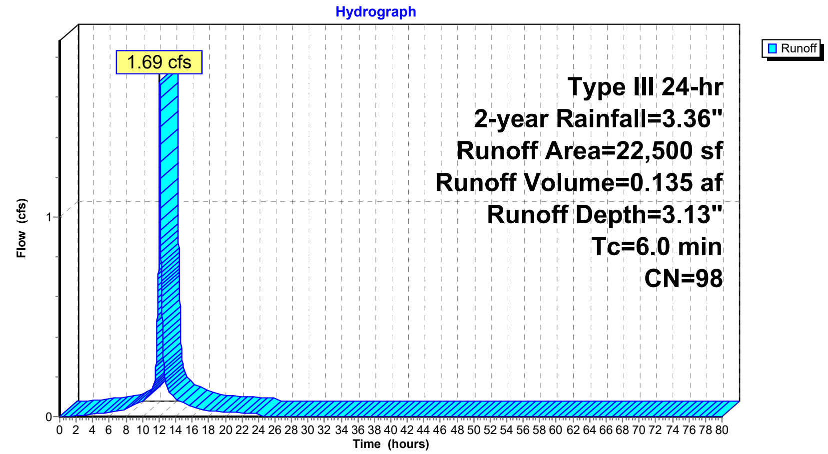
Runoff = 1.69 cfs @ 12.08 hrs, Volume= 0.135 af, Depth= 3.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-year Rainfall=3.36"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 22,500 | 98 | Impervious |
| | 22,500 | | 100.00% Impervious Area |

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

### Subcatchment 9S: Subcatchment 3S



## Summary for Pond 1P: Detention System 1

Inflow Area = 3.735 ac,100.00% Impervious, Inflow Depth = 3.13" for 2-year event
Inflow = 12.19 cfs @ 12.08 hrs, Volume= 0.973 af
Outflow = 3.65 cfs @ 12.40 hrs, Volume= 0.973 af, Atten= 70%, Lag= 18.9 min
Primary = 3.65 cfs @ 12.40 hrs, Volume= 0.973 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 338.85' @ 12.40 hrs Surf.Area= 5,839 sf Storage= 10,605 cf

Plug-Flow detention time= 33.4 min calculated for 0.973 af (100% of inflow)
Center-of-Mass det. time= 33.4 min ( 788.8 - 755.4 )

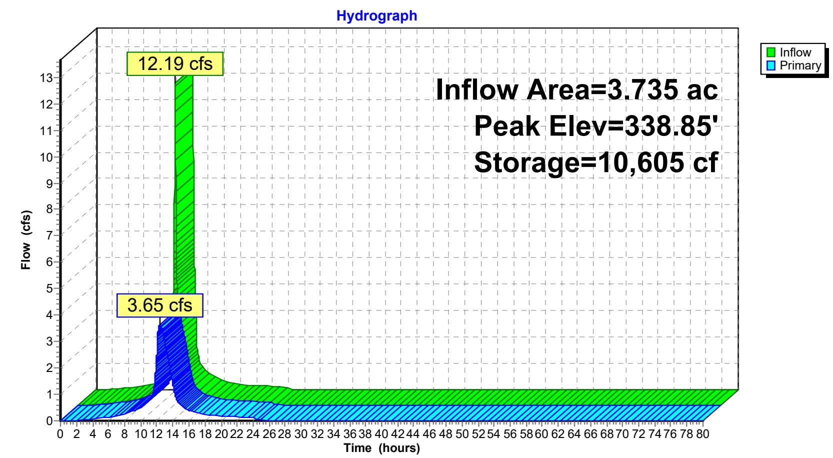
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 336.50' | 22,973 cf | **60.0" Round Pipe Storage** L= 1,170.0' |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 336.50' | **30.0" Round Culvert** L= 52.0' Ke= 0.500 Inlet / Outlet Invert= 336.50' / 334.70' S= 0.0346 '/' Cc= 0.900 n= 0.011 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 336.50' | **10.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 338.95' | **13.0" W x 6.0" H Vert. Orifice/Grate** X 2 rows with 6.0" cc spacing C= 0.600 |
| #4 | Device 1 | 340.65' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=3.65 cfs @ 12.40 hrs HW=338.85' TW=333.67' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.65 cfs of 24.98 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.65 cfs @ 6.69 fps)
  ├─**3=Orifice/Grate** ( Controls 0.00 cfs)
  └─**4=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)



## Pond 1P: Detention System 1



## Summary for Pond DMH 115: DMH 115

[57] Hint: Peaked at 334.12' (Flood elevation advised)

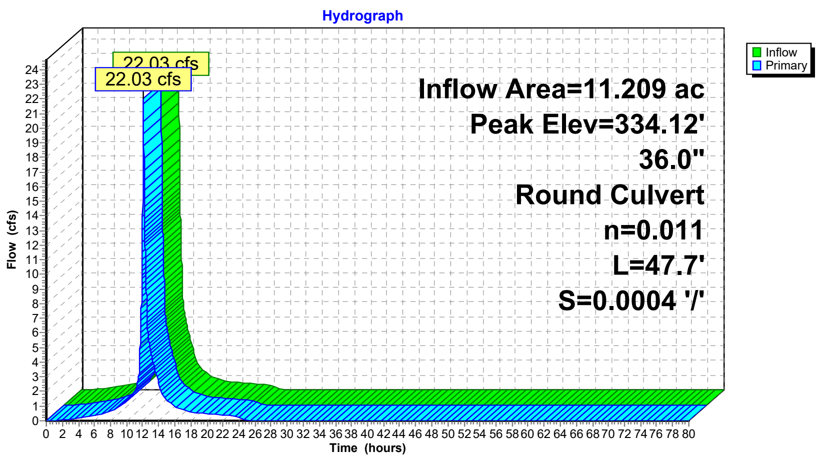
Inflow Area = 11.209 ac, 79.69% Impervious, Inflow Depth = 2.71" for 2-year event
Inflow = 22.03 cfs @ 12.09 hrs, Volume= 2.528 af
Outflow = 22.03 cfs @ 12.09 hrs, Volume= 2.528 af, Atten= 0%, Lag= 0.0 min
Primary = 22.03 cfs @ 12.09 hrs, Volume= 2.528 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 334.12' @ 12.09 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 331.68' | **36.0" Round Culvert** L= 47.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.68' / 331.66' S= 0.0004 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=22.01 cfs @ 12.09 hrs HW=334.12' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 22.01 cfs @ 4.87 fps)

**Pond DMH 115: DMH 115**






## Summary for Pond DMH 126: DMH 125

[57] Hint: Peaked at 334.67' (Flood elevation advised)

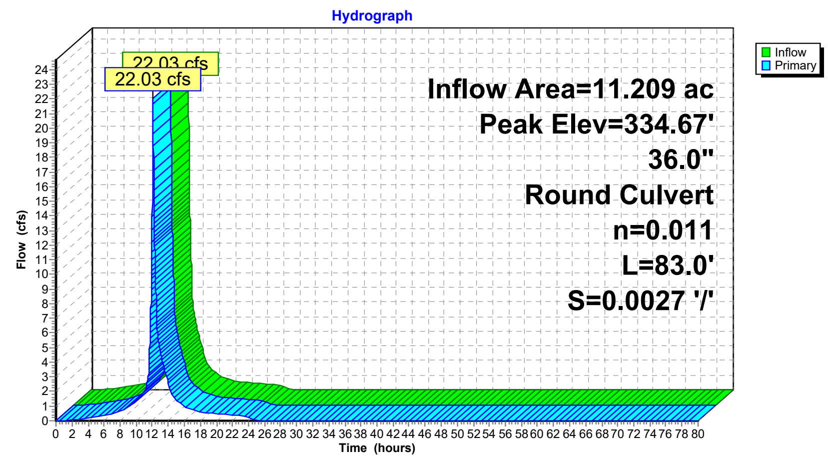
Inflow Area = 11.209 ac, 79.69% Impervious, Inflow Depth = 2.71" for 2-year event
Inflow = 22.03 cfs @ 12.09 hrs, Volume= 2.528 af
Outflow = 22.03 cfs @ 12.09 hrs, Volume= 2.528 af, Atten= 0%, Lag= 0.0 min
Primary = 22.03 cfs @ 12.09 hrs, Volume= 2.528 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 334.67' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 332.00' | **36.0" Round Culvert** L= 83.0' Ke= 0.500<br>Inlet / Outlet Invert= 332.00' / 331.78' S= 0.0027 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=21.83 cfs @ 12.09 hrs HW=334.67' TW=334.12' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 21.83 cfs @ 4.36 fps)

**Pond DMH 126: DMH 125**



## Summary for Pond INF 1: Inf System #1

[80] Warning: Exceeded Pond OCS1 by 8.81' @ 24.30 hrs (1.16 cfs 0.288 af)

Inflow Area = 1.865 ac, 90.37% Impervious, Inflow Depth = 1.33" for 2-year event
Inflow = 1.29 cfs @ 12.06 hrs, Volume= 0.206 af
Outflow = 0.07 cfs @ 6.90 hrs, Volume= 0.206 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.07 cfs @ 6.90 hrs, Volume= 0.206 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.69' @ 12.16 hrs Surf.Area= 2,800 sf Storage= 4,931 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 617.8 min ( 1,342.7 - 724.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 338.30' | 2,266 cf | **Crushed Stone (Prismatic)**Listed below (Recalc)<br>9,800 cf Overall - 4,135 cf Embedded = 5,665 cf x 40.0% Voids |
| #2 | 338.80' | 4,135 cf | **ADS_StormTech SC-740 +Cap** x 90 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>90 Chambers in 9 Rows |
| | | 6,401 cf | Total Available Storage |

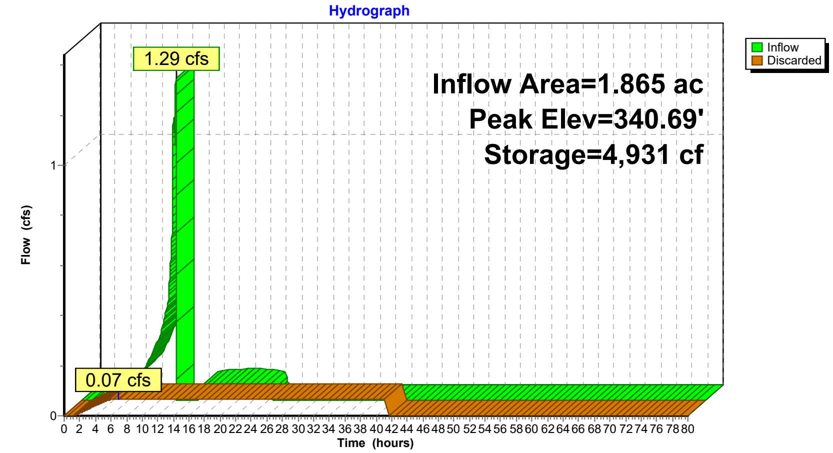
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 338.30 | 2,800 | 0 | 0 |
| 341.80 | 2,800 | 9,800 | 9,800 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 338.30' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.07 cfs @ 6.90 hrs HW=338.34' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.07 cfs)



## Pond INF 1: Inf System #1



## Summary for Pond OCS1: OCS 1

[57] Hint: Peaked at 340.73' (Flood elevation advised)

Inflow Area = 1.865 ac, 90.37% Impervious, Inflow Depth = 2.93" for 2-year event
Inflow = 5.73 cfs @ 12.08 hrs, Volume= 0.456 af
Outflow = 5.73 cfs @ 12.08 hrs, Volume= 0.456 af, Atten= 0%, Lag= 0.0 min
Primary = 1.29 cfs @ 12.06 hrs, Volume= 0.206 af
Secondary = 4.57 cfs @ 12.09 hrs, Volume= 0.250 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.73' @ 12.09 hrs

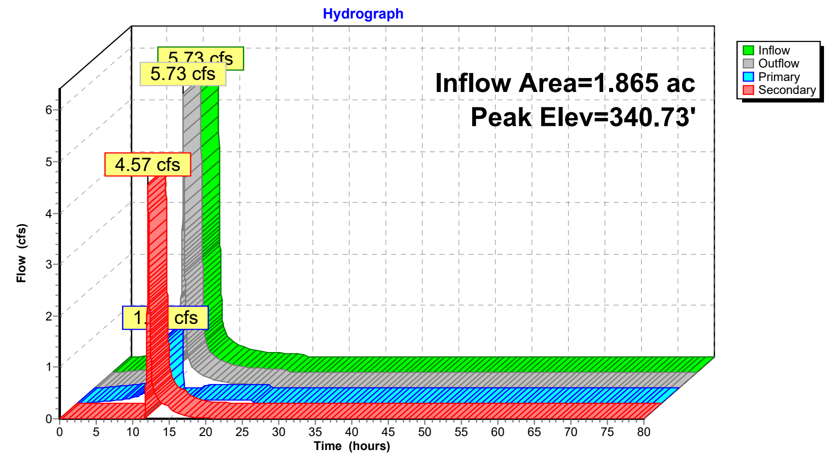
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.69' | **12.0" Round Culvert** L= 81.0' Ke= 0.500<br>Inlet / Outlet Invert= 339.69' / 338.50' S= 0.0147 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 0.79 sf |
| #2 | Secondary | 331.44' | **24.0" Round Culvert** L= 50.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.44' / 330.94' S= 0.0099 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 3.14 sf |
| #3 | Device 2 | 340.30' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=1.21 cfs @ 12.06 hrs HW=340.70' TW=340.53' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.21 cfs @ 1.90 fps)

**Secondary OutFlow** Max=4.56 cfs @ 12.09 hrs HW=340.73' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 4.56 cfs of 43.54 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 4.56 cfs @ 2.14 fps)



## Pond OCS1: OCS 1



### Summary for Pond PMF 1: PMF 1

[57] Hint: Peaked at 335.26' (Flood elevation advised)

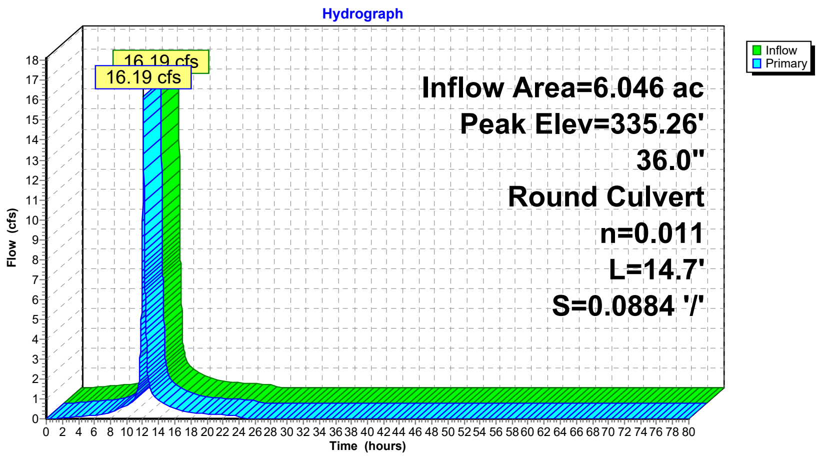
Inflow Area = 6.046 ac, 71.70% Impervious, Inflow Depth = 2.55" for 2-year event
Inflow = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af
Outflow = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af, Atten= 0%, Lag= 0.0 min
Primary = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 335.26' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 333.40' | **36.0" Round Culvert** L= 14.7' Ke= 0.500<br>Inlet / Outlet Invert= 333.40' / 332.10' S= 0.0884 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=15.68 cfs @ 12.09 hrs HW=335.25' TW=334.65' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 15.68 cfs @ 4.91 fps)

**Pond PMF 1: PMF 1**






### Summary for Pond WQU 2: WQU 2

[57] Hint: Peaked at 336.01' (Flood elevation advised)

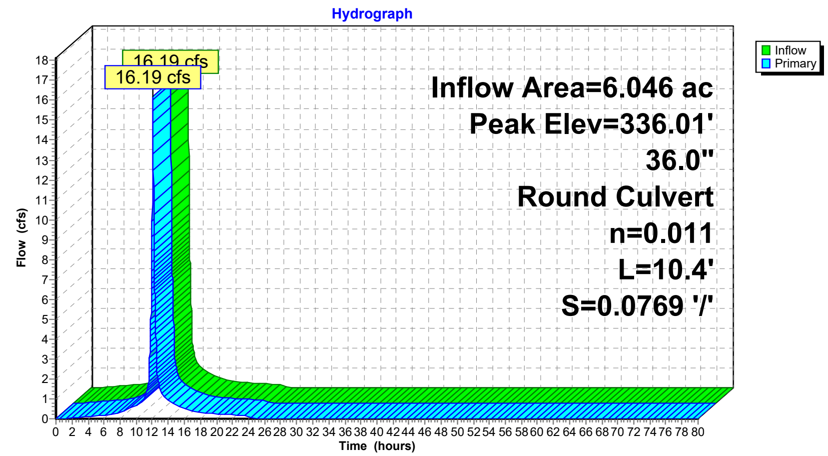
Inflow Area = 6.046 ac, 71.70% Impervious, Inflow Depth = 2.55" for 2-year event
Inflow = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af
Outflow = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af, Atten= 0%, Lag= 0.0 min
Primary = 16.19 cfs @ 12.09 hrs, Volume= 1.284 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 336.01' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 334.30' | **36.0" Round Culvert** L= 10.4' Ke= 0.500<br>Inlet / Outlet Invert= 334.30' / 333.50' S= 0.0769 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=15.80 cfs @ 12.09 hrs HW=335.99' TW=335.25' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 15.80 cfs @ 5.55 fps)

**Pond WQU 2: WQU 2**

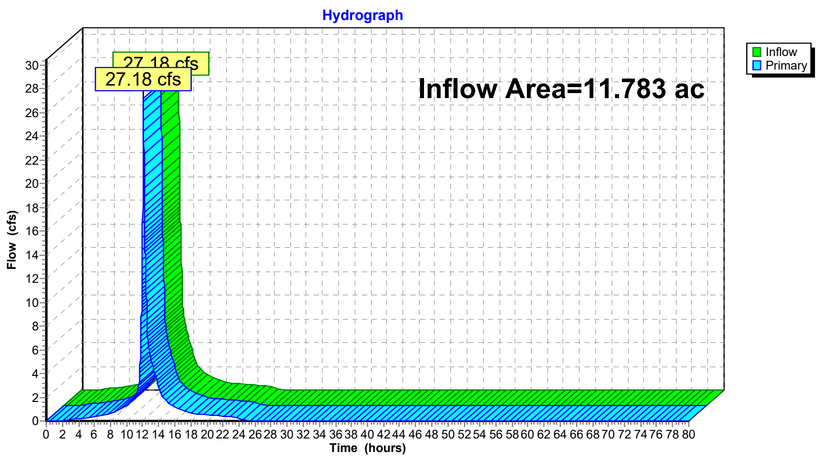


## Summary for Link POA1: P.O.A. #1

Inflow Area = 11.783 ac, 75.80% Impervious, Inflow Depth = 2.88" for 2-year event
Inflow = 27.18 cfs @ 12.09 hrs, Volume= 2.828 af
Primary = 27.18 cfs @ 12.09 hrs, Volume= 2.828 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA1: P.O.A. #1



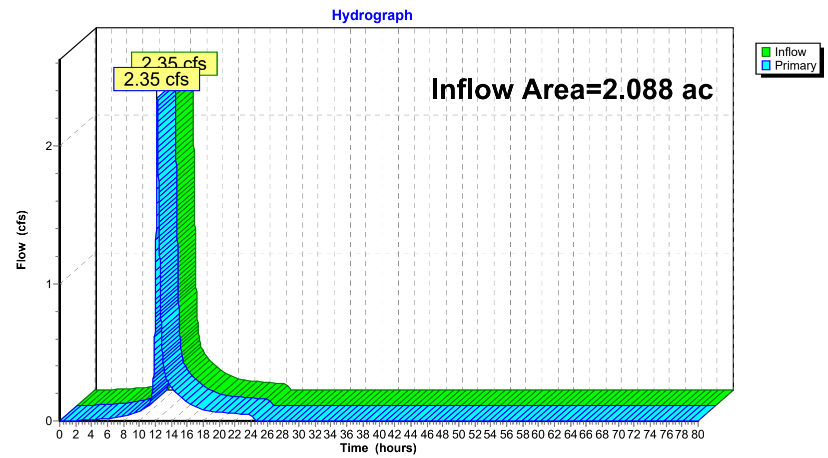



## Summary for Link POA2: P.O.A. #2

Inflow Area = 2.088 ac, 21.76% Impervious, Inflow Depth = 1.44" for 2-year event
Inflow = 2.35 cfs @ 12.22 hrs, Volume= 0.250 af
Primary = 2.35 cfs @ 12.22 hrs, Volume= 0.250 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA2: P.O.A. #2

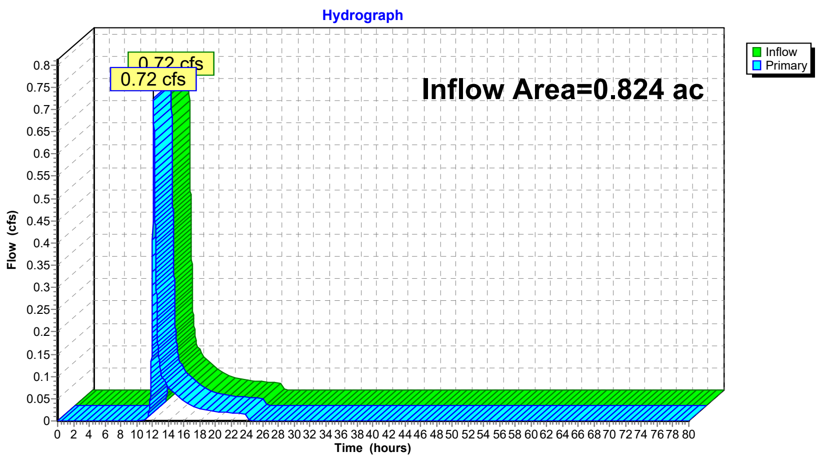


## Summary for Link POA3: P.O.A. #3

Inflow Area = 0.824 ac, 0.00% Impervious, Inflow Depth = 0.96" for 2-year event
Inflow = 0.72 cfs @ 12.16 hrs, Volume= 0.066 af
Primary = 0.72 cfs @ 12.16 hrs, Volume= 0.066 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA3: P.O.A. #3






Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S** Runoff Area=102,375 sf 100.00% Impervious Runoff Depth=4.97"
Tc=6.0 min CN=98 Runoff=11.98 cfs 0.974 af

**Subcatchment 2S: Subcatchment 2S** Runoff Area=60,300 sf 100.00% Impervious Runoff Depth=4.97"
Tc=6.0 min CN=98 Runoff=7.06 cfs 0.574 af

**Subcatchment 3S: Subcatchment 3S** Runoff Area=58,760 sf 86.68% Impervious Runoff Depth=4.64"
Tc=6.0 min CN=WQ Runoff=6.49 cfs 0.522 af

**Subcatchment 4S: Subcatchment 4S** Runoff Area=263,351 sf 71.70% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=WQ Runoff=26.95 cfs 2.144 af

**Subcatchment 5S: Subcatchment 5S** Runoff Area=62,236 sf 60.40% Impervious Runoff Depth=3.91"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=5.27 cfs 0.465 af

**Subcatchment 6S: Subcatchment 6S** Runoff Area=25,017 sf 0.00% Impervious Runoff Depth=2.37"
Flow Length=216' Tc=7.8 min CN=WQ Runoff=1.49 cfs 0.114 af

**Subcatchment 7S: Subcatchment 7S** Runoff Area=90,963 sf 21.76% Impervious Runoff Depth=2.85"
Flow Length=400' Tc=15.9 min CN=WQ Runoff=4.89 cfs 0.497 af

**Subcatchment 8S: Subcatchment 6S** Runoff Area=35,912 sf 0.00% Impervious Runoff Depth=2.25"
Flow Length=152' Tc=10.5 min CN=WQ Runoff=1.84 cfs 0.154 af

**Subcatchment 9S: Subcatchment 3S** Runoff Area=22,500 sf 100.00% Impervious Runoff Depth=4.97"
Tc=6.0 min CN=98 Runoff=2.63 cfs 0.214 af

**Pond 1P: Detention System 1** Peak Elev=339.84' Storage=16,285 cf Inflow=19.04 cfs 1.548 af
Outflow=7.39 cfs 1.548 af

**Pond DMH 115: DMH 115** Peak Elev=335.02' Inflow=35.93 cfs 4.157 af
36.0" Round Culvert n=0.011 L=47.7' S=0.0004 '/' Outflow=35.93 cfs 4.157 af

**Pond DMH 126: DMH 125** Peak Elev=336.12' Inflow=35.93 cfs 4.157 af
36.0" Round Culvert n=0.011 L=83.0' S=0.0027 '/' Outflow=35.93 cfs 4.157 af

**Pond INF 1: Inf System #1** Peak Elev=340.92' Storage=5,330 cf Inflow=1.15 cfs 0.216 af
Outflow=0.07 cfs 0.216 af

**Pond OCS1: OCS 1** Peak Elev=340.93' Inflow=9.12 cfs 0.736 af
Primary=1.15 cfs 0.216 af Secondary=8.16 cfs 0.520 af Outflow=9.12 cfs 0.736 af

**Pond PMF 1: PMF 1** Peak Elev=336.70' Inflow=26.95 cfs 2.144 af
36.0" Round Culvert n=0.011 L=14.7' S=0.0884 '/' Outflow=26.95 cfs 2.144 af

**Pond WQU 2: WQU 2** Peak Elev=337.27' Inflow=26.95 cfs 2.144 af
36.0" Round Culvert n=0.011 L=10.4' S=0.0769 '/' Outflow=26.95 cfs 2.144 af

**Link POA1: P.O.A. #1** Inflow=45.53 cfs 4.790 af
Primary=45.53 cfs 4.790 af

**Link POA2: P.O.A. #2** Inflow=4.89 cfs 0.497 af
Primary=4.89 cfs 0.497 af

**Link POA3: P.O.A. #3** Inflow=1.84 cfs 0.154 af
Primary=1.84 cfs 0.154 af

**Total Runoff Area = 16.561 ac Runoff Volume = 5.657 af Average Runoff Depth = 4.10"**
**33.14% Pervious = 5.489 ac 66.86% Impervious = 11.072 ac**



## Summary for Subcatchment 1S: Subcatchment 1S

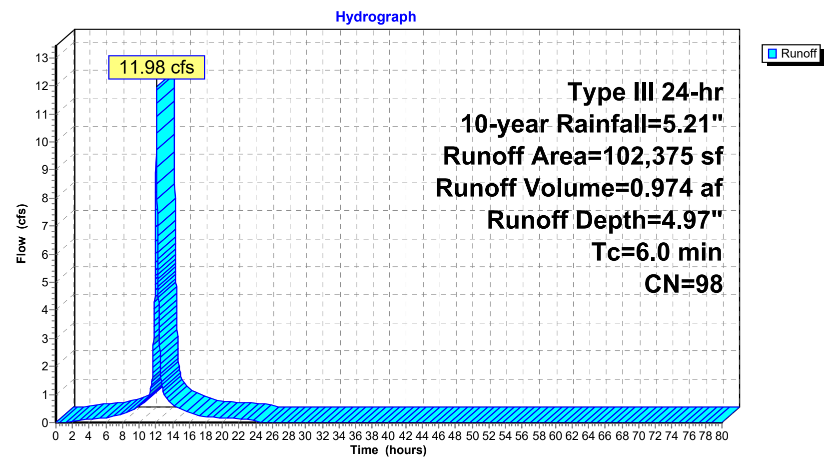
Runoff = 11.98 cfs @ 12.08 hrs, Volume= 0.974 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 102,375 | 98 | Building/Impervious |
| | 102,375 | | 100.00% Impervious Area |

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

### Subcatchment 1S: Subcatchment 1S



## Summary for Subcatchment 2S: Subcatchment 2S

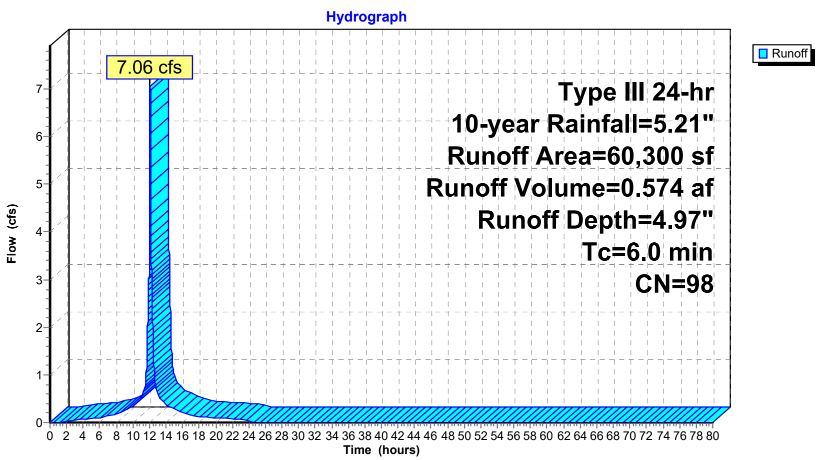
Runoff = 7.06 cfs @ 12.08 hrs, Volume= 0.574 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 60,300 | 98 | Impervious |
| | 60,300 | | 100.00% Impervious Area |

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

### Subcatchment 2S: Subcatchment 2S






## Summary for Subcatchment 3S: Subcatchment 3S

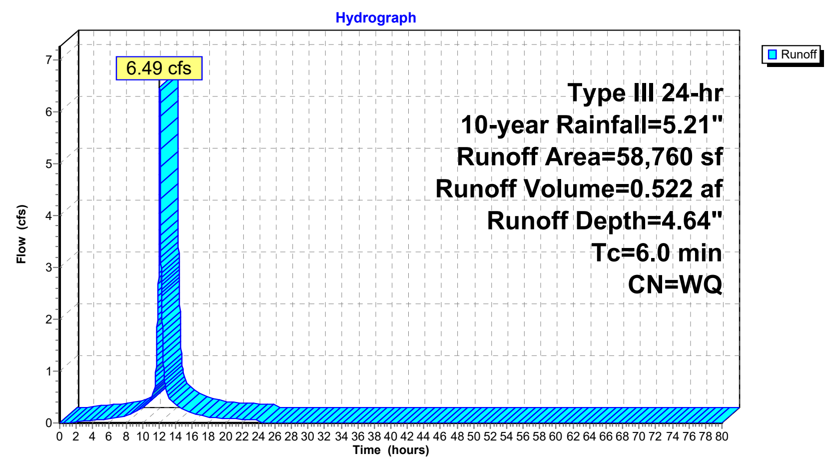
Runoff = 6.49 cfs @ 12.08 hrs, Volume= 0.522 af, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 50,932 | 98 | Impervious |
| | 7,322 | 74 | >75% Grass cover, Good, HSG C |
| | 506 | 70 | Woods, Good, HSG C |
| | 58,760 | | Weighted Average |
| | 7,828 | | 13.32% Pervious Area |
| | 50,932 | | 86.68% Impervious Area |

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

### Subcatchment 3S: Subcatchment 3S



### Summary for Subcatchment 4S: Subcatchment 4S

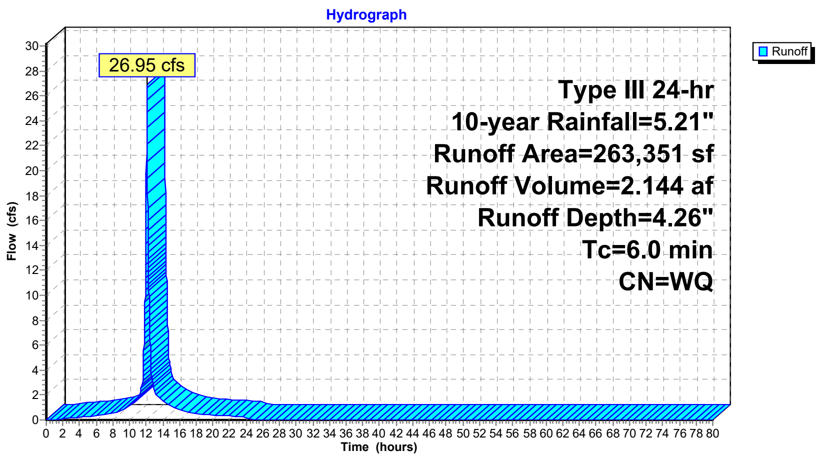
Runoff = 26.95 cfs @ 12.08 hrs, Volume= 2.144 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 188,818 | 98 | Impervious |
| | 53,700 | 74 | >75% Grass cover, Good, HSG C |
| | 20,833 | 70 | Woods, Good, HSG C |
| | 263,351 | | Weighted Average |
| | 74,533 | | 28.30% Pervious Area |
| | 188,818 | | 71.70% Impervious Area |

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

### Subcatchment 4S: Subcatchment 4S






### Summary for Subcatchment 5S: Subcatchment 5S

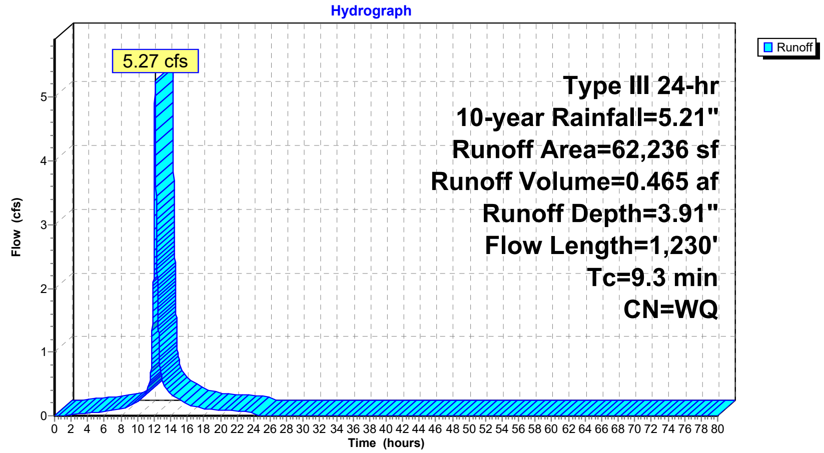
Runoff = 5.27 cfs @ 12.13 hrs, Volume= 0.465 af, Depth= 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 37,592 | 98 | Impervious |
| | 6,102 | 74 | >75% Grass cover, Good, HSG C |
| | 18,542 | 70 | Woods, Good, HSG C |
| | 62,236 | | Weighted Average |
| | 24,644 | | 39.60% Pervious Area |
| | 37,592 | | 60.40% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

## Subcatchment 5S: Subcatchment 5S






## Summary for Subcatchment 6S: Subcatchment 6S

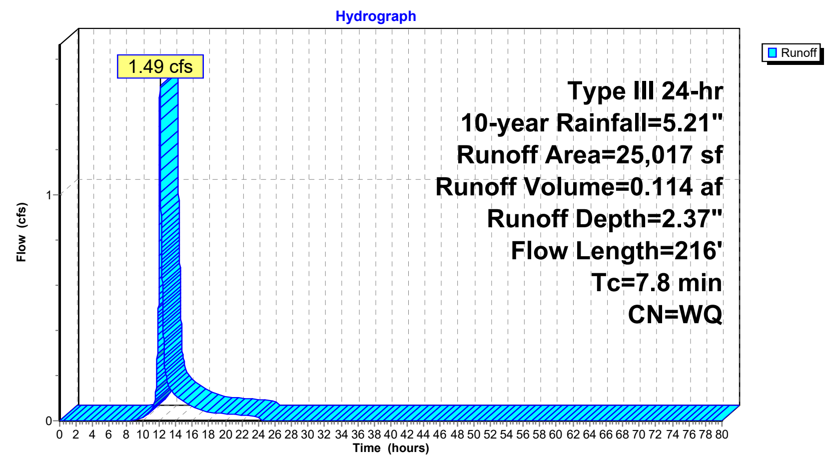
Runoff = 1.49 cfs @ 12.11 hrs, Volume= 0.114 af, Depth= 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| Area (sf) | CN | Description |
|---|---|---|
| 13,156 | 74 | >75% Grass cover, Good, HSG C |
| 11,861 | 70 | Woods, Good, HSG C |
| 25,017 | | Weighted Average |
| 25,017 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.8 | 20 | 0.0486 | 0.18 | | **Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36" |
| 3.7 | 30 | 0.1333 | 0.13 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.3 | 166 | 0.0602 | 1.23 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 7.8 | 216 | Total | | | |

## Subcatchment 6S: Subcatchment 6S



## Summary for Subcatchment 7S: Subcatchment 7S

Runoff = 4.89 cfs @ 12.21 hrs, Volume= 0.497 af, Depth= 2.85"

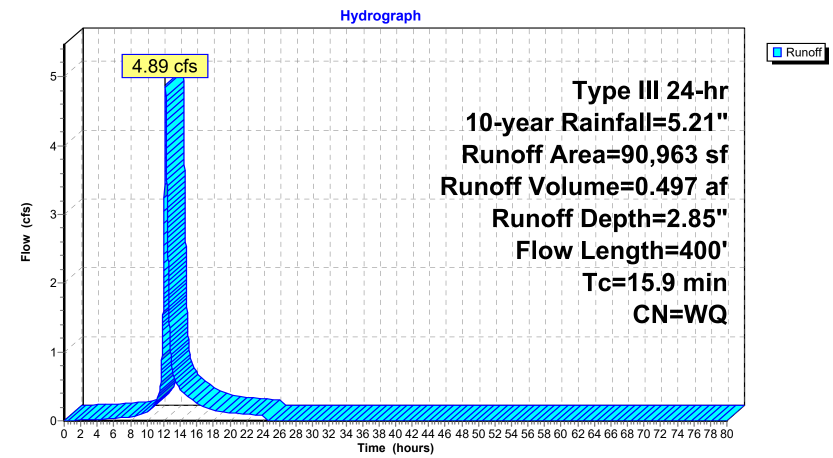
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 15,149 | 74 | >75% Grass cover, Good, HSG C |
| | 56,019 | 70 | Woods, Good, HSG C |
| * | 19,795 | 98 | Wetland |
| | 90,963 | | Weighted Average |
| | 71,168 | | 78.24% Pervious Area |
| | 19,795 | | 21.76% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.3 | 17 | 0.0788 | 0.21 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 8.7 | 33 | 0.0194 | 0.06 | | **Sheet Flow, B-C**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 5.9 | 316 | 0.0315 | 0.89 | | **Shallow Concentrated Flow, C-D**<br>Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, RCP_Round 24"**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, finished |
| 15.9 | 400 | Total | | | |



## Subcatchment 7S: Subcatchment 7S



## Summary for Subcatchment 8S: Subcatchment 6S

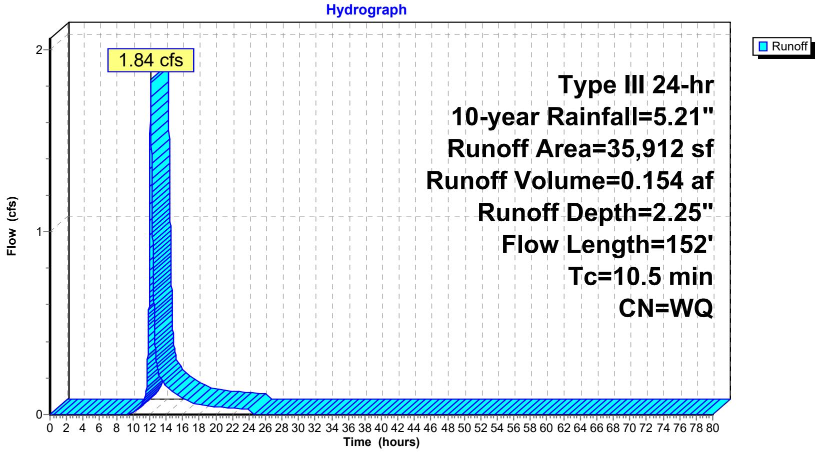
Runoff = 1.84 cfs @ 12.15 hrs, Volume= 0.154 af, Depth= 2.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| Area (sf) | CN | Description |
|---|---|---|
| 5,512 | 74 | >75% Grass cover, Good, HSG C |
| 30,400 | 70 | Woods, Good, HSG C |
| 35,912 | | Weighted Average |
| 35,912 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.3 | 50 | 0.0500 | 0.10 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.2 | 102 | 0.0245 | 0.78 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 10.5 | 152 | Total | | | |

### Subcatchment 8S: Subcatchment 6S






## Summary for Subcatchment 9S: Subcatchment 3S

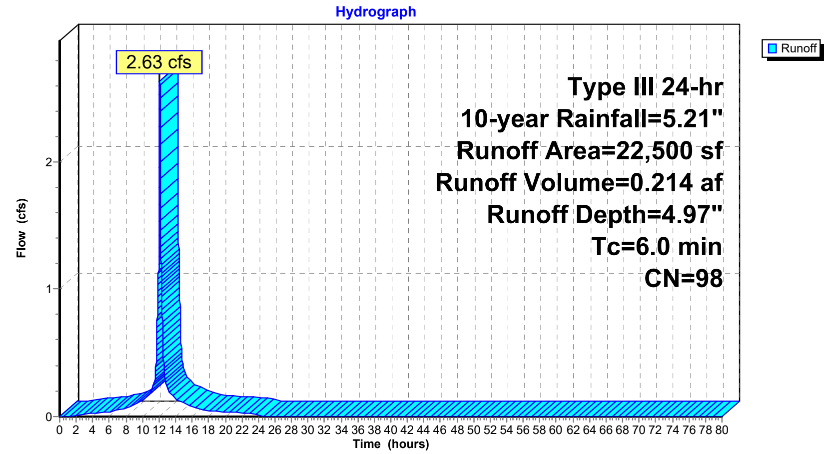
Runoff = 2.63 cfs @ 12.08 hrs, Volume= 0.214 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-year Rainfall=5.21"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 22,500 | 98 | Impervious |
| | 22,500 | | 100.00% Impervious Area |

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

### Subcatchment 9S: Subcatchment 3S



### Summary for Pond 1P: Detention System 1

Inflow Area = 3.735 ac,100.00% Impervious, Inflow Depth = 4.97" for 10-year event
Inflow = 19.04 cfs @ 12.08 hrs, Volume= 1.548 af
Outflow = 7.39 cfs @ 12.31 hrs, Volume= 1.548 af, Atten= 61%, Lag= 13.3 min
Primary = 7.39 cfs @ 12.31 hrs, Volume= 1.548 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 339.84' @ 12.31 hrs Surf.Area= 5,513 sf Storage= 16,285 cf

Plug-Flow detention time= 33.7 min calculated for 1.547 af (100% of inflow)
Center-of-Mass det. time= 33.8 min ( 781.1 - 747.3 )

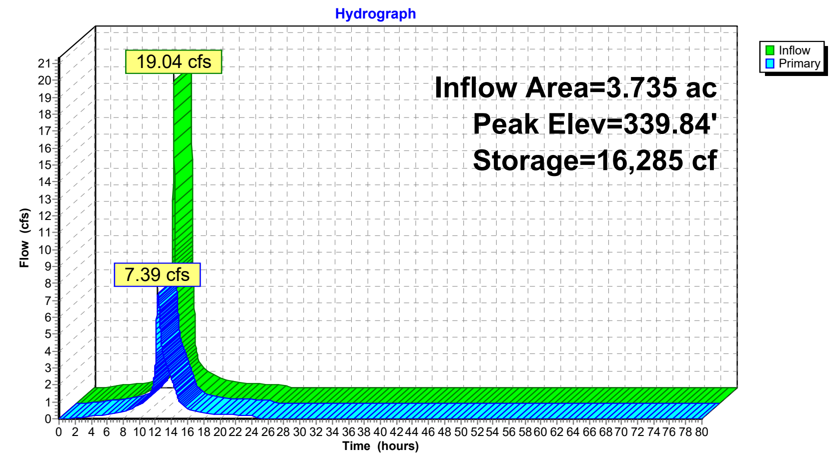
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 336.50' | 22,973 cf | **60.0" Round Pipe Storage**<br>L= 1,170.0' |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 336.50' | **30.0" Round Culvert** L= 52.0' Ke= 0.500<br>Inlet / Outlet Invert= 336.50' / 334.70' S= 0.0346 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 336.50' | **10.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 338.95' | **13.0" W x 6.0" H Vert. Orifice/Grate**<br>X 2 rows with 6.0" cc spacing C= 0.600 |
| #4 | Device 1 | 340.65' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=7.39 cfs @ 12.31 hrs HW=339.84' TW=334.61' (Dynamic Tailwater)
└1=**Culvert** (Passes 7.39 cfs of 34.14 cfs potential flow)
 ├2=**Orifice/Grate** (Orifice Controls 4.49 cfs @ 8.23 fps)
 ├3=**Orifice/Grate** (Orifice Controls 2.90 cfs @ 3.02 fps)
 └4=**Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)



### Pond 1P: Detention System 1



## Summary for Pond DMH 115: DMH 115

[57] Hint: Peaked at 335.02' (Flood elevation advised)

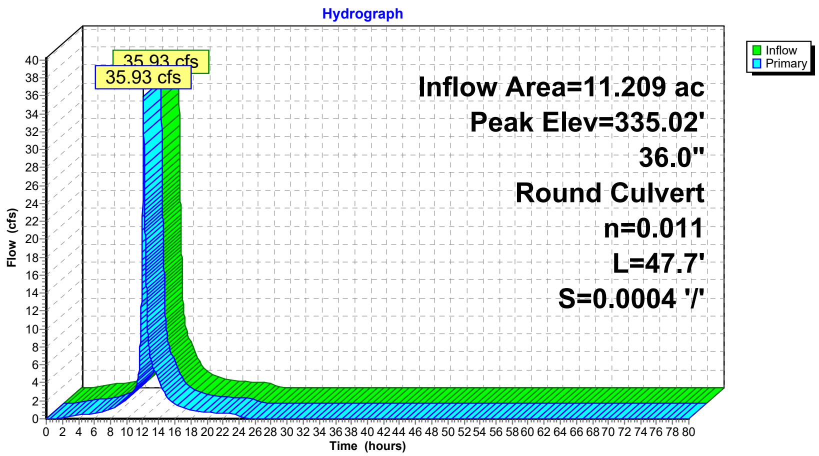
| | | | |
|---|---|---|---|
| Inflow Area = | 11.209 ac, 79.69% Impervious, Inflow Depth = 4.45" | for 10-year event | |
| Inflow = | 35.93 cfs @ 12.10 hrs, Volume= | 4.157 af | |
| Outflow = | 35.93 cfs @ 12.10 hrs, Volume= | 4.157 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 35.93 cfs @ 12.10 hrs, Volume= | 4.157 af | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 335.02' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 331.68' | **36.0" Round Culvert** L= 47.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.68' / 331.66' S= 0.0004 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=35.88 cfs @ 12.10 hrs HW=335.01' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 35.88 cfs @ 5.70 fps)

### Pond DMH 115: DMH 115






## Summary for Pond DMH 126: DMH 125

[57] Hint: Peaked at 336.12' (Flood elevation advised)

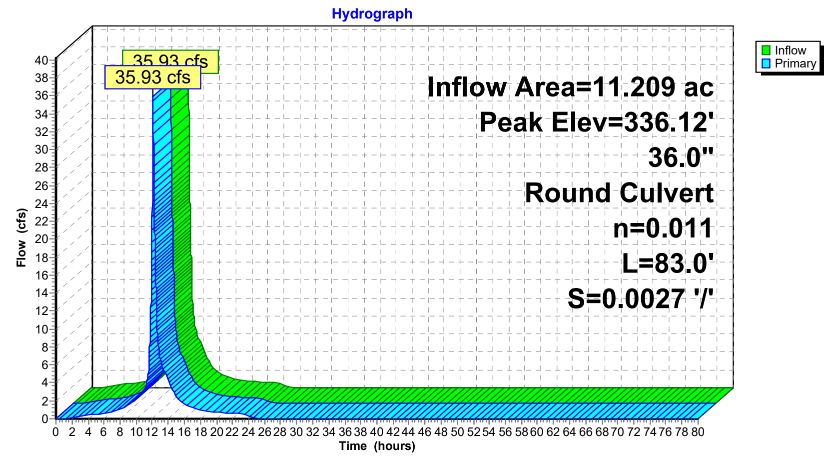
| | | | |
|---|---|---|---|
| Inflow Area = | 11.209 ac, 79.69% Impervious, Inflow Depth = 4.45" | for 10-year event | |
| Inflow = | 35.93 cfs @ 12.10 hrs, Volume= | 4.157 af | |
| Outflow = | 35.93 cfs @ 12.10 hrs, Volume= | 4.157 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 35.93 cfs @ 12.10 hrs, Volume= | 4.157 af | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 336.12' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 332.00' | **36.0" Round Culvert** L= 83.0' Ke= 0.500<br>Inlet / Outlet Invert= 332.00' / 331.78' S= 0.0027 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=35.67 cfs @ 12.10 hrs HW=336.11' TW=335.01' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 35.67 cfs @ 5.05 fps)

### Pond DMH 126: DMH 125



## Summary for Pond INF 1: Inf System #1

[80] Warning: Exceeded Pond OCS1 by 8.84' @ 24.34 hrs (1.26 cfs 0.576 af)

Inflow Area = 1.865 ac, 90.37% Impervious, Inflow Depth = 1.39" for 10-year event
Inflow = 1.15 cfs @ 12.06 hrs, Volume= 0.216 af
Outflow = 0.07 cfs @ 4.31 hrs, Volume= 0.216 af, Atten= 94%, Lag= 0.0 min
Discarded = 0.07 cfs @ 4.31 hrs, Volume= 0.216 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.92' @ 12.13 hrs Surf.Area= 2,800 sf Storage= 5,330 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 653.3 min ( 1,305.9 - 652.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 338.30' | 2,266 cf | **Crushed Stone (Prismatic)**Listed below (Recalc)<br>9,800 cf Overall - 4,135 cf Embedded = 5,665 cf x 40.0% Voids |
| #2 | 338.80' | 4,135 cf | **ADS_StormTech SC-740 +Cap** x 90 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>90 Chambers in 9 Rows |
| | | 6,401 cf | Total Available Storage |

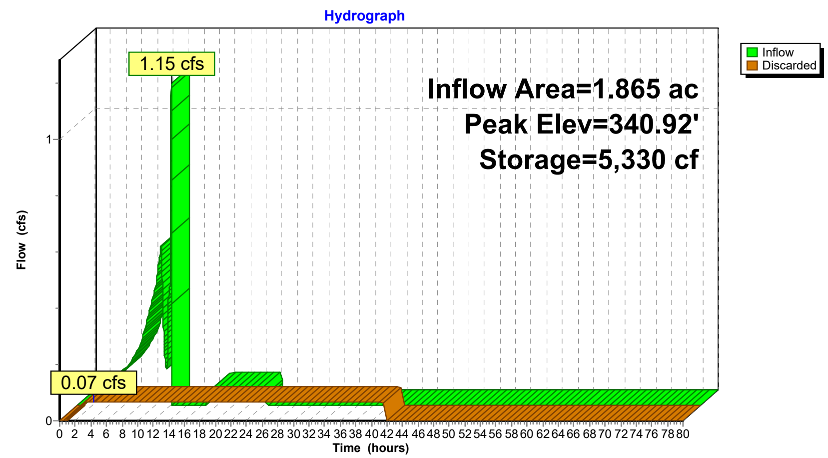
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 338.30 | 2,800 | 0 | 0 |
| 341.80 | 2,800 | 9,800 | 9,800 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 338.30' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.07 cfs @ 4.31 hrs HW=338.34' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)



## Pond INF 1: Inf System #1



## Summary for Pond OCS1: OCS 1

[57] Hint: Peaked at 340.93' (Flood elevation advised)

Inflow Area = 1.865 ac, 90.37% Impervious, Inflow Depth = 4.74" for 10-year event
Inflow = 9.12 cfs @ 12.08 hrs, Volume= 0.736 af
Outflow = 9.12 cfs @ 12.08 hrs, Volume= 0.736 af, Atten= 0%, Lag= 0.0 min
Primary = 1.15 cfs @ 12.06 hrs, Volume= 0.216 af
Secondary = 8.16 cfs @ 12.09 hrs, Volume= 0.520 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.93' @ 12.09 hrs

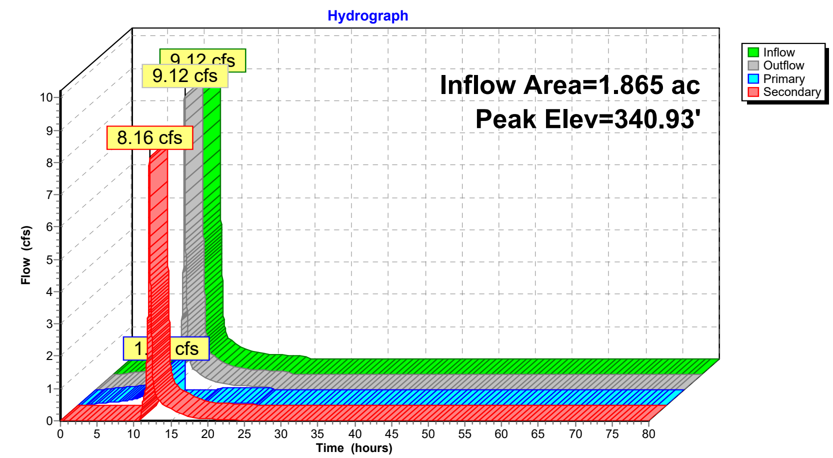
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.69' | **12.0" Round Culvert** L= 81.0' Ke= 0.500<br>Inlet / Outlet Invert= 339.69' / 338.50' S= 0.0147 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 0.79 sf |
| #2 | Secondary | 331.44' | **24.0" Round Culvert** L= 50.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.44' / 330.94' S= 0.0099 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 3.14 sf |
| #3 | Device 2 | 340.30' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=1.02 cfs @ 12.06 hrs HW=340.89' TW=340.81' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.02 cfs @ 1.37 fps)

**Secondary OutFlow** Max=8.14 cfs @ 12.09 hrs HW=340.93' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 8.14 cfs of 44.07 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 8.14 cfs @ 2.59 fps)



## Pond OCS1: OCS 1



## Summary for Pond PMF 1: PMF 1

[57] Hint: Peaked at 336.70' (Flood elevation advised)

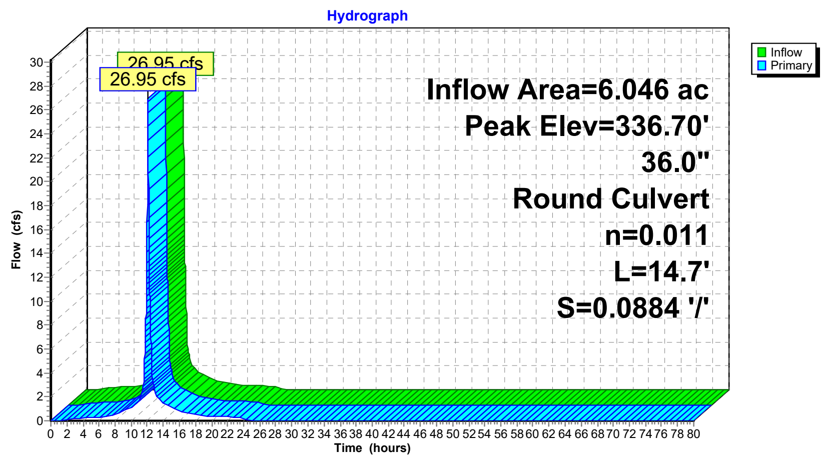
```
Inflow Area =      6.046 ac,  71.70% Impervious,  Inflow Depth =  4.26"   for  10-year event
Inflow      =     26.95 cfs @  12.08 hrs,  Volume=        2.144 af
Outflow     =     26.95 cfs @  12.08 hrs,  Volume=        2.144 af,  Atten= 0%,  Lag= 0.0 min
Primary     =     26.95 cfs @  12.08 hrs,  Volume=        2.144 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 336.70' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 333.40' | **36.0" Round Culvert** L= 14.7' Ke= 0.500<br>Inlet / Outlet Invert= 333.40' / 332.10' S= 0.0884 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=24.61 cfs @ 12.08 hrs HW=336.57' TW=336.05' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 24.61 cfs @ 3.48 fps)

### Pond PMF 1: PMF 1






## Summary for Pond WQU 2: WQU 2

[57] Hint: Peaked at 337.27' (Flood elevation advised)

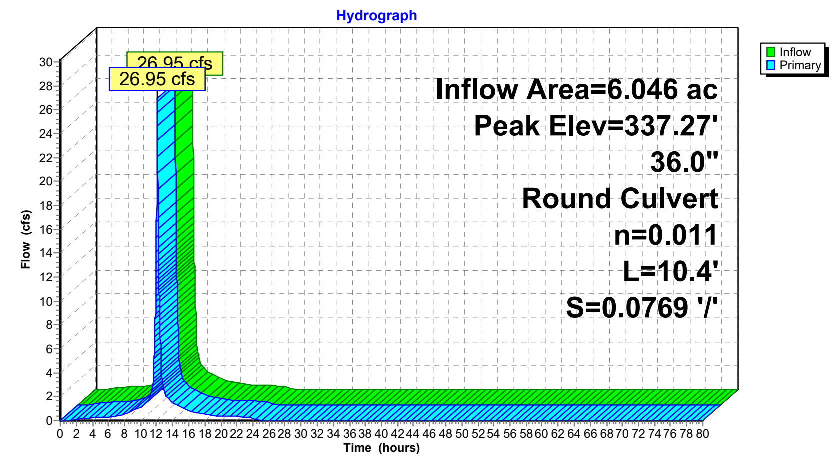
```
Inflow Area =      6.046 ac,  71.70% Impervious,  Inflow Depth =  4.26"   for  10-year event
Inflow      =     26.95 cfs @  12.08 hrs,  Volume=        2.144 af
Outflow     =     26.95 cfs @  12.08 hrs,  Volume=        2.144 af,  Atten= 0%,  Lag= 0.0 min
Primary     =     26.95 cfs @  12.08 hrs,  Volume=        2.144 af
```

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 337.27' @ 12.11 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 334.30' | **36.0" Round Culvert** L= 10.4' Ke= 0.500<br>Inlet / Outlet Invert= 334.30' / 333.50' S= 0.0769 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=23.64 cfs @ 12.08 hrs HW=337.09' TW=336.57' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 23.64 cfs @ 3.45 fps)

### Pond WQU 2: WQU 2

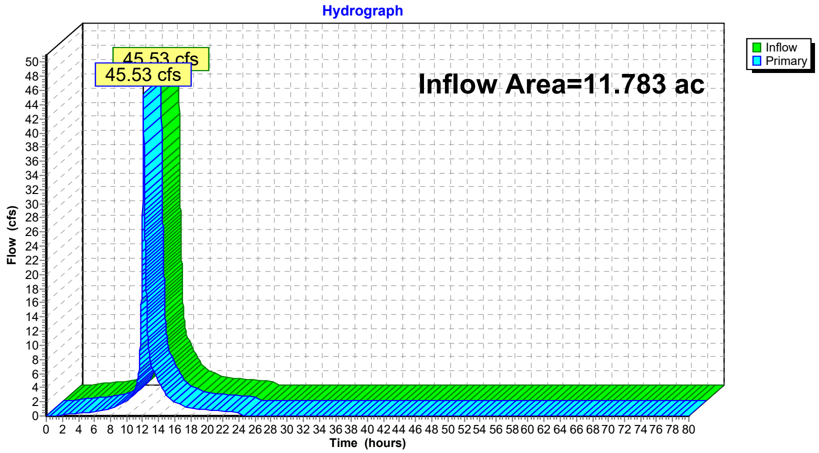


## Summary for Link POA1: P.O.A. #1

Inflow Area = 11.783 ac, 75.80% Impervious, Inflow Depth = 4.88" for 10-year event
Inflow = 45.53 cfs @ 12.10 hrs, Volume= 4.790 af
Primary = 45.53 cfs @ 12.10 hrs, Volume= 4.790 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA1: P.O.A. #1



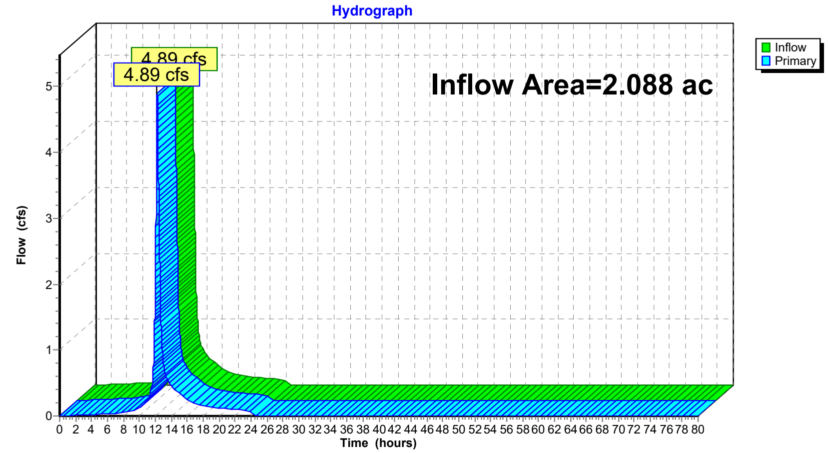



## Summary for Link POA2: P.O.A. #2

Inflow Area = 2.088 ac, 21.76% Impervious, Inflow Depth = 2.85" for 10-year event
Inflow = 4.89 cfs @ 12.21 hrs, Volume= 0.497 af
Primary = 4.89 cfs @ 12.21 hrs, Volume= 0.497 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA2: P.O.A. #2

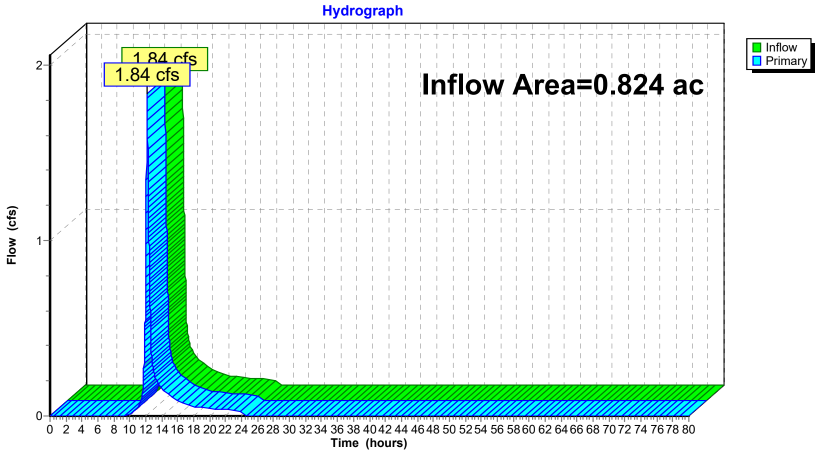


### Summary for Link POA3: P.O.A. #3

Inflow Area = 0.824 ac, 0.00% Impervious, Inflow Depth = 2.25" for 10-year event
Inflow = 1.84 cfs @ 12.15 hrs, Volume= 0.154 af
Primary = 1.84 cfs @ 12.15 hrs, Volume= 0.154 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA3: P.O.A. #3






Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S** Runoff Area=102,375 sf 100.00% Impervious Runoff Depth=6.13"
Tc=6.0 min CN=98 Runoff=14.68 cfs 1.201 af

**Subcatchment 2S: Subcatchment 2S** Runoff Area=60,300 sf 100.00% Impervious Runoff Depth=6.13"
Tc=6.0 min CN=98 Runoff=8.65 cfs 0.707 af

**Subcatchment 3S: Subcatchment 3S** Runoff Area=58,760 sf 86.68% Impervious Runoff Depth=5.78"
Tc=6.0 min CN=WQ Runoff=8.03 cfs 0.649 af

**Subcatchment 4S: Subcatchment 4S** Runoff Area=263,351 sf 71.70% Impervious Runoff Depth=5.35"
Tc=6.0 min CN=WQ Runoff=33.85 cfs 2.698 af

**Subcatchment 5S: Subcatchment 5S** Runoff Area=62,236 sf 60.40% Impervious Runoff Depth=4.97"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=6.72 cfs 0.592 af

**Subcatchment 6S: Subcatchment 6S** Runoff Area=25,017 sf 0.00% Impervious Runoff Depth=3.31"
Flow Length=216' Tc=7.8 min CN=WQ Runoff=2.09 cfs 0.158 af

**Subcatchment 7S: Subcatchment 7S** Runoff Area=90,963 sf 21.76% Impervious Runoff Depth=3.83"
Flow Length=400' Tc=15.9 min CN=WQ Runoff=6.62 cfs 0.666 af

**Subcatchment 8S: Subcatchment 6S** Runoff Area=35,912 sf 0.00% Impervious Runoff Depth=3.16"
Flow Length=152' Tc=10.5 min CN=WQ Runoff=2.62 cfs 0.217 af

**Subcatchment 9S: Subcatchment 3S** Runoff Area=22,500 sf 100.00% Impervious Runoff Depth=6.13"
Tc=6.0 min CN=98 Runoff=3.23 cfs 0.264 af

**Pond 1P: Detention System 1** Peak Elev=340.44' Storage=19,399 cf Inflow=23.32 cfs 1.908 af
Outflow=10.05 cfs 1.908 af

**Pond DMH 115: DMH 115** Peak Elev=335.81' Inflow=46.01 cfs 5.198 af
36.0" Round Culvert n=0.011 L=47.7' S=0.0004 '/' Outflow=46.01 cfs 5.198 af

**Pond DMH 126: DMH 125** Peak Elev=337.63' Inflow=46.01 cfs 5.198 af
36.0" Round Culvert n=0.011 L=83.0' S=0.0027 '/' Outflow=46.01 cfs 5.198 af

**Pond INF 1: Inf System #1** Peak Elev=341.02' Storage=5,487 cf Inflow=1.25 cfs 0.219 af
Outflow=0.07 cfs 0.219 af

**Pond OCS1: OCS 1** Peak Elev=341.03' Inflow=11.26 cfs 0.913 af
Primary=1.25 cfs 0.219 af Secondary=10.24 cfs 0.694 af Outflow=11.26 cfs 0.913 af

**Pond PMF 1: PMF 1** Peak Elev=338.54' Inflow=33.85 cfs 2.698 af
36.0" Round Culvert n=0.011 L=14.7' S=0.0884 '/' Outflow=33.85 cfs 2.698 af

**Pond WQU 2: WQU 2** Peak Elev=339.45' Inflow=33.85 cfs 2.698 af
36.0" Round Culvert n=0.011 L=10.4' S=0.0769 '/' Outflow=33.85 cfs 2.698 af

**Link POA1: P.O.A. #1** Inflow=58.28 cfs 6.050 af
Primary=58.28 cfs 6.050 af

**Link POA2: P.O.A. #2** Inflow=6.62 cfs 0.666 af
Primary=6.62 cfs 0.666 af

**Link POA3: P.O.A. #3** Inflow=2.62 cfs 0.217 af
Primary=2.62 cfs 0.217 af

**Total Runoff Area = 16.561 ac Runoff Volume = 7.153 af Average Runoff Depth = 5.18"**
**33.14% Pervious = 5.489 ac 66.86% Impervious = 11.072 ac**



## Summary for Subcatchment 1S: Subcatchment 1S

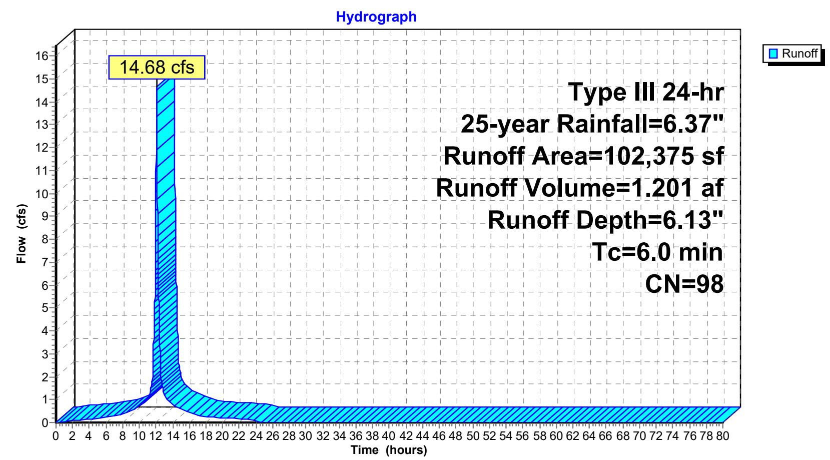
Runoff = 14.68 cfs @ 12.08 hrs, Volume= 1.201 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 102,375 | 98 | Building/Impervious |
| | 102,375 | | 100.00% Impervious Area |

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

### Subcatchment 1S: Subcatchment 1S



### Summary for Subcatchment 2S: Subcatchment 2S

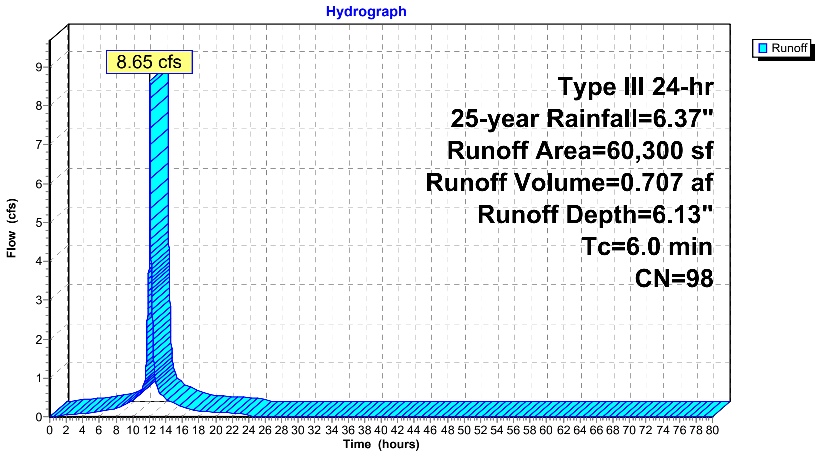
Runoff = 8.65 cfs @ 12.08 hrs, Volume= 0.707 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 60,300 | 98 | Impervious |
| | 60,300 | | 100.00% Impervious Area |

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

### Subcatchment 2S: Subcatchment 2S






### Summary for Subcatchment 3S: Subcatchment 3S

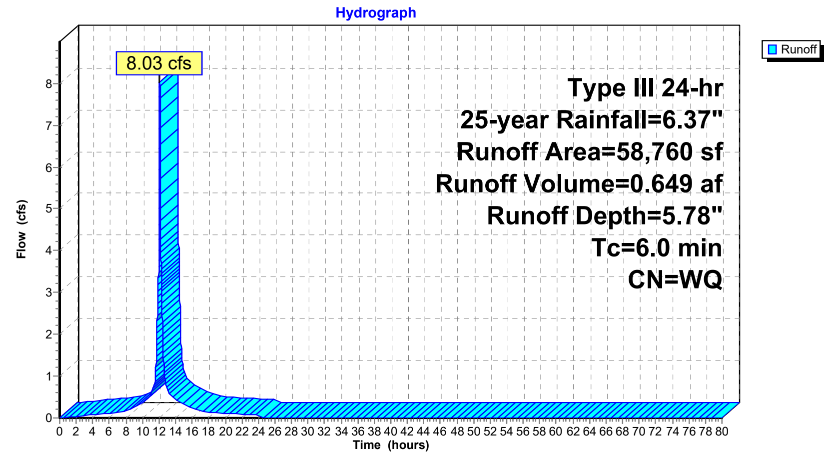
Runoff = 8.03 cfs @ 12.08 hrs, Volume= 0.649 af, Depth= 5.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 50,932 | 98 | Impervious |
| | 7,322 | 74 | >75% Grass cover, Good, HSG C |
| | 506 | 70 | Woods, Good, HSG C |
| | 58,760 | | Weighted Average |
| | 7,828 | | 13.32% Pervious Area |
| | 50,932 | | 86.68% Impervious Area |

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

### Subcatchment 3S: Subcatchment 3S



### Summary for Subcatchment 4S: Subcatchment 4S

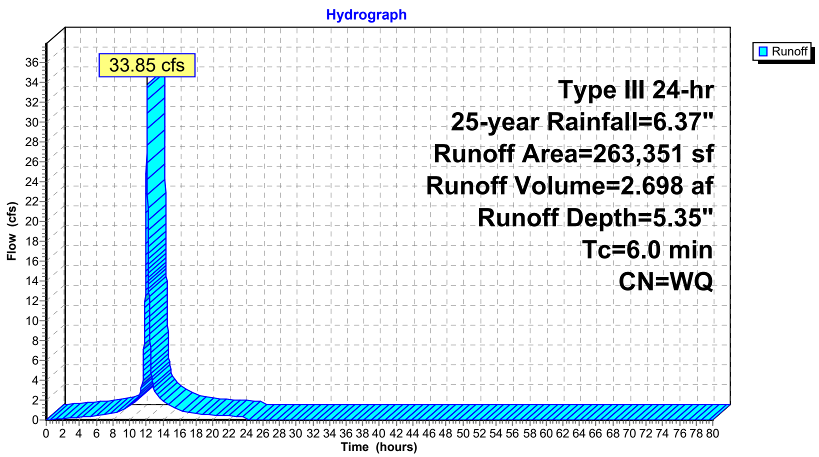
Runoff = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af, Depth= 5.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 188,818 | 98 | Impervious |
| | 53,700 | 74 | >75% Grass cover, Good, HSG C |
| | 20,833 | 70 | Woods, Good, HSG C |
| | 263,351 | | Weighted Average |
| | 74,533 | | 28.30% Pervious Area |
| | 188,818 | | 71.70% Impervious Area |

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

### Subcatchment 4S: Subcatchment 4S






### Summary for Subcatchment 5S: Subcatchment 5S

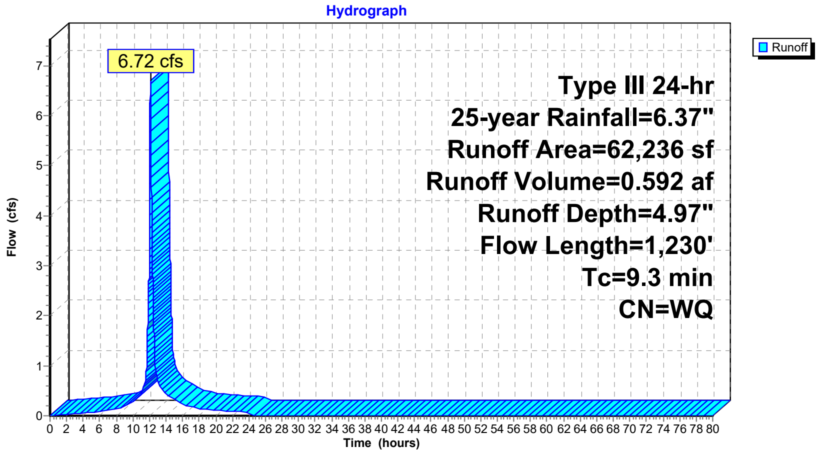
Runoff = 6.72 cfs @ 12.13 hrs, Volume= 0.592 af, Depth= 4.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 37,592 | 98 | Impervious |
| | 6,102 | 74 | >75% Grass cover, Good, HSG C |
| | 18,542 | 70 | Woods, Good, HSG C |
| | 62,236 | | Weighted Average |
| | 24,644 | | 39.60% Pervious Area |
| | 37,592 | | 60.40% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

## Subcatchment 5S: Subcatchment 5S






## Summary for Subcatchment 6S: Subcatchment 6S

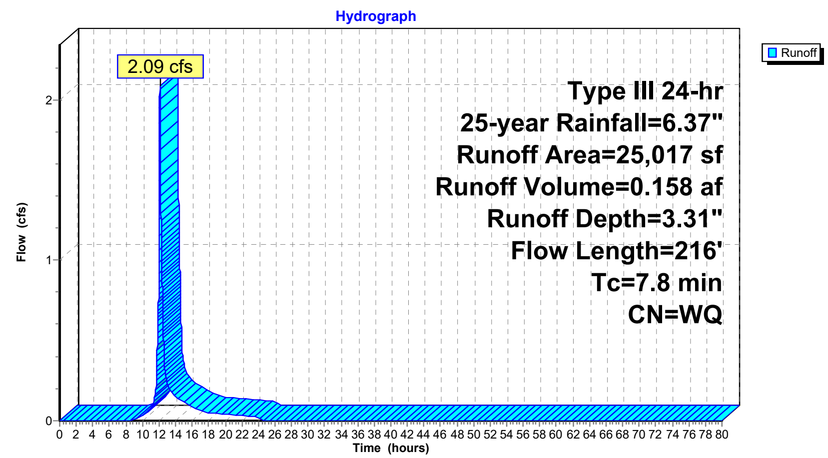
Runoff = 2.09 cfs @ 12.11 hrs, Volume= 0.158 af, Depth= 3.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| Area (sf) | CN | Description |
|---|---|---|
| 13,156 | 74 | >75% Grass cover, Good, HSG C |
| 11,861 | 70 | Woods, Good, HSG C |
| 25,017 | | Weighted Average |
| 25,017 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.8 | 20 | 0.0486 | 0.18 | | **Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36" |
| 3.7 | 30 | 0.1333 | 0.13 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.3 | 166 | 0.0602 | 1.23 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 7.8 | 216 | Total | | | |

## Subcatchment 6S: Subcatchment 6S



## Summary for Subcatchment 7S: Subcatchment 7S

Runoff = 6.62 cfs @ 12.21 hrs, Volume= 0.666 af, Depth= 3.83"

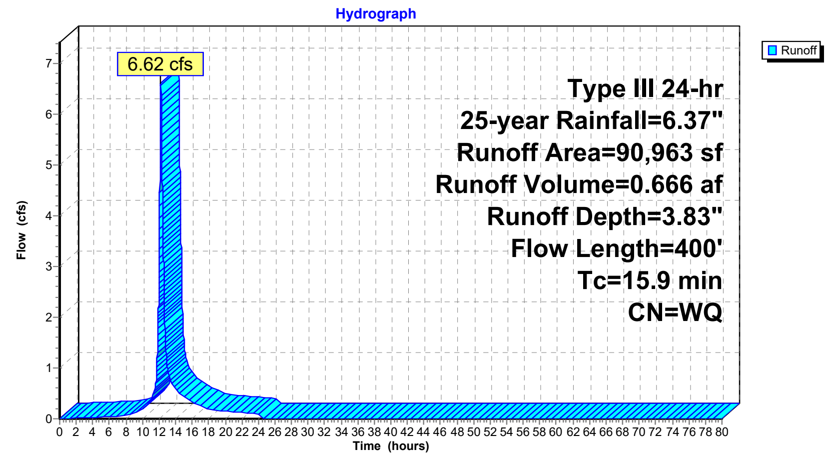
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 15,149 | 74 | >75% Grass cover, Good, HSG C |
| | 56,019 | 70 | Woods, Good, HSG C |
| * | 19,795 | 98 | Wetland |
| | 90,963 | | Weighted Average |
| | 71,168 | | 78.24% Pervious Area |
| | 19,795 | | 21.76% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.3 | 17 | 0.0788 | 0.21 | | **Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36" |
| 8.7 | 33 | 0.0194 | 0.06 | | **Sheet Flow, B-C** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 5.9 | 316 | 0.0315 | 0.89 | | **Shallow Concentrated Flow, C-D** Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, RCP_Round 24"** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.011 Concrete pipe, finished |
| 15.9 | 400 | Total | | | |



## Subcatchment 7S: Subcatchment 7S



### Summary for Subcatchment 8S: Subcatchment 6S

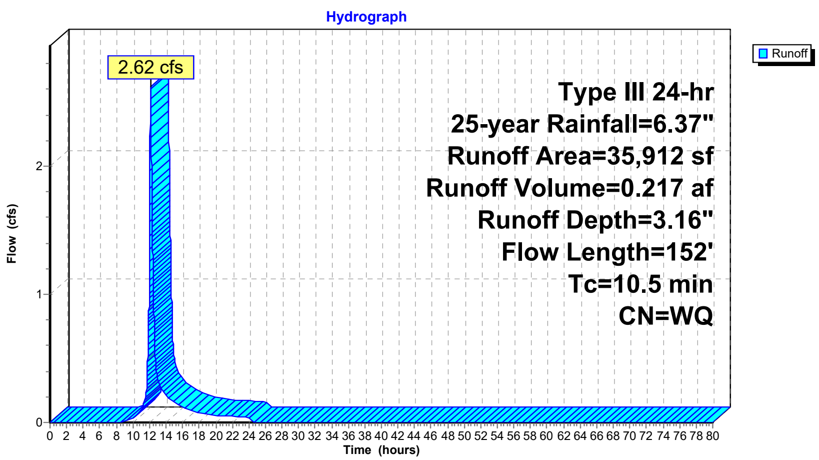
Runoff = 2.62 cfs @ 12.15 hrs, Volume= 0.217 af, Depth= 3.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| Area (sf) | CN | Description |
|---|---|---|
| 5,512 | 74 | >75% Grass cover, Good, HSG C |
| 30,400 | 70 | Woods, Good, HSG C |
| 35,912 | | Weighted Average |
| 35,912 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.3 | 50 | 0.0500 | 0.10 | | **Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.2 | 102 | 0.0245 | 0.78 | | **Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps |
| 10.5 | 152 | Total | | | |

### Subcatchment 8S: Subcatchment 6S






### Summary for Subcatchment 9S: Subcatchment 3S

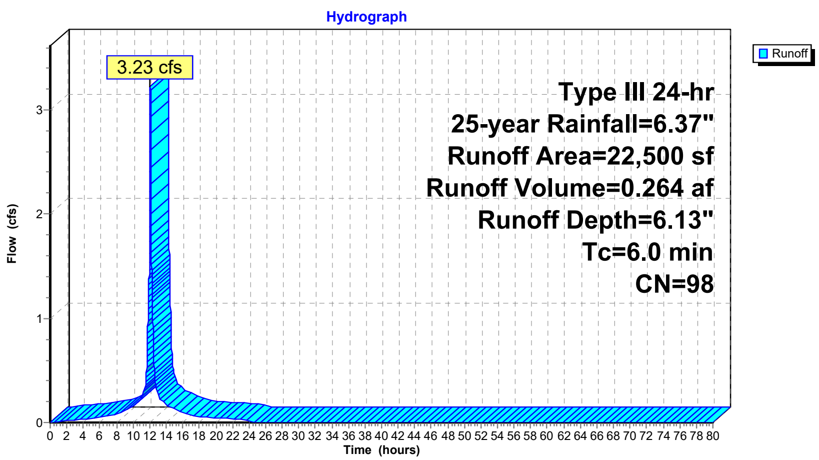
Runoff = 3.23 cfs @ 12.08 hrs, Volume= 0.264 af, Depth= 6.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-year Rainfall=6.37"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 22,500 | 98 | Impervious |
| | 22,500 | | 100.00% Impervious Area |

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

### Subcatchment 9S: Subcatchment 3S



## Summary for Pond 1P: Detention System 1

Inflow Area = 3.735 ac,100.00% Impervious, Inflow Depth = 6.13" for 25-year event
Inflow = 23.32 cfs @ 12.08 hrs, Volume= 1.908 af
Outflow = 10.05 cfs @ 12.27 hrs, Volume= 1.908 af, Atten= 57%, Lag= 11.1 min
Primary = 10.05 cfs @ 12.27 hrs, Volume= 1.908 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.44' @ 12.27 hrs Surf.Area= 4,789 sf Storage= 19,399 cf

Plug-Flow detention time= 32.8 min calculated for 1.908 af (100% of inflow)
Center-of-Mass det. time= 32.8 min ( 777.1 - 744.3 )

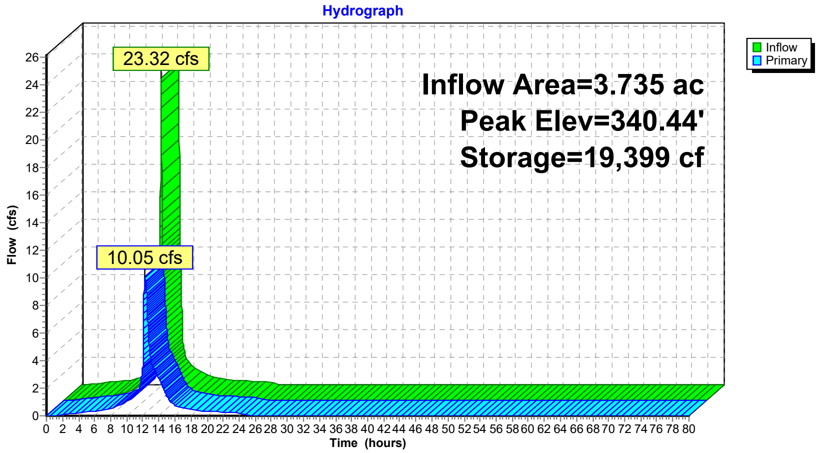
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 336.50' | 22,973 cf | **60.0" Round Pipe Storage** L= 1,170.0' |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 336.50' | **30.0" Round Culvert** L= 52.0' Ke= 0.500 Inlet / Outlet Invert= 336.50' / 334.70' S= 0.0346 '/' Cc= 0.900 n= 0.011 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 336.50' | **10.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 338.95' | **13.0" W x 6.0" H Vert. Orifice/Grate** X 2 rows with 6.0" cc spacing C= 0.600 |
| #4 | Device 1 | 340.65' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=10.05 cfs @ 12.27 hrs HW=340.44' TW=335.34' (Dynamic Tailwater)
└─**1=Culvert** (Passes 10.05 cfs of 38.73 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 4.93 cfs @ 9.03 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 5.12 cfs @ 4.73 fps)
  └─**4=Sharp-Crested Rectangular Weir** ( Controls 0.00 cfs)



## Pond 1P: Detention System 1



## Summary for Pond DMH 115: DMH 115

[57] Hint: Peaked at 335.81' (Flood elevation advised)

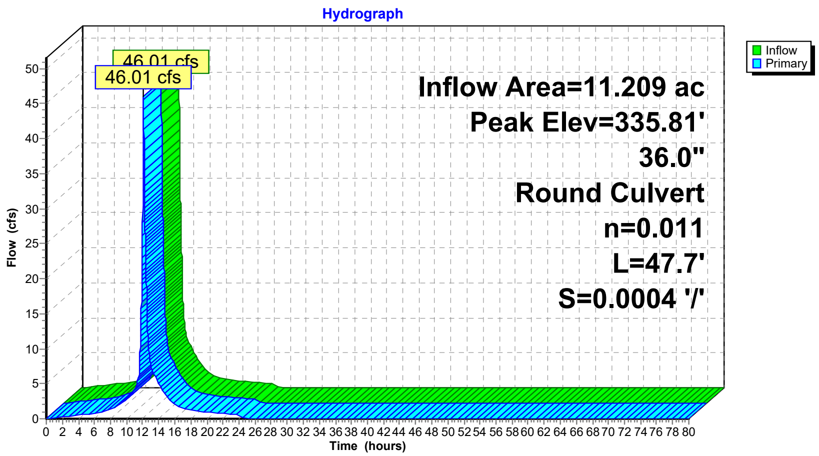
Inflow Area = 11.209 ac, 79.69% Impervious, Inflow Depth = 5.56" for 25-year event
Inflow = 46.01 cfs @ 12.10 hrs, Volume= 5.198 af
Outflow = 46.01 cfs @ 12.10 hrs, Volume= 5.198 af, Atten= 0%, Lag= 0.0 min
Primary = 46.01 cfs @ 12.10 hrs, Volume= 5.198 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 335.81' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 331.68' | **36.0" Round Culvert** L= 47.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.68' / 331.66' S= 0.0004 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=45.99 cfs @ 12.10 hrs HW=335.81' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 45.99 cfs @ 6.51 fps)

### Pond DMH 115: DMH 115






## Summary for Pond DMH 126: DMH 125

[57] Hint: Peaked at 337.63' (Flood elevation advised)

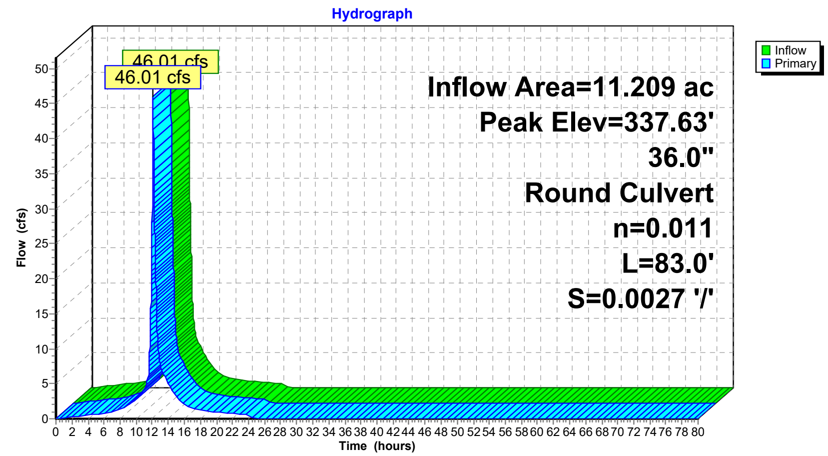
Inflow Area = 11.209 ac, 79.69% Impervious, Inflow Depth = 5.56" for 25-year event
Inflow = 46.01 cfs @ 12.10 hrs, Volume= 5.198 af
Outflow = 46.01 cfs @ 12.10 hrs, Volume= 5.198 af, Atten= 0%, Lag= 0.0 min
Primary = 46.01 cfs @ 12.10 hrs, Volume= 5.198 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 337.63' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 332.00' | **36.0" Round Culvert** L= 83.0' Ke= 0.500<br>Inlet / Outlet Invert= 332.00' / 331.78' S= 0.0027 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=45.85 cfs @ 12.10 hrs HW=337.62' TW=335.81' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 45.85 cfs @ 6.49 fps)

### Pond DMH 126: DMH 125



## Summary for Pond INF 1: Inf System #1

[80] Warning: Exceeded Pond OCS1 by 8.85' @ 24.32 hrs (1.29 cfs 0.714 af)

Inflow Area = 1.865 ac, 90.37% Impervious, Inflow Depth = 1.41" for 25-year event
Inflow = 1.25 cfs @ 12.05 hrs, Volume= 0.219 af
Outflow = 0.07 cfs @ 3.33 hrs, Volume= 0.219 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.07 cfs @ 3.33 hrs, Volume= 0.219 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 341.02' @ 12.13 hrs Surf.Area= 2,800 sf Storage= 5,487 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 676.4 min ( 1,292.3 - 615.8 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 338.30' | 2,266 cf | **Crushed Stone (Prismatic)**Listed below (Recalc)<br>9,800 cf Overall - 4,135 cf Embedded = 5,665 cf x 40.0% Voids |
| #2 | 338.80' | 4,135 cf | **ADS_StormTech SC-740 +Cap** x 90 Inside #1<br>Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf<br>Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap<br>90 Chambers in 9 Rows |
| | | 6,401 cf | Total Available Storage |

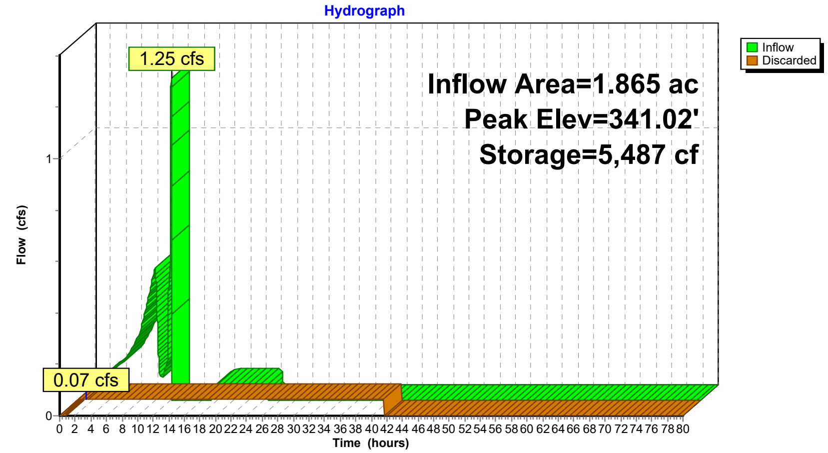
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 338.30 | 2,800 | 0 | 0 |
| 341.80 | 2,800 | 9,800 | 9,800 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 338.30' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.07 cfs @ 3.33 hrs HW=338.34' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.07 cfs)



## Pond INF 1: Inf System #1



## Summary for Pond OCS1: OCS 1

[57] Hint: Peaked at 341.03' (Flood elevation advised)

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 1.865 ac, | 90.37% Impervious, | Inflow Depth = 5.88" | for 25-year event | |
| Inflow = | 11.26 cfs @ | 12.08 hrs, | Volume= | 0.913 af | |
| Outflow = | 11.26 cfs @ | 12.08 hrs, | Volume= | 0.913 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 1.25 cfs @ | 12.05 hrs, | Volume= | 0.219 af | |
| Secondary = | 10.24 cfs @ | 12.09 hrs, | Volume= | 0.694 af | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 341.03' @ 12.09 hrs

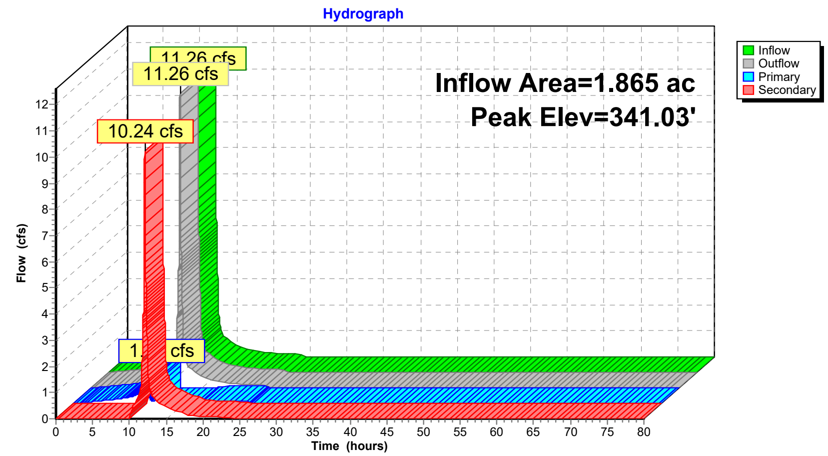
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.69' | **12.0" Round Culvert** L= 81.0' Ke= 0.500<br>Inlet / Outlet Invert= 339.69' / 338.50' S= 0.0147 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 0.79 sf |
| #2 | Secondary | 331.44' | **24.0" Round Culvert** L= 50.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.44' / 330.94' S= 0.0099 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 3.14 sf |
| #3 | Device 2 | 340.30' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=1.12 cfs @ 12.05 hrs HW=340.98' TW=340.88' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.12 cfs @ 1.44 fps)

**Secondary OutFlow** Max=10.23 cfs @ 12.09 hrs HW=341.03' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 10.23 cfs of 44.34 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 10.23 cfs @ 2.80 fps)



## Pond OCS1: OCS 1



## Summary for Pond PMF 1: PMF 1

[57] Hint: Peaked at 338.54' (Flood elevation advised)

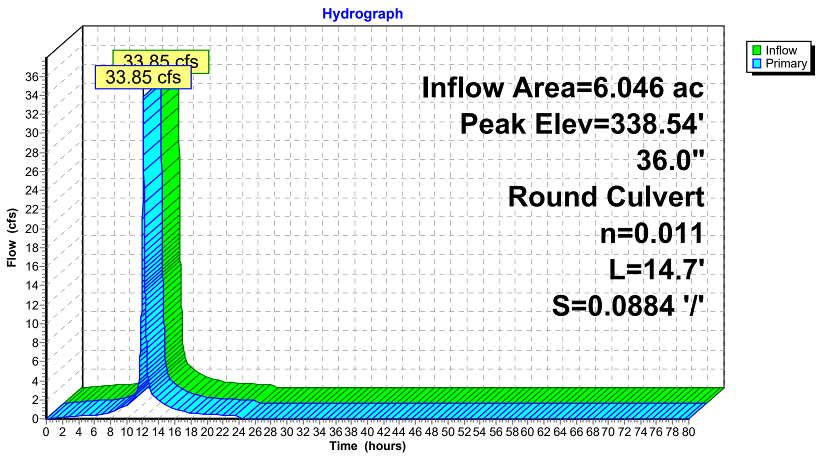
Inflow Area = 6.046 ac, 71.70% Impervious, Inflow Depth = 5.35" for 25-year event
Inflow = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af
Outflow = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af, Atten= 0%, Lag= 0.0 min
Primary = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 338.54' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 333.40' | **36.0" Round Culvert** L= 14.7' Ke= 0.500<br>Inlet / Outlet Invert= 333.40' / 332.10' S= 0.0884 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=30.23 cfs @ 12.08 hrs HW=338.32' TW=337.53' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 30.23 cfs @ 4.28 fps)

### Pond PMF 1: PMF 1






## Summary for Pond WQU 2: WQU 2

[57] Hint: Peaked at 339.45' (Flood elevation advised)

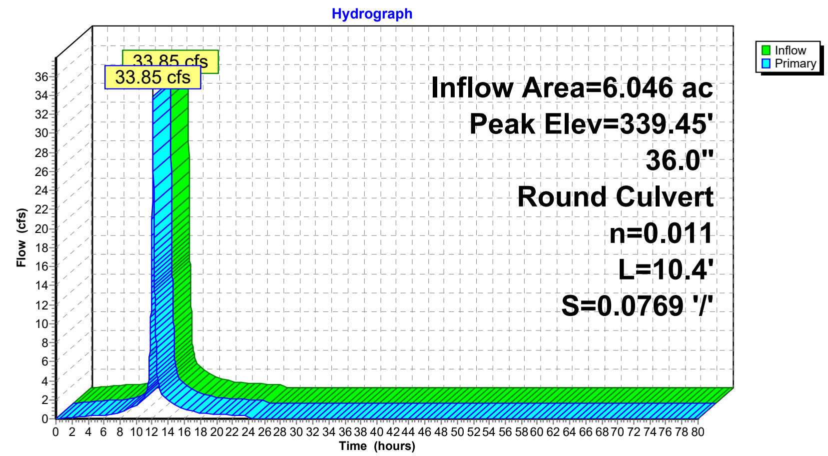
Inflow Area = 6.046 ac, 71.70% Impervious, Inflow Depth = 5.35" for 25-year event
Inflow = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af
Outflow = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af, Atten= 0%, Lag= 0.0 min
Primary = 33.85 cfs @ 12.08 hrs, Volume= 2.698 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 339.45' @ 12.11 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 334.30' | **36.0" Round Culvert** L= 10.4' Ke= 0.500<br>Inlet / Outlet Invert= 334.30' / 333.50' S= 0.0769 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=27.66 cfs @ 12.08 hrs HW=338.98' TW=338.32' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 27.66 cfs @ 3.91 fps)

### Pond WQU 2: WQU 2

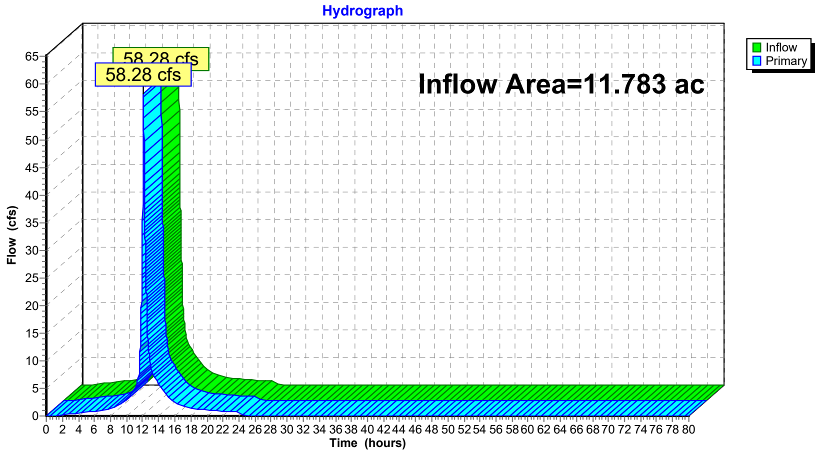


## Summary for Link POA1: P.O.A. #1

Inflow Area = 11.783 ac, 75.80% Impervious, Inflow Depth = 6.16" for 25-year event
Inflow = 58.28 cfs @ 12.10 hrs, Volume= 6.050 af
Primary = 58.28 cfs @ 12.10 hrs, Volume= 6.050 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA1: P.O.A. #1



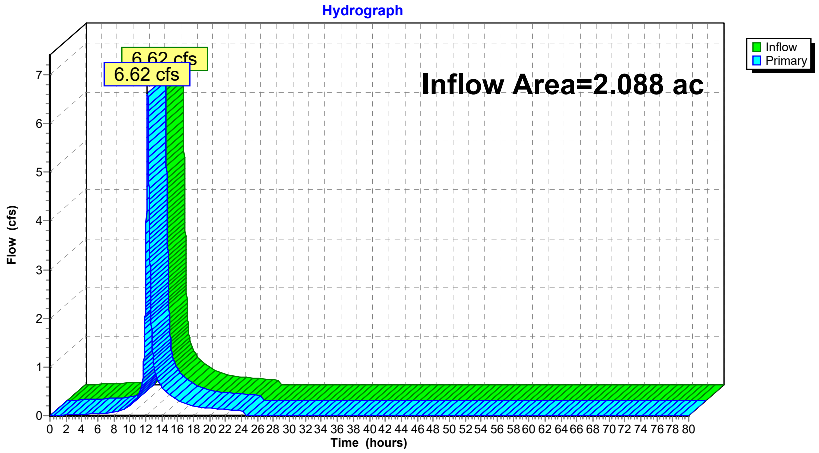



## Summary for Link POA2: P.O.A. #2

Inflow Area = 2.088 ac, 21.76% Impervious, Inflow Depth = 3.83" for 25-year event
Inflow = 6.62 cfs @ 12.21 hrs, Volume= 0.666 af
Primary = 6.62 cfs @ 12.21 hrs, Volume= 0.666 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA2: P.O.A. #2

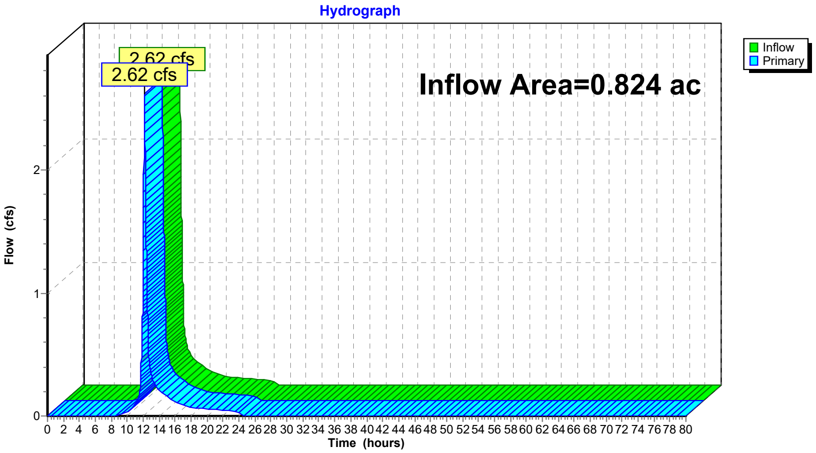


### Summary for Link POA3: P.O.A. #3

Inflow Area = 0.824 ac, 0.00% Impervious, Inflow Depth = 3.16" for 25-year event
Inflow = 2.62 cfs @ 12.15 hrs, Volume= 0.217 af
Primary = 2.62 cfs @ 12.15 hrs, Volume= 0.217 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA3: P.O.A. #3






Time span=0.00-80.00 hrs, dt=0.01 hrs, 8001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: Subcatchment 1S** Runoff Area=102,375 sf 100.00% Impervious Runoff Depth=7.91"
Tc=6.0 min CN=98 Runoff=18.81 cfs 1.549 af

**Subcatchment 2S: Subcatchment 2S** Runoff Area=60,300 sf 100.00% Impervious Runoff Depth=7.91"
Tc=6.0 min CN=98 Runoff=11.08 cfs 0.912 af

**Subcatchment 3S: Subcatchment 3S** Runoff Area=58,760 sf 86.68% Impervious Runoff Depth=7.53"
Tc=6.0 min CN=WQ Runoff=10.41 cfs 0.846 af

**Subcatchment 4S: Subcatchment 4S** Runoff Area=263,351 sf 71.70% Impervious Runoff Depth=7.07"
Tc=6.0 min CN=WQ Runoff=44.54 cfs 3.560 af

**Subcatchment 5S: Subcatchment 5S** Runoff Area=62,236 sf 60.40% Impervious Runoff Depth=6.64"
Flow Length=1,230' Tc=9.3 min CN=WQ Runoff=8.98 cfs 0.791 af

**Subcatchment 6S: Subcatchment 6S** Runoff Area=25,017 sf 0.00% Impervious Runoff Depth=4.84"
Flow Length=216' Tc=7.8 min CN=WQ Runoff=3.06 cfs 0.232 af

**Subcatchment 7S: Subcatchment 7S** Runoff Area=90,963 sf 21.76% Impervious Runoff Depth=5.39"
Flow Length=400' Tc=15.9 min CN=WQ Runoff=9.37 cfs 0.938 af

**Subcatchment 8S: Subcatchment 6S** Runoff Area=35,912 sf 0.00% Impervious Runoff Depth=4.67"
Flow Length=152' Tc=10.5 min CN=WQ Runoff=3.88 cfs 0.321 af

**Subcatchment 9S: Subcatchment 3S** Runoff Area=22,500 sf 100.00% Impervious Runoff Depth=7.91"
Tc=6.0 min CN=98 Runoff=4.13 cfs 0.340 af

**Pond 1P: Detention System 1** Peak Elev=341.46' Storage=22,944 cf Inflow=29.88 cfs 2.462 af
Outflow=20.98 cfs 2.462 af

**Pond DMH 115: DMH 115** Peak Elev=336.80' Inflow=62.71 cfs 6.813 af
36.0" Round Culvert n=0.011 L=47.7' S=0.0004 '/' Outflow=62.71 cfs 6.813 af

**Pond DMH 126: DMH 125** Peak Elev=340.18' Inflow=62.71 cfs 6.813 af
36.0" Round Culvert n=0.011 L=83.0' S=0.0027 '/' Outflow=62.71 cfs 6.813 af

**Pond INF 1: Inf System #1** Peak Elev=341.17' Storage=5,685 cf Inflow=1.34 cfs 0.222 af
Outflow=0.07 cfs 0.222 af

**Pond OCS1: OCS 1** Peak Elev=341.18' Inflow=14.55 cfs 1.187 af
Primary=1.34 cfs 0.222 af Secondary=13.45 cfs 0.964 af Outflow=14.55 cfs 1.187 af

**Pond PMF 1: PMF 1** Peak Elev=341.37' Inflow=44.54 cfs 3.560 af
36.0" Round Culvert n=0.011 L=14.7' S=0.0884 '/' Outflow=44.54 cfs 3.560 af

**Pond WQU 2: WQU 2** Peak Elev=342.98' Inflow=44.54 cfs 3.560 af
36.0" Round Culvert n=0.011 L=10.4' S=0.0769 '/' Outflow=44.54 cfs 3.560 af

**Link POA1: P.O.A. #1** Inflow=78.24 cfs 8.009 af
Primary=78.24 cfs 8.009 af

**Link POA2: P.O.A. #2** Inflow=9.37 cfs 0.938 af
Primary=9.37 cfs 0.938 af

**Link POA3: P.O.A. #3** Inflow=3.88 cfs 0.321 af
Primary=3.88 cfs 0.321 af

**Total Runoff Area = 16.561 ac Runoff Volume = 9.490 af Average Runoff Depth = 6.88"**
**33.14% Pervious = 5.489 ac 66.86% Impervious = 11.072 ac**



### Summary for Subcatchment 1S: Subcatchment 1S

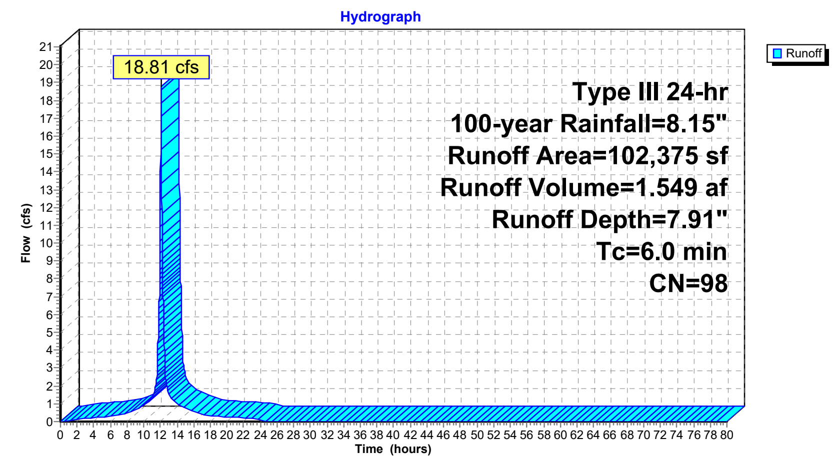
Runoff = 18.81 cfs @ 12.08 hrs, Volume= 1.549 af, Depth= 7.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 102,375 | 98 | Building/Impervious |
| | 102,375 | | 100.00% Impervious Area |

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

### Subcatchment 1S: Subcatchment 1S



### Summary for Subcatchment 2S: Subcatchment 2S

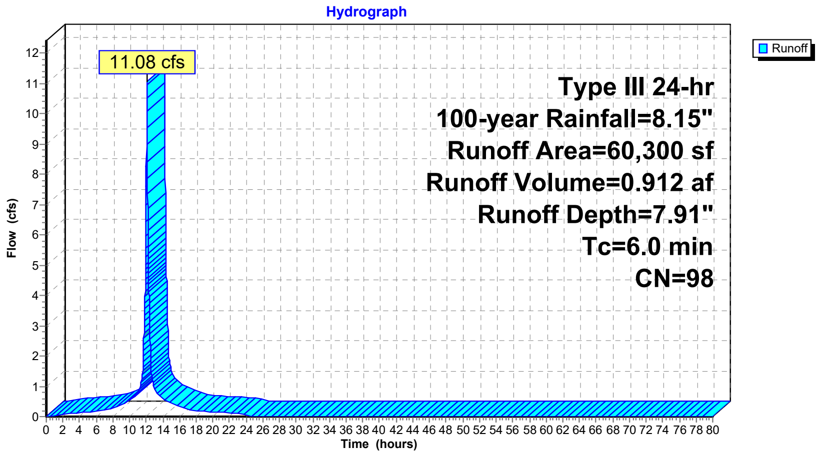
Runoff = 11.08 cfs @ 12.08 hrs, Volume= 0.912 af, Depth= 7.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 60,300 | 98 | Impervious |
| | 60,300 | | 100.00% Impervious Area |

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

### Subcatchment 2S: Subcatchment 2S






### Summary for Subcatchment 3S: Subcatchment 3S

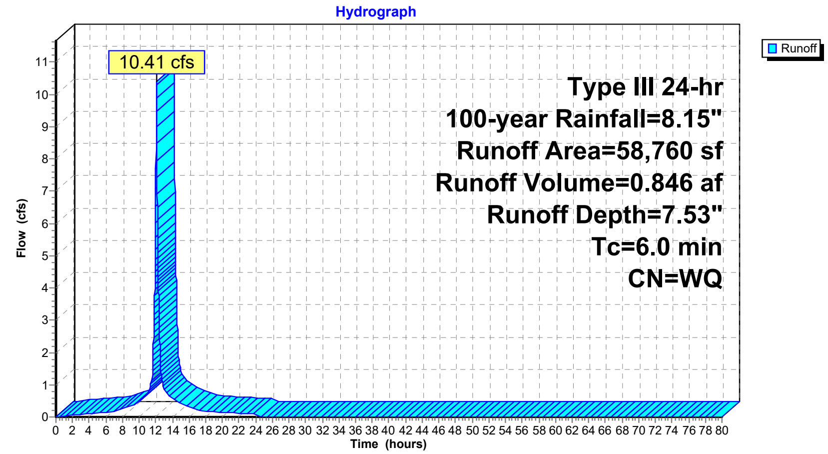
Runoff = 10.41 cfs @ 12.08 hrs, Volume= 0.846 af, Depth= 7.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 50,932 | 98 | Impervious |
| | 7,322 | 74 | >75% Grass cover, Good, HSG C |
| | 506 | 70 | Woods, Good, HSG C |
| | 58,760 | | Weighted Average |
| | 7,828 | | 13.32% Pervious Area |
| | 50,932 | | 86.68% Impervious Area |

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

### Subcatchment 3S: Subcatchment 3S



## Summary for Subcatchment 4S: Subcatchment 4S

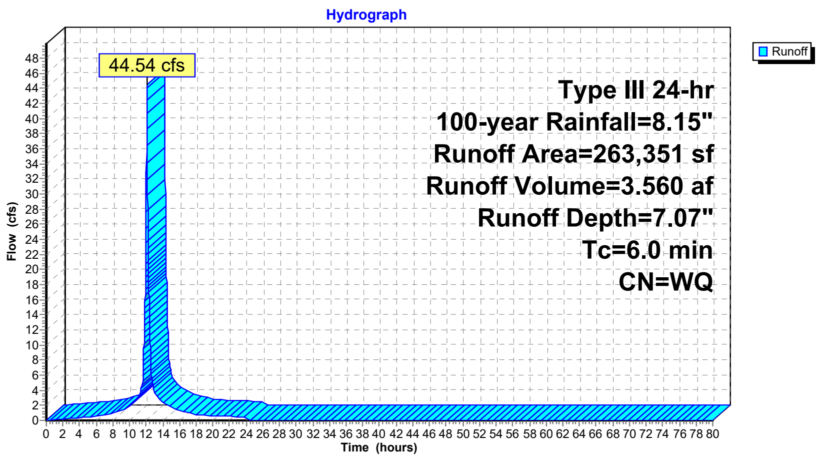
Runoff = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af, Depth= 7.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 188,818 | 98 | Impervious |
| | 53,700 | 74 | >75% Grass cover, Good, HSG C |
| | 20,833 | 70 | Woods, Good, HSG C |
| | 263,351 | | Weighted Average |
| | 74,533 | | 28.30% Pervious Area |
| | 188,818 | | 71.70% Impervious Area |

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

### Subcatchment 4S: Subcatchment 4S






## Summary for Subcatchment 5S: Subcatchment 5S

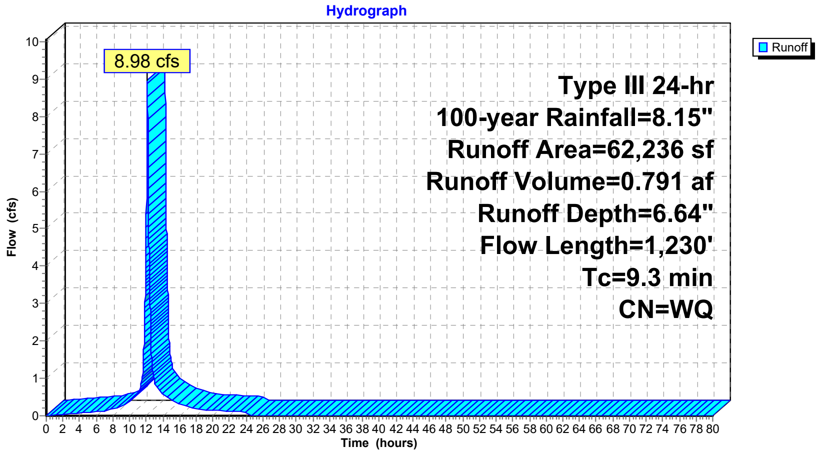
Runoff = 8.98 cfs @ 12.13 hrs, Volume= 0.791 af, Depth= 6.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 37,592 | 98 | Impervious |
| | 6,102 | 74 | >75% Grass cover, Good, HSG C |
| | 18,542 | 70 | Woods, Good, HSG C |
| | 62,236 | | Weighted Average |
| | 24,644 | | 39.60% Pervious Area |
| | 37,592 | | 60.40% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.5 | 50 | 0.1414 | 0.15 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 0.0 | 2 | 0.0226 | 0.75 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 0.8 | 126 | 0.0166 | 2.62 | | **Shallow Concentrated Flow, C-D**<br>Paved Kv= 20.3 fps |
| 0.0 | 3 | 0.1000 | 2.21 | | **Shallow Concentrated Flow, D-E**<br>Short Grass Pasture Kv= 7.0 fps |
| 1.0 | 130 | 0.0120 | 2.22 | | **Shallow Concentrated Flow, E-F**<br>Paved Kv= 20.3 fps |
| 0.8 | 358 | 0.0077 | 7.47 | 23.46 | **Pipe Channel, F-G**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, straight & clean |
| 0.2 | 57 | 0.0035 | 5.84 | 28.68 | **Pipe Channel, G-H**<br>30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63'<br>n= 0.011 Concrete pipe, straight & clean |
| 1.0 | 504 | 0.0052 | 8.04 | 56.84 | **Pipe Channel, H-I**<br>36.0" Round Area= 7.1 sf Perim= 9.4' r= 0.75'<br>n= 0.011 Concrete pipe, straight & clean |
| 9.3 | 1,230 | Total | | | |

## Subcatchment 5S: Subcatchment 5S






## Summary for Subcatchment 6S: Subcatchment 6S

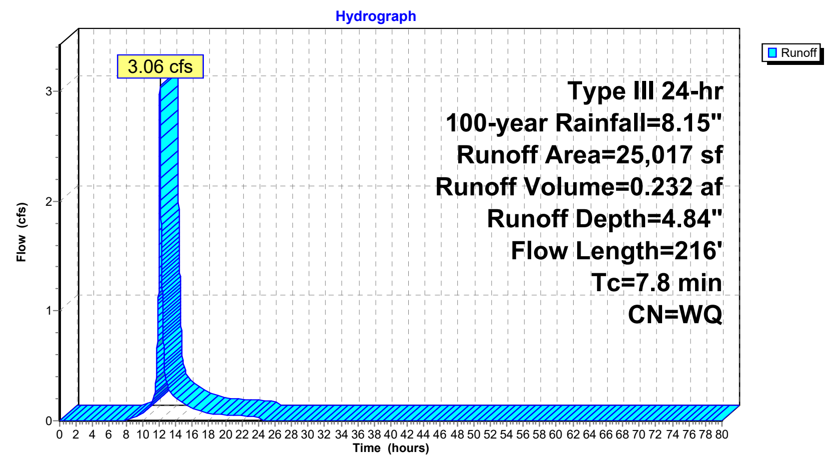
Runoff = 3.06 cfs @ 12.11 hrs, Volume= 0.232 af, Depth= 4.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| Area (sf) | CN | Description |
|---|---|---|
| 13,156 | 74 | >75% Grass cover, Good, HSG C |
| 11,861 | 70 | Woods, Good, HSG C |
| 25,017 | | Weighted Average |
| 25,017 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.8 | 20 | 0.0486 | 0.18 | | **Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.36" |
| 3.7 | 30 | 0.1333 | 0.13 | | **Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.3 | 166 | 0.0602 | 1.23 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 7.8 | 216 | Total | | | |

## Subcatchment 6S: Subcatchment 6S



### Summary for Subcatchment 7S: Subcatchment 7S

Runoff = 9.37 cfs @ 12.21 hrs, Volume= 0.938 af, Depth= 5.39"

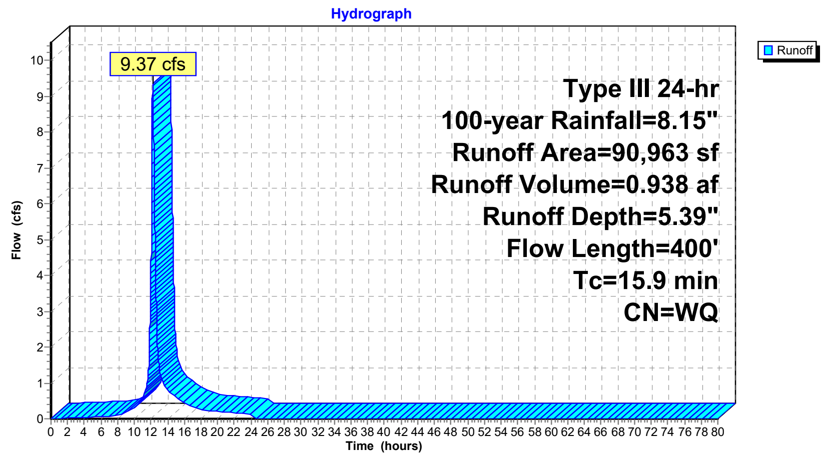
Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| | 15,149 | 74 | >75% Grass cover, Good, HSG C |
| | 56,019 | 70 | Woods, Good, HSG C |
| * | 19,795 | 98 | Wetland |
| | 90,963 | | Weighted Average |
| | 71,168 | | 78.24% Pervious Area |
| | 19,795 | | 21.76% Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 1.3 | 17 | 0.0788 | 0.21 | | **Sheet Flow, A-B**<br>Grass: Short n= 0.150 P2= 3.36" |
| 8.7 | 33 | 0.0194 | 0.06 | | **Sheet Flow, B-C**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 5.9 | 316 | 0.0315 | 0.89 | | **Shallow Concentrated Flow, C-D**<br>Woodland Kv= 5.0 fps |
| 0.0 | 34 | 0.0271 | 14.01 | 44.01 | **Pipe Channel, RCP_Round 24"**<br>24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50'<br>n= 0.011 Concrete pipe, finished |
| 15.9 | 400 | Total | | | |



### Subcatchment 7S: Subcatchment 7S



### Summary for Subcatchment 8S: Subcatchment 6S

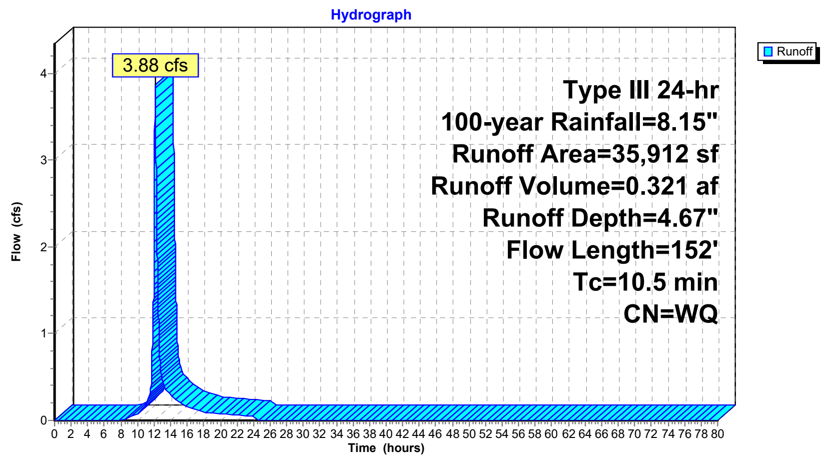
Runoff = 3.88 cfs @ 12.15 hrs, Volume= 0.321 af, Depth= 4.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| Area (sf) | CN | Description |
|---|---|---|
| 5,512 | 74 | >75% Grass cover, Good, HSG C |
| 30,400 | 70 | Woods, Good, HSG C |
| 35,912 | | Weighted Average |
| 35,912 | | 100.00% Pervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 8.3 | 50 | 0.0500 | 0.10 | | **Sheet Flow, A-B**<br>Woods: Light underbrush n= 0.400 P2= 3.36" |
| 2.2 | 102 | 0.0245 | 0.78 | | **Shallow Concentrated Flow, B-C**<br>Woodland Kv= 5.0 fps |
| 10.5 | 152 | Total | | | |

### Subcatchment 8S: Subcatchment 6S






### Summary for Subcatchment 9S: Subcatchment 3S

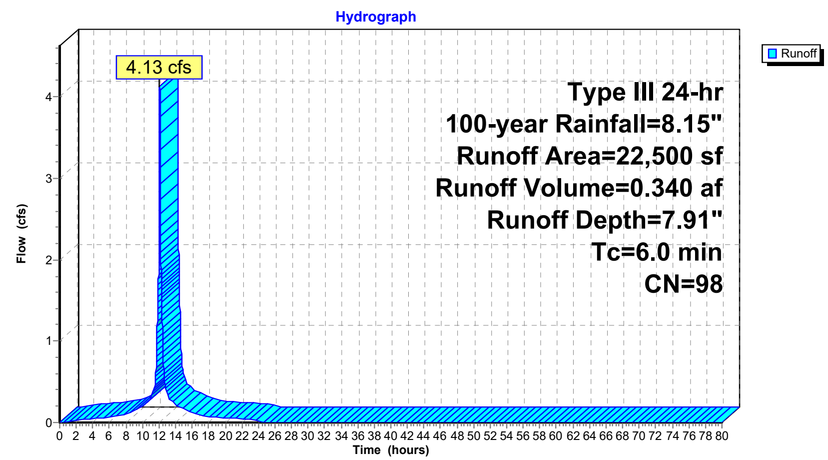
Runoff = 4.13 cfs @ 12.08 hrs, Volume= 0.340 af, Depth= 7.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-Q, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=8.15"

| | Area (sf) | CN | Description |
|---|---|---|---|
| * | 22,500 | 98 | Impervious |
| | 22,500 | | 100.00% Impervious Area |

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

### Subcatchment 9S: Subcatchment 3S



## Summary for Pond 1P: Detention System 1

Inflow Area = 3.735 ac,100.00% Impervious, Inflow Depth = 7.91" for 100-year event
Inflow = 29.88 cfs @ 12.08 hrs, Volume= 2.462 af
Outflow = 20.98 cfs @ 12.17 hrs, Volume= 2.462 af, Atten= 30%, Lag= 5.2 min
Primary = 20.98 cfs @ 12.17 hrs, Volume= 2.462 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 341.46' @ 12.16 hrs Surf.Area= 1,052 sf Storage= 22,944 cf

Plug-Flow detention time= 31.2 min calculated for 2.461 af (100% of inflow)
Center-of-Mass det. time= 31.2 min ( 772.2 - 741.0 )

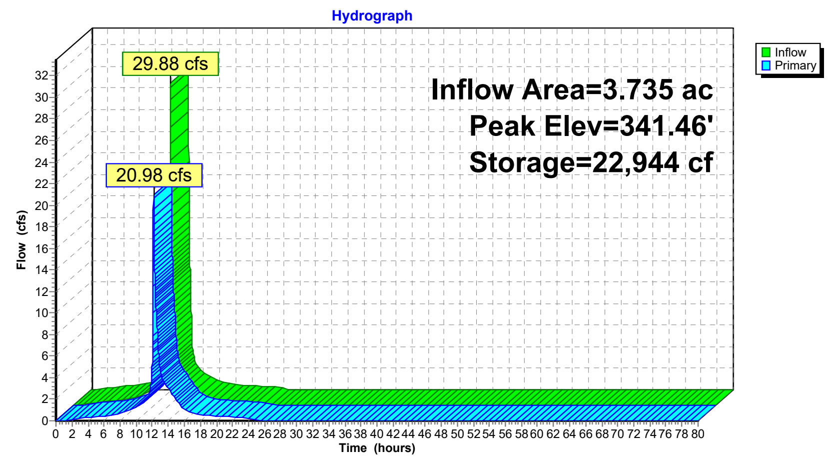
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 336.50' | 22,973 cf | **60.0" Round Pipe Storage** L= 1,170.0' |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 336.50' | **30.0" Round Culvert** L= 52.0' Ke= 0.500 Inlet / Outlet Invert= 336.50' / 334.70' S= 0.0346 '/' Cc= 0.900 n= 0.011 Concrete pipe, finished, Flow Area= 4.91 sf |
| #2 | Device 1 | 336.50' | **10.0" Vert. Orifice/Grate** C= 0.600 |
| #3 | Device 1 | 338.95' | **13.0" W x 6.0" H Vert. Orifice/Grate** X 2 rows with 6.0" cc spacing C= 0.600 |
| #4 | Device 1 | 340.65' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=21.86 cfs @ 12.17 hrs HW=341.44' TW=339.70' (Dynamic Tailwater)
└─**1=Culvert** (Passes 21.86 cfs of 31.20 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 3.47 cfs @ 6.36 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 6.82 cfs @ 6.30 fps)
  └─**4=Sharp-Crested Rectangular Weir** (Weir Controls 11.57 cfs @ 2.91 fps)



## Pond 1P: Detention System 1



## Summary for Pond DMH 115: DMH 115

[57] Hint: Peaked at 336.80' (Flood elevation advised)

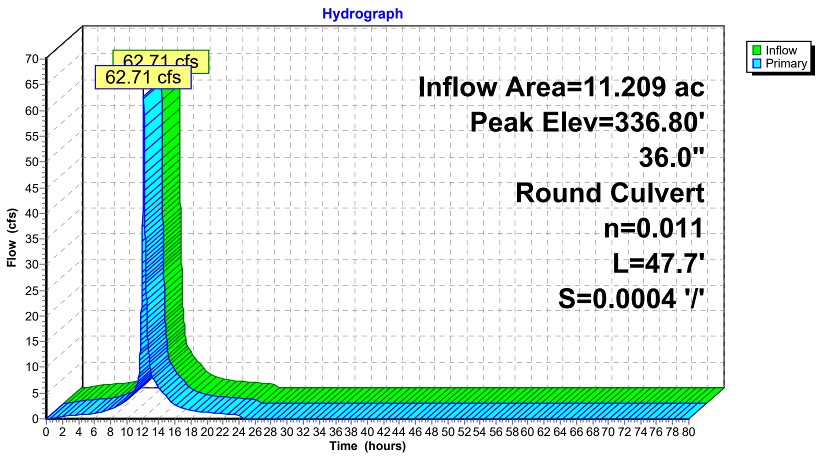
Inflow Area = 11.209 ac, 79.69% Impervious, Inflow Depth = 7.29" for 100-year event
Inflow = 62.71 cfs @ 12.14 hrs, Volume= 6.813 af
Outflow = 62.71 cfs @ 12.14 hrs, Volume= 6.813 af, Atten= 0%, Lag= 0.0 min
Primary = 62.71 cfs @ 12.14 hrs, Volume= 6.813 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 336.80' @ 12.14 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 331.68' | **36.0" Round Culvert** L= 47.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.68' / 331.66' S= 0.0004 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=62.68 cfs @ 12.14 hrs HW=336.79' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 62.68 cfs @ 8.87 fps)

### Pond DMH 115: DMH 115






## Summary for Pond DMH 126: DMH 125

[57] Hint: Peaked at 340.18' (Flood elevation advised)

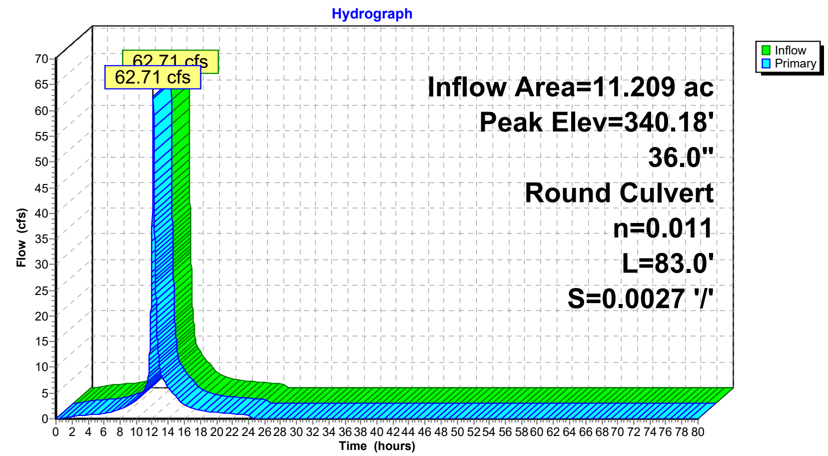
Inflow Area = 11.209 ac, 79.69% Impervious, Inflow Depth = 7.29" for 100-year event
Inflow = 62.71 cfs @ 12.14 hrs, Volume= 6.813 af
Outflow = 62.71 cfs @ 12.14 hrs, Volume= 6.813 af, Atten= 0%, Lag= 0.0 min
Primary = 62.71 cfs @ 12.14 hrs, Volume= 6.813 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 340.18' @ 12.14 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 332.00' | **36.0" Round Culvert** L= 83.0' Ke= 0.500<br>Inlet / Outlet Invert= 332.00' / 331.78' S= 0.0027 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=62.54 cfs @ 12.14 hrs HW=340.17' TW=336.79' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 62.54 cfs @ 8.85 fps)

### Pond DMH 126: DMH 125



## Summary for Pond INF 1: Inf System #1

[80] Warning: Exceeded Pond OCS1 by 8.85' @ 24.35 hrs (1.30 cfs 0.900 af)

Inflow Area = 1.865 ac, 90.37% Impervious, Inflow Depth = 1.43" for 100-year event
Inflow = 1.34 cfs @ 12.05 hrs, Volume= 0.222 af
Outflow = 0.07 cfs @ 2.34 hrs, Volume= 0.222 af, Atten= 95%, Lag= 0.0 min
Discarded = 0.07 cfs @ 2.34 hrs, Volume= 0.222 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 341.17' @ 12.13 hrs Surf.Area= 2,800 sf Storage= 5,685 cf

Plug-Flow detention time= 709.6 min calculated for 0.222 af (100% of inflow)
Center-of-Mass det. time= 709.7 min ( 1,280.4 - 570.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 338.30' | 2,266 cf | **Crushed Stone (Prismatic)**Listed below (Recalc) |
| | | | 9,800 cf Overall - 4,135 cf Embedded = 5,665 cf x 40.0% Voids |
| #2 | 338.80' | 4,135 cf | **ADS_StormTech SC-740 +Cap** x 90 Inside #1 |
| | | | Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf |
| | | | Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap |
| | | | 90 Chambers in 9 Rows |
| | | 6,401 cf | Total Available Storage |

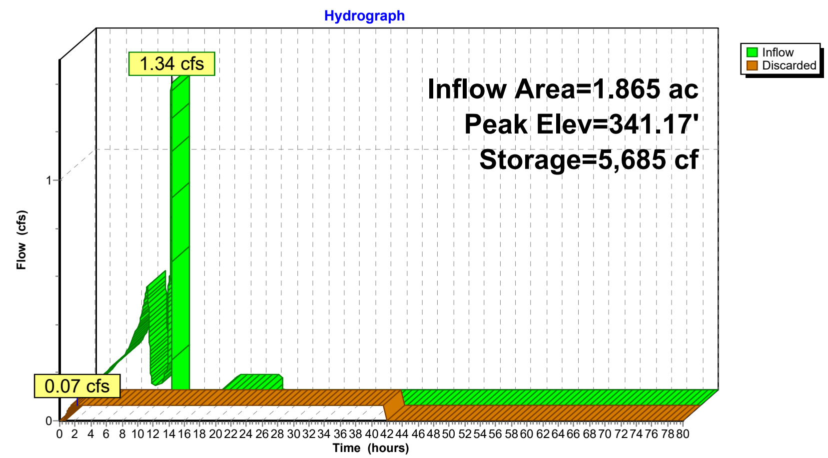
| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 338.30 | 2,800 | 0 | 0 |
| 341.80 | 2,800 | 9,800 | 9,800 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 338.30' | **1.020 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.07 cfs @ 2.34 hrs HW=338.34' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.07 cfs)



## Pond INF 1: Inf System #1



## Summary for Pond OCS1: OCS 1

[57] Hint: Peaked at 341.18' (Flood elevation advised)

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1.865 ac, 90.37% Impervious, Inflow Depth = 7.63" for 100-year event | | | |
| Inflow = | 14.55 cfs @ | 12.08 hrs, Volume= | 1.187 af | |
| Outflow = | 14.55 cfs @ | 12.08 hrs, Volume= | 1.187 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 1.34 cfs @ | 12.05 hrs, Volume= | 0.222 af | |
| Secondary = | 13.45 cfs @ | 12.09 hrs, Volume= | 0.964 af | |

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 341.18' @ 12.09 hrs

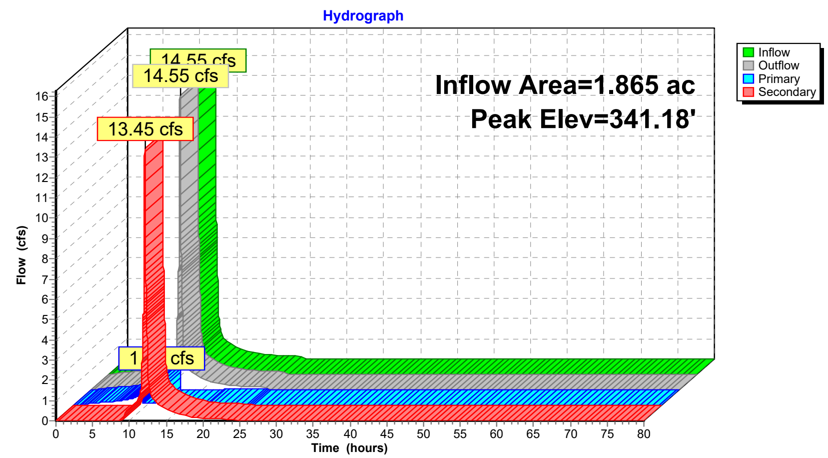
| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 339.69' | **12.0" Round Culvert** L= 81.0' Ke= 0.500<br>Inlet / Outlet Invert= 339.69' / 338.50' S= 0.0147 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 0.79 sf |
| #2 | Secondary | 331.44' | **24.0" Round Culvert** L= 50.7' Ke= 0.500<br>Inlet / Outlet Invert= 331.44' / 330.94' S= 0.0099 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 3.14 sf |
| #3 | Device 2 | 340.30' | **5.0' long Sharp-Crested Rectangular Weir** 0 End Contraction(s) |

**Primary OutFlow** Max=1.20 cfs @ 12.05 hrs HW=341.12' TW=341.00' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.20 cfs @ 1.52 fps)

**Secondary OutFlow** Max=13.43 cfs @ 12.09 hrs HW=341.18' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 13.43 cfs of 44.71 cfs potential flow)
  └─**3=Sharp-Crested Rectangular Weir** (Weir Controls 13.43 cfs @ 3.06 fps)



## Pond OCS1: OCS 1



## Summary for Pond PMF 1: PMF 1

[57] Hint: Peaked at 341.37' (Flood elevation advised)

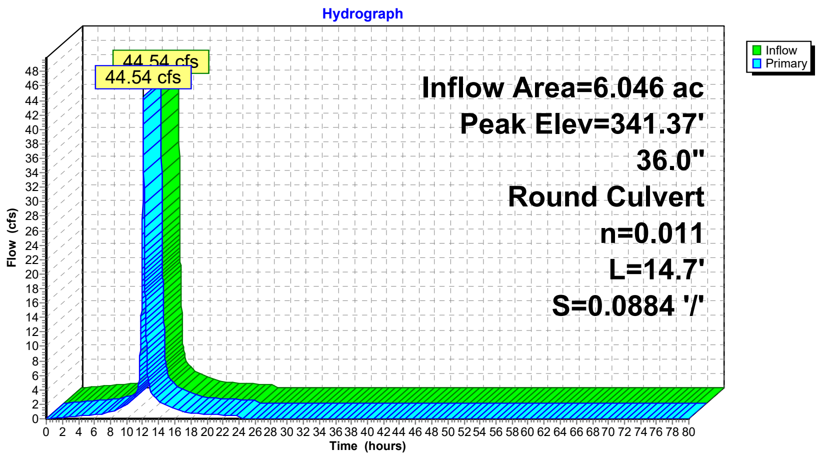
Inflow Area = 6.046 ac, 71.70% Impervious, Inflow Depth = 7.07" for 100-year event
Inflow = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af
Outflow = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af, Atten= 0%, Lag= 0.0 min
Primary = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 341.37' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 333.40' | **36.0" Round Culvert** L= 14.7' Ke= 0.500<br>Inlet / Outlet Invert= 333.40' / 332.10' S= 0.0884 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=42.10 cfs @ 12.08 hrs HW=341.19' TW=339.66' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 42.10 cfs @ 5.96 fps)

### Pond PMF 1: PMF 1






## Summary for Pond WQU 2: WQU 2

[57] Hint: Peaked at 342.98' (Flood elevation advised)

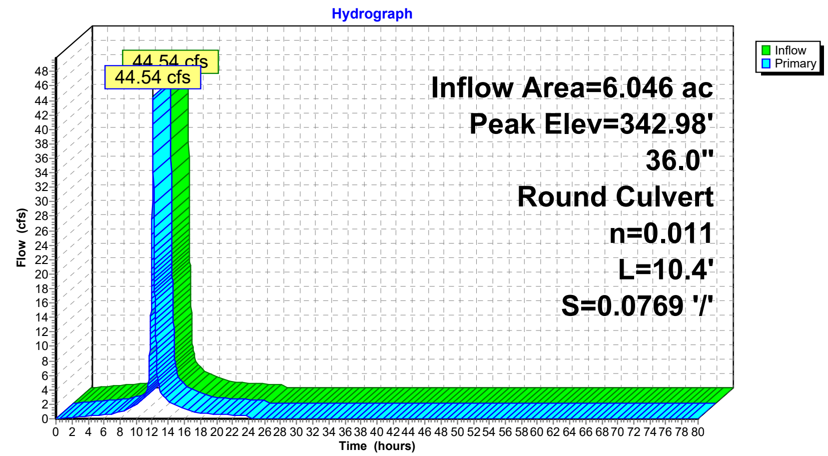
Inflow Area = 6.046 ac, 71.70% Impervious, Inflow Depth = 7.07" for 100-year event
Inflow = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af
Outflow = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af, Atten= 0%, Lag= 0.0 min
Primary = 44.54 cfs @ 12.08 hrs, Volume= 3.560 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs
Peak Elev= 342.98' @ 12.10 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 334.30' | **36.0" Round Culvert** L= 10.4' Ke= 0.500<br>Inlet / Outlet Invert= 334.30' / 333.50' S= 0.0769 '/' Cc= 0.900<br>n= 0.011 Concrete pipe, finished, Flow Area= 7.07 sf |

**Primary OutFlow** Max=39.94 cfs @ 12.08 hrs HW=342.57' TW=341.19' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 39.94 cfs @ 5.65 fps)

### Pond WQU 2: WQU 2

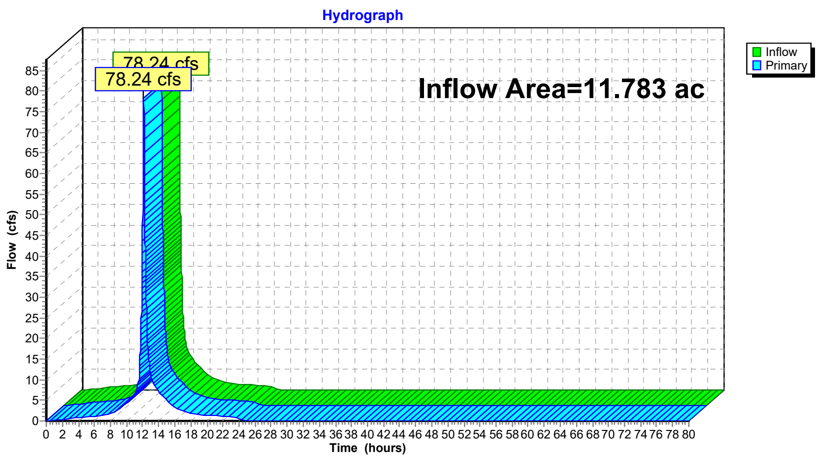


### Summary for Link POA1: P.O.A. #1

Inflow Area = 11.783 ac, 75.80% Impervious, Inflow Depth = 8.16" for 100-year event
Inflow = 78.24 cfs @ 12.12 hrs, Volume= 8.009 af
Primary = 78.24 cfs @ 12.12 hrs, Volume= 8.009 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA1: P.O.A. #1



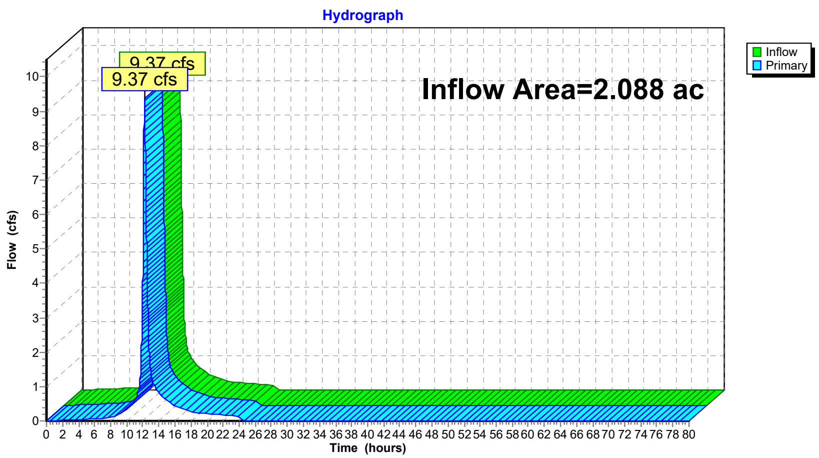



### Summary for Link POA2: P.O.A. #2

Inflow Area = 2.088 ac, 21.76% Impervious, Inflow Depth = 5.39" for 100-year event
Inflow = 9.37 cfs @ 12.21 hrs, Volume= 0.938 af
Primary = 9.37 cfs @ 12.21 hrs, Volume= 0.938 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA2: P.O.A. #2

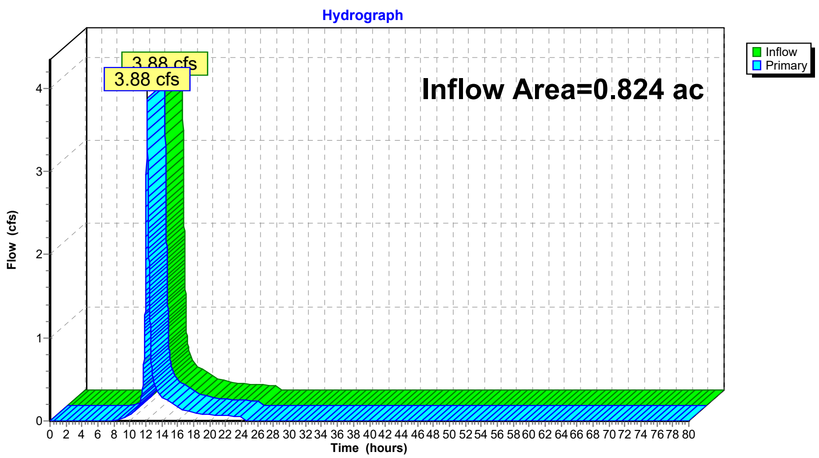


## Summary for Link POA3: P.O.A. #3

Inflow Area = 0.824 ac, 0.00% Impervious, Inflow Depth = 4.67" for 100-year event
Inflow = 3.88 cfs @ 12.15 hrs, Volume= 0.321 af
Primary = 3.88 cfs @ 12.15 hrs, Volume= 0.321 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-80.00 hrs, dt= 0.01 hrs

### Link POA3: P.O.A. #3



# APPENDIX I: TSS DOCUMENTATION FOR PROPRIETARY DEVICES

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

Location: Treatment Train 1

# TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump Catch Basin** | **25%** | **100%** | **25%** | **75%** |
| **CDS System (Proprietary Device)** | **80%** | **75%** | **60%** | **15%** |
| **Subsurface Infiltration System** | **80%** | **15%** | **12%** | **3%** |
| | | **Total TSS Removal =** | **97%** | **Completed for Each Outlet or BMP Train** |

Project: **55 Consitution Boulevard**
Prepared By: **Beals Assoc. Inc.**
Date: **10-Oct-24**

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

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

Location: Treatment Train 2

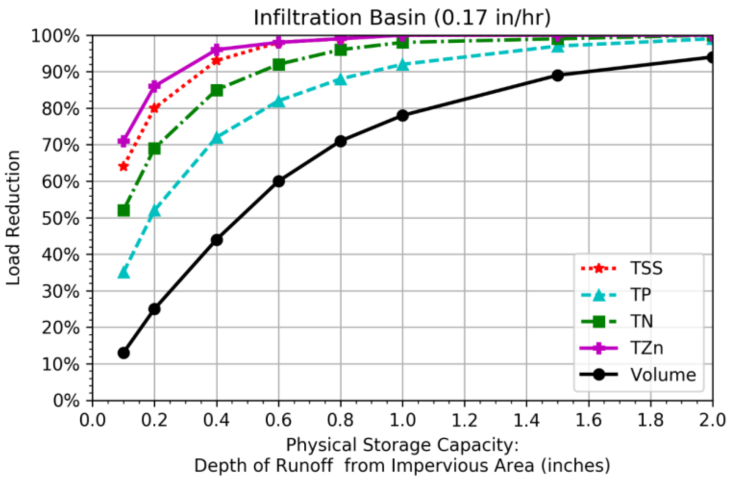
# TSS Removal Calculation Worksheet

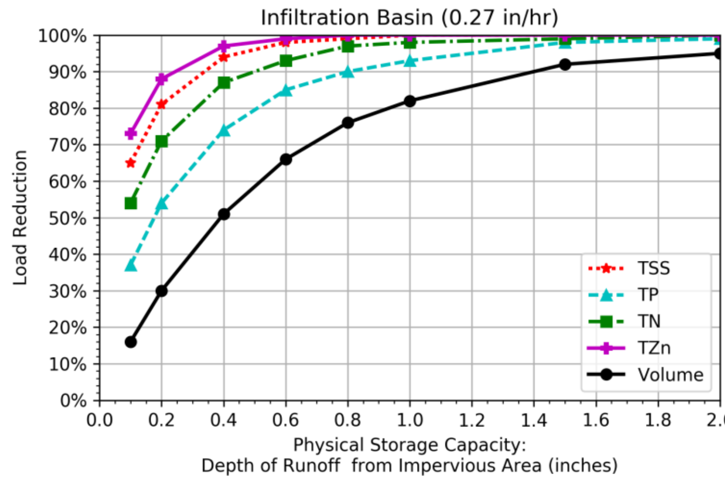
| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump Catch Basin** | **25%** | **100%** | **25%** | **75%** |
| **Cascade System (Proprietary Device)** | **80%** | **75%** | **60%** | **15%** |
| **Jellyfish Filter (Proprietary Filtration Device)** | **85%** | **15%** | **13%** | **2%** |
| | | **Total TSS Removal =** | **98%** | **Completed for Each Outlet or BMP Train** |

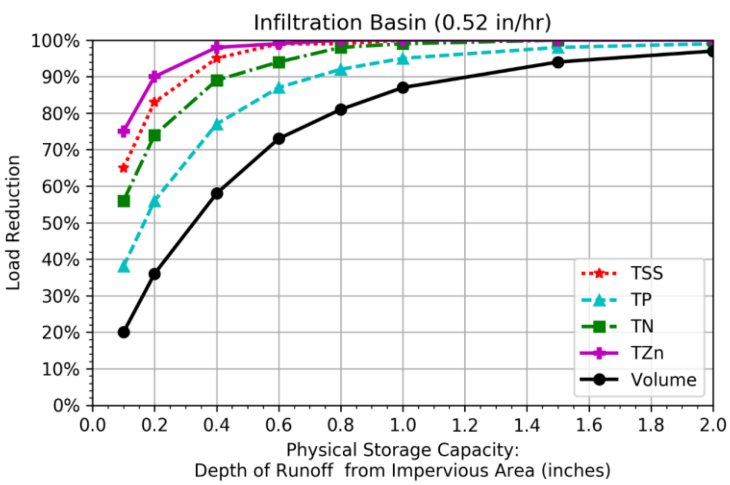
Project: **55 Consitution Boulevard**
Prepared By: **Beals Assoc. Inc.**
Date: **10-Oct-24**

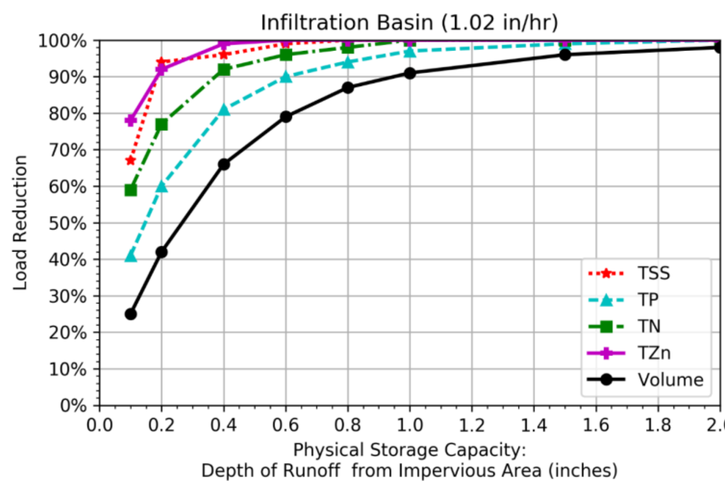
*Equals remaining load from previous BMP (E) which enters the BMP

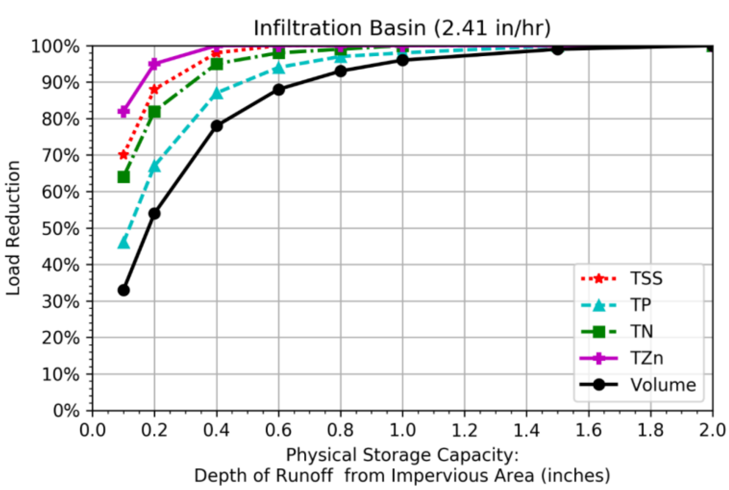
# BMP Performance Curves for Soil Infiltration Rate: Infiltration Basin

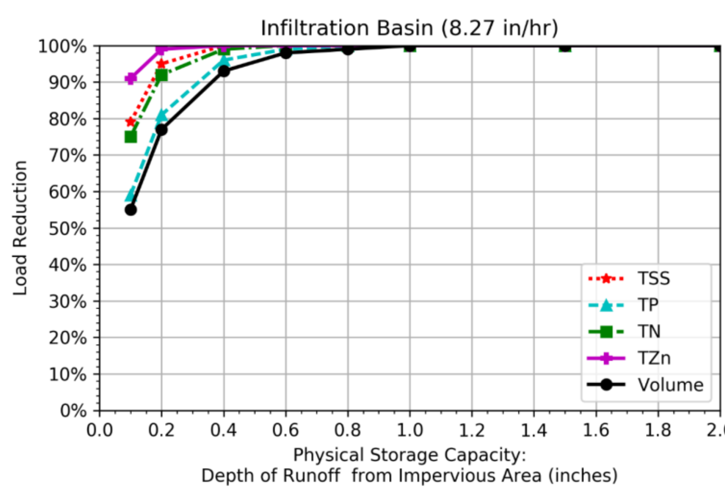


# BMP Performance Tables for Soil Infiltration Rate: Infiltration Basin

| | | Cumulative Load Reduction | | | | |
|---|---|---|---|---|---|---|
| Infiltration Rate (in/hr) | Depth of Runoff from Impervious Area (inches) | TSS | Phosphorus | Nitrogen | Zinc | Runoff Volume |
| 1.02 | 0.1 | 67% | 41% | 59% | 78% | 25% |
| | 0.2 | 94% | 60% | 77% | 92% | 42% |
| | 0.4 | 96% | 81% | 92% | 99% | 66% |
| | 0.6 | 99% | 90% | 96% | 100% | 79% |
| | 0.8 | 100% | 94% | 98% | 100% | 87% |
| | 1.0 | 100% | 97% | 100% | 100% | 91% |
| | 1.5 | 100% | 99% | 100% | 100% | 96% |
| | 2.0 | 100% | 100% | 100% | 100% | 98% |
| | | | | | | |
| 2.41 | 0.1 | 70% | 46% | 64% | 82% | 33% |
| | 0.2 | 88% | 67% | 82% | 95% | 54% |
| | 0.4 | 98% | 87% | 95% | 100% | 78% |
| | 0.6 | 100% | 94% | 98% | 100% | 88% |
| | 0.8 | 100% | 97% | 99% | 100% | 93% |
| | 1.0 | 100% | 98% | 100% | 100% | 96% |
| | 1.5 | 100% | 100% | 100% | 100% | 99% |
| | 2.0 | 100% | 100% | 100% | 100% | 100% |
| | | | | | | |
| 8.27 | 0.1 | 79% | 59% | 75% | 91% | 55% |
| | 0.2 | 95% | 81% | 92% | 99% | 77% |
| | 0.4 | 100% | 96% | 99% | 100% | 93% |
| | 0.6 | 100% | 99% | 100% | 100% | 98% |
| | 0.8 | 100% | 100% | 100% | 100% | 99% |
| | 1.0 | 100% | 100% | 100% | 100% | 100% |
| | 1.5 | 100% | 100% | 100% | 100% | 100% |
| | 2.0 | 100% | 100% | 100% | 100% | 100% |

CONTECH®
ENGINEERED SOLUTIONS

# Jellyfish® Filter
## Stormwater Treatment

# The experts you need to solve your stormwater challenges

## Your Contech Team

**Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.**

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

**STORMWATER CONSULTANT**

*It's my job to recommend the best solution to meet permitting requirements.*

**STORMWATER DESIGN ENGINEER**

*I work with consultants to design the best approved solution to meet your project's needs.*

**REGULATORY MANAGER**

*I understand the local stormwater regulations and what solutions will be approved.*

**SALES ENGINEER**

*I make sure our solutions meet the needs of the contractor during construction.*

Contech is your partner in stormwater management solutions

# Setting new standards in Stormwater Treatment – Jellyfish® Filter

*The Jellyfish Filter has been tested in the field and laboratory, and has received approval from numerous stormwater regulatory agencies.*

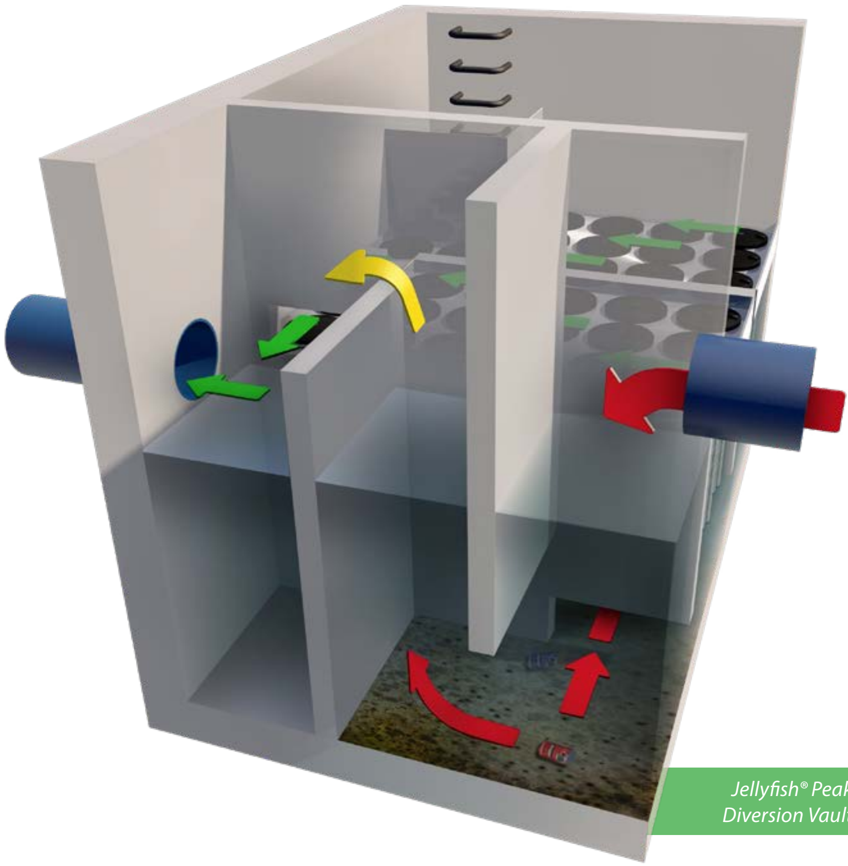
Jellyfish® Filter

The Jellyfish Filter is a stormwater quality treatment technology featuring high flow pretreatment and membrane filtration in a compact stand-alone system. Jellyfish removes floatables, trash, oil, debris, TSS, fine silt-sized particles, and a high percentage of particulate-bound pollutants; including phosphorus, nitrogen, metals, and hydrocarbons. The high surface area membrane cartridges, combined with up-flow hydraulics, frequent, passive backwashing, and rinseable/ reusable cartridges ensure long-lasting performance.

# How the Jellyfish® Filter Treats Stormwater

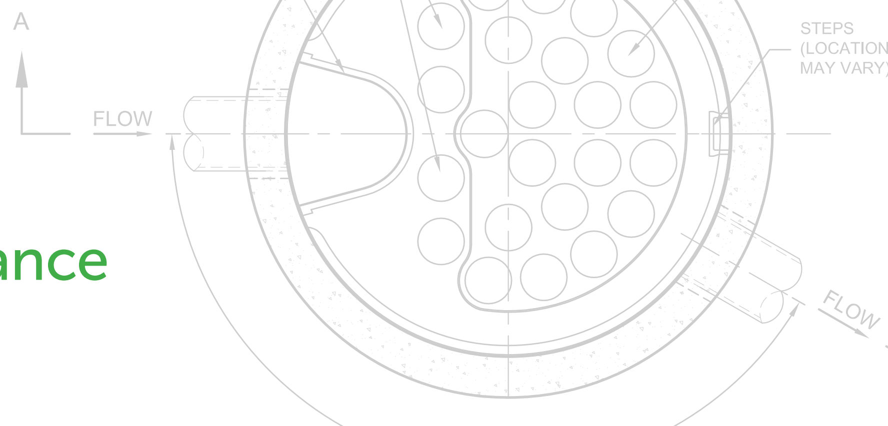
### Tested in the field and laboratory ...

- Water enters the vault via an inlet bay where floating pollutants, oil, and grease are trapped behind a baffle wall.
- Water flows through the inlet bay transfer opening into the treatment chamber.
- Water is forced up from the treatment chamber, through the membrane filtration, and into the backwash pool.
- The water then fills and overflows the backwash pool and exits via the outlet bay transfer opening.
- As each storm subsides, the remaining water caught in the backwash pool flows back into the treatment chamber through the cartridges.
- This passive backwash extends cartridge life and prepares them for the next storm event. The draindown cartridges located outside the backwash pool enables water levels to balance.
- During peak flows, the internal weir allows high flows to bypass treatment, eliminating the need for an external bypass structure.



*Jellyfish® Peak Diversion Vault*

*Learn More:*
*www.ContechES.com/jellyfish*




# Jellyfish® Filter Performance Testing Results

## APPLICATION TIPS

- The Peak Diversion Jellyfish provides treatment and high-flow bypass in one structure, eliminating the need for a separate bypass structure.
- LID and GI are complemented by filtration solutions, as they help keep sites free from fine sediments that can impede performance, remove unsightly trash, and provide a single point of maintenance.
- Selecting a filter with a long maintenance cycle and low maintenance cost will result in healthy waterways and happy property owners.

*The pleated tentacles of the Jellyfish® Filter provide a large surface area for pollutant removal.*

| POLLUTANT OF CONCERN | % REMOVAL |
|---|---|
| Total Suspended Solids (TSS) | 85% |
| Total Phosphorus (TP) | 75% |
| Total Copper (TCu) | 67% |
| Total Zinc (TZn) | 60% |

*Sources:*
*WA DOE TAPE Testing: https://fortress.wa.gov/ecy/ezshare/wq/tape/use_designations/JELLYFISHfilterIMBRIUMguld.pdf*

CONTECH®
ENGINEERED SOLUTIONS

# Hydrodynamic Separation

# The experts you need to solve your stormwater challenges

## Your Contech Team

**Contech is the leader in stormwater solutions, helping engineers, contractors and owners with infrastructure and land development projects throughout North America.**

With our responsive team of stormwater experts, local regulatory expertise and flexible solutions, Contech is the trusted partner you can count on for stormwater management solutions.

**STORMWATER CONSULTANT**

*It's my job to recommend the best solution to meet permitting requirements.*

**STORMWATER DESIGN ENGINEER**

*I work with consultants to design the best approved solution to meet your project's needs.*

**REGULATORY MANAGER**

*I understand the local stormwater regulations and what solutions will be approved.*

**SALES ENGINEER**

*I make sure our solutions meet the needs of the contractor during construction.*

## Contech is your partner in stormwater management solutions


# Removing Pollutants using Hydrodynamic Separation

*Utilize high-performance hydrodynamic separation to effectively remove finer sediment, oil and grease, and floating and sinking debris.*

HDS systems play a vital role in protecting our waterways by removing high levels of sediment, trash, debris, and hydrocarbons from stormwater runoff.

Frequently used as end-of-pipe solutions, they are also used to provide stormwater quality treatment in places where space is limited.

HDS systems capture and retain a variety of stormwater pollutants and are very easy to maintain. These two key benefits have resulted in new uses for HDS technologies, such as pretreating detention, Low Impact Development, and green infrastructure practices, as well as other land-based stormwater treatment systems.

CASCADE separator®

CDS®

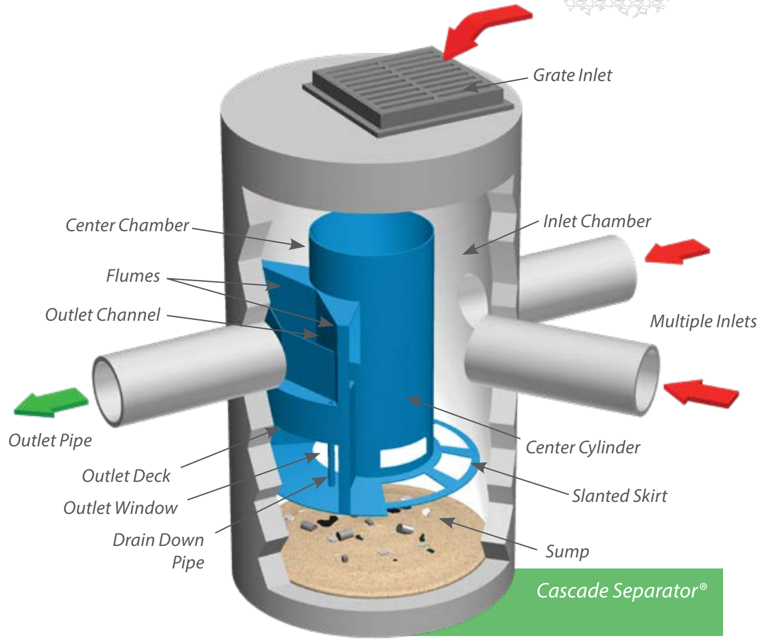
Vortechs®

# The Cascade Separator® System

## Advanced Sediment Capture Technology ...

The Cascade Separator® is the newest innovation in stormwater treatment from Contech. The Cascade Separator was developed by Contech's stormwater experts using advanced modeling tools and Contech's industry leading stormwater laboratory.

This innovative hydrodynamic separator excels at sediment capture and retention while also removing hydrocarbons, trash, and debris from stormwater runoff. What makes the Cascade Separator unique is the use of opposing vortices that enhance particle settling and a unique skirt design that allows for sediment transport into the sump while reducing turbulence and resuspension of previously captured material. These two factors allow the Cascade Separator to treat high flow rates in a small footprint, resulting in an efficient and economical solution for any site.




| FEATURE | BENEFIT |
|---|---|
| Unique skirt design & opposing vortices | Superior TSS removal; reduced system size and costs |
| Inlet area accepts wide range of inlet pipe angles | Design and installation flexibility |
| Accepts multiple inlet pipes * | Eliminates the need for separate junction structure |
| Grate inlet option* | Eliminates the need for a separate grate inlet structure |
| Internal bypass | Eliminates the need for a separate bypass structure |
| Clear access to sump and stored pollutants | Fast, easy maintenance |

** NJDEP testing based on Cascade Separator with one inlet pipe and no grate inlet*

*Learn More:*
*www.ContechES.com/cascade*

### SELECT CASCADE APPROVALS

- New Jersey Department of Environmental Protection Certification (NJDEP)

### CASCADE MAINTENANCE

Cascade provides unobstructed access to stored pollutants, making it easy to maintain using a vacuum truck, with no requirement to enter the unit.

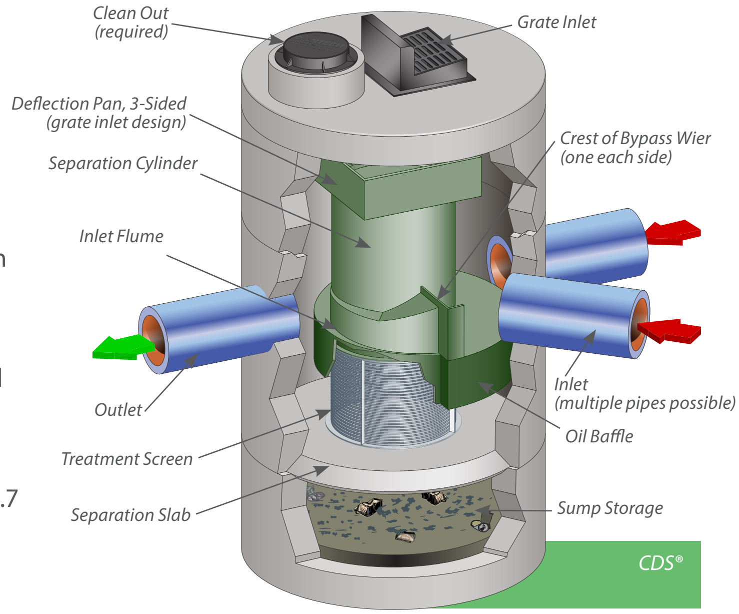
**Setting new standards in Stormwater Treatment**

# The CDS® System

## Superior Trash Removal ...

The CDS is a hybrid technology that uses a combination of swirl concentration and indirect screening to separate and trap trash, debris, sediment, and hydrocarbons from stormwater runoff.

At the heart of the CDS system is a unique screening technology used to capture and retain trash and debris. The screen face is louvered so that it is smooth in the downstream direction. The effect created is called "Continuous Deflective Separation." The power of the incoming flow is harnessed to continually shear debris off the screen and to direct trash and sediment toward the center of the separation cylinder. This results in a screen that is self-cleaning and provides 100% removal of floatables and neutrally buoyant material debris 4.7 mm or larger, without blinding.




| FEATURE | BENEFIT |
|---|---|
| Captures and retains 100% of floatables and neutrally buoyant debris 4.7 mm or larger | Superior trash removal |
| Self-cleaning screen | Ease of maintenance |
| Isolated storage sump eliminates scour potential | Excellent pollutant retention |
| Internal bypass | Eliminates the need for additional structures |
| Multiple pipe inlets and 90-180º angles | Design flexibility |
| Clear access to sump and stored pollutants | Fast, easy maintenance |

*Learn More:*
*www.ContechES.com/cds*

**SELECT CDS APPROVALS**

- Washington Department of Ecology (GULD) – Pretreatment
- Canadian Environmental Technology Verification (ETV)
- California Statewide Trash Amendments Full Capture System Certified*

** The CDS System has been certified by the California State Water Resources Control Board as a Full Capture System provided that it is sized to treat the peak flow rate from the region specific 1-year, 1-hour design storm, or the peak flow capacity of the corresponding storm drain, whichever is less.*

# The Vortechs® System

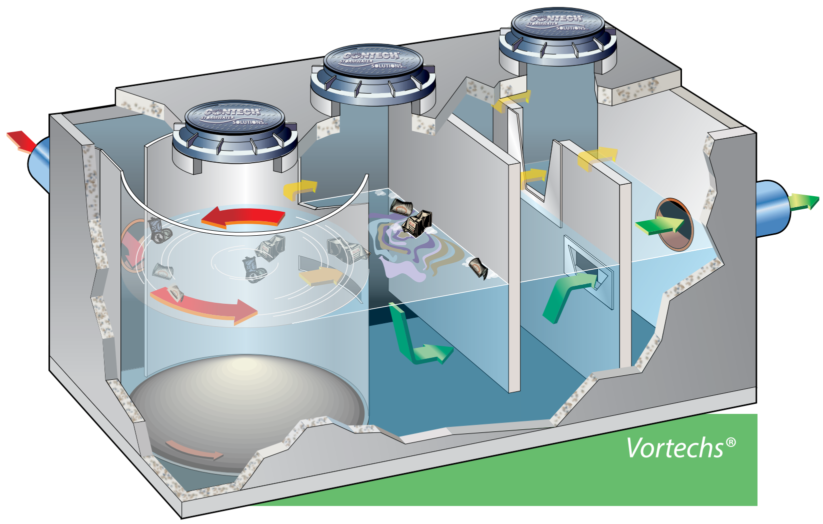
### Stormwater Treatment in a Shallow Footprint ....

Vortechs combines swirl concentration and flow controls into a single treatment unit that captures and retains trash, debris, sediment, and hydrocarbons from stormwater runoff.

The Vortechs system's large swirl chamber and flow controls work together to create a low energy environment, ideal for capturing and retaining particles down to 50 microns.

Vortechs is the ideal solution for sites with high groundwater, bedrock, utility conflicts, or sites with a large volume runoff.

The Vortechs System is approved by the Washington Department of Ecology (GULD) - Pretreatment.




### Select Vortechs Approvals

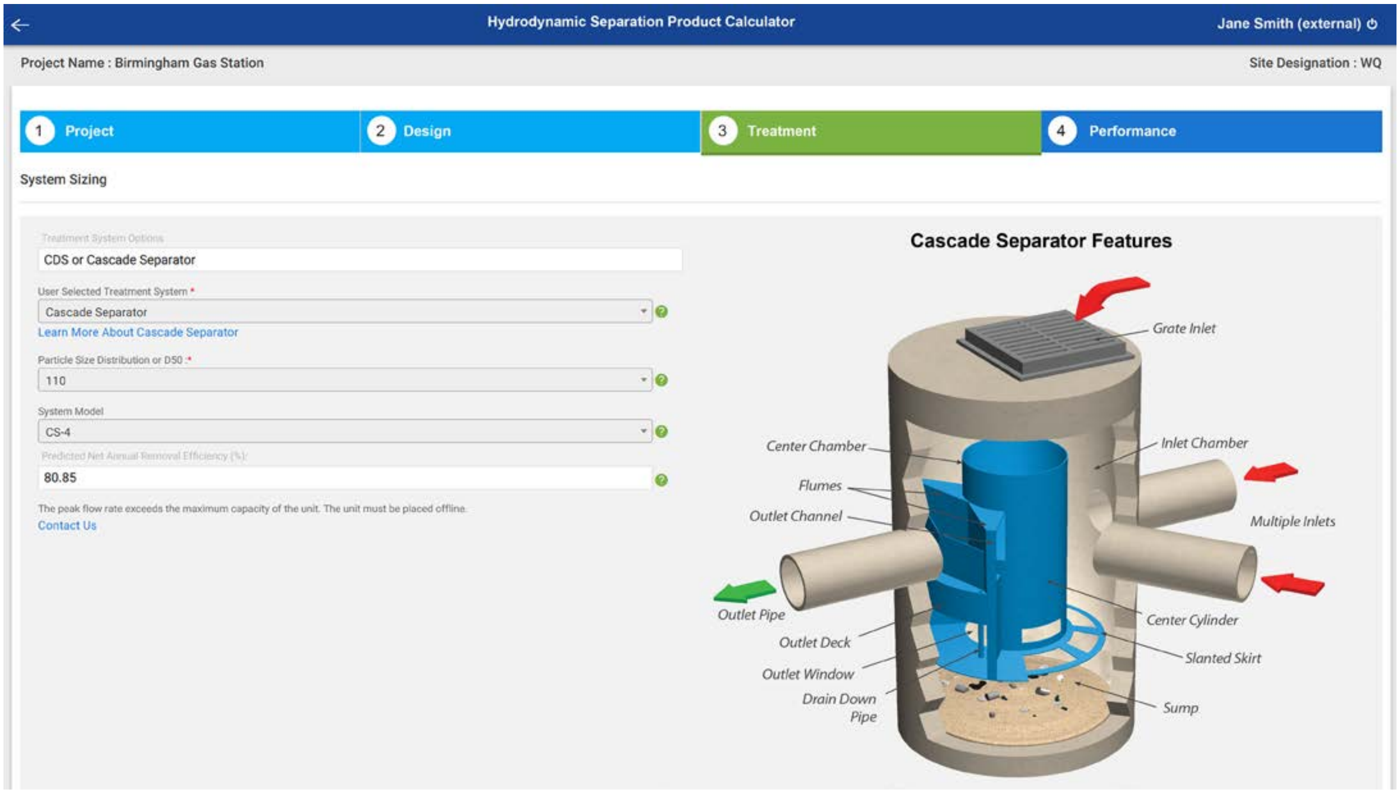
- Washington Department of Ecology (GULD) – Pretreatment

*Learn More:*
*www.ContechES.com/vortechs*

| FEATURE | BENEFIT |
|---|---|
| Large swirl chamber | Fine particle removal down to 50 microns |
| Shallow profile – Typical depth below pipe invert is only 3 feet. | Can be used on sites with high groundwater, bedrock, or utility conflicts |
| Unobstructed access to stored pollutants | Fast, easy maintenance |

**The ideal solution for sites with high groundwater**

# Hydrodynamic Separator Selection & Sizing Tool




*Learn More:*
*www.ContechES.com/designcenter*

## Quickly prepare designs for estimates and project meetings ...

Engineers are always looking for new ways to quickly prepare designs for estimates and project meetings. Contech has developed an online tool to help with the hydrodynamic separation product selection process… the Hydrodynamic Separator Selection and Sizing Tool.

Part of the Contech Design Center, this free, online tool fully automates the layout process for identifying the proper hydrodynamic separator for your site. You can create multiple systems for each project while saving all project information for future use.

- Multiple sizing methods available.
- Site-specific questions ensure the selected unit will comply with site constraints.
- Multiple treatment options may be available based on regulations and site parameters.
- Follow up reports contain a site-specific design, sizing summary, standard detail, and specification.

CONTECH® DESIGNCENTER
DESIGN MADE EASY

A free, online tool to aid in the selection of a hydrodynamic separation solution.

# A partner you can rely on

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURES SOLUTIONS

Few companies offer the wide range of high-quality stormwater resources you can find with us — state-of-the-art products, decades of expertise, and all the maintenance support you need to operate your system cost-effectively.

## THE CONTECH WAY

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

## TAKE THE NEXT STEP

For more information: www.ContechES.com



CONTECH® ENGINEERED SOLUTIONS

Get social with us:

800-338-1122 | www.ContechES.com

# Jellyfish® Filter Features and Benefits

| FEATURE | BENEFITS |
|---|---|
| High surface area membrane filtration | Low flux rate promotes cake filtration and slows membrane occlusion |
| High design treatment flow rate per cartridge (up to 80 gpm (5 L/s)) | Compact system with a small footprint, lower construction cost |
| Low driving head (typically 18-21 inches or less (457-533 mm)) | Design flexibility, lower construction cost |
| Lightweight cartridges with passive backwash | Easy maintenance and low life-cycle cost |

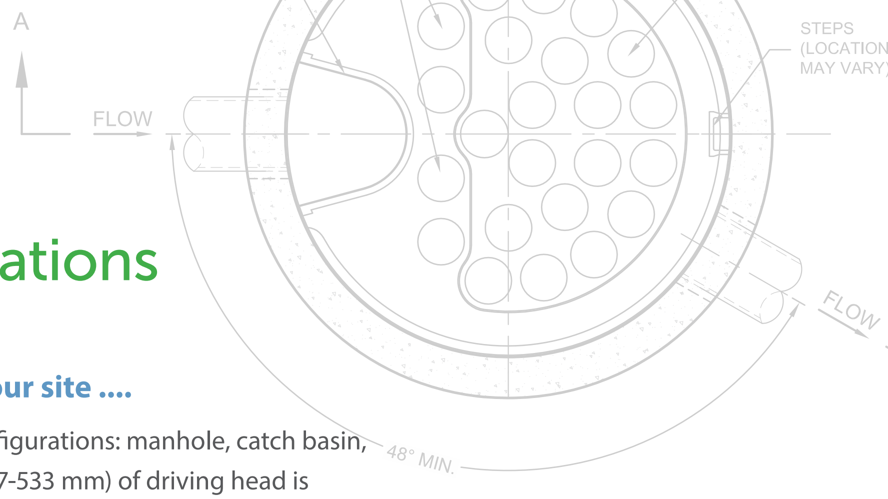
**The Jellyfish Filter can be configured in a manhole, catch basin, or vault.**

# Select Jellyfish® Filter Certifications and Verifications

The Jellyfish Filter has been reviewed by numerous state and federal programs, including:

- New Jersey Corporation for Advanced Technology (NJCAT) – Field Performance per TARP Tier II Protocol
- Washington State Department of Ecology (TAPE – GULD)
- Maryland Department of the Environment (MD DOE)
- Canada ISO 14034 Environmental Management - Environmental Technology Verification (ETV)
- Texas Commission on Environmental Quality (TCEQ)
- Virginia Department of Environmental Quality (VA DEQ)

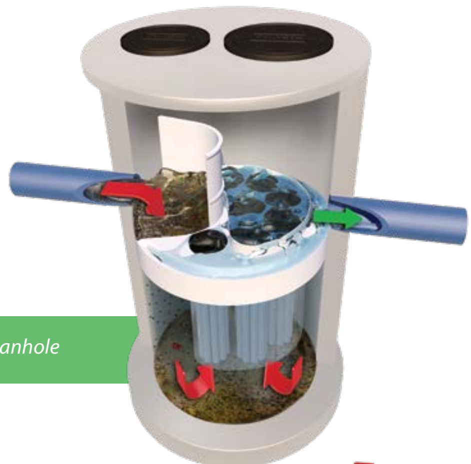
**Field tested and performance verified**



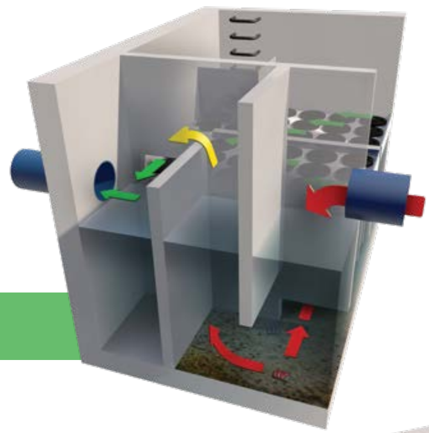

# Jellyfish® Filter Configurations

## Multiple system configurations to optimize your site ....

The Jellyfish Filter can be manufactured in a variety of configurations: manhole, catch basin, vault, or custom configurations. Typically, 18-21 inches (457-533 mm) of driving head is designed into the system.

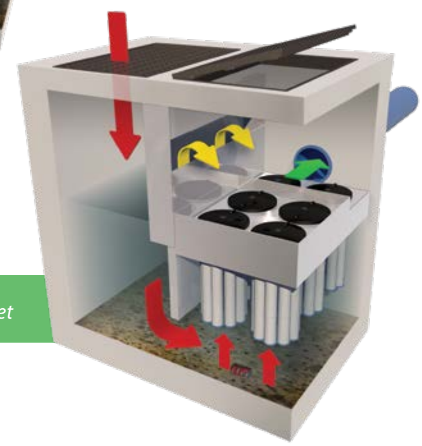


*Manhole*



*Vault*

*Curb Inlet*



*Grated Inlet*

# Jellyfish® Filter Maintenance

- Jellyfish Filter cartridges are light weight and reusable
- Maintenance of the filter cartridges is performed by removing, rinsing and reusing the cartridge tentacles.
- Vacuum extraction of captured pollutants in the sump is recommended at the same time.
- Full cartridge replacement intervals differ by site due to varying pollutant loading and type, and maintenance frequency. Replacement is anticipated every 2-5 years.
- Contech® has created a network of Certified Maintenance Providers to provide maintenance on stormwater BMPs.

*The Jellyfish® Filter tentacle is light and easy to clean.*

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**THE CONTECH WAY**

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors, and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

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# Parameter Brief

## Removal of Suspended Solids using the CDS® System – Laboratory Evaluations

The CDS® system is a hydrodynamic separator which uses patented continuous deflective separation (CDS) technology to separate and capture trash, debris, sediment and oil and grease from stormwater runoff. Indirect screening allows for 100% removal of floatables and neutrally buoyant material without blinding the screen. Flow and screening controls separate captured solids and minimize resuspension of previously captured pollutants.

The CDS system can effectively capture 100% of particulate material, including trash and debris, greater than screen aperture size (2400 or 4700 microns). In addition, the CDS can remove medium and coarse sediments. A full-scale laboratory evaluation of the CDS system using test materials with various particle size distributions is summarized here.

### Laboratory Study – Full-Scale Evaluation at University of Florida

A full-scale CDS unit (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This full-scale CDS unit was evaluated under controlled laboratory conditions of pumped influent and the controlled addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSD) of the test materials were analyzed using standard method "Gradation ASTM D-422 with Hydrometer" by a certified laboratory. UF Sediment is a mixture of three different U.S. Silica Sand products referred as: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation ($d_{50}$ = 20 to 30 µm) covering a wide size range (uniform coefficient $C_u$ averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer $d_{50}$ ($d_{50}$ for NJDEP is approximately 50 µm) (NJDEP, 2003). The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size ($d_{50}$) of 106 microns. The PSDs for the test material are shown in Figure 1.

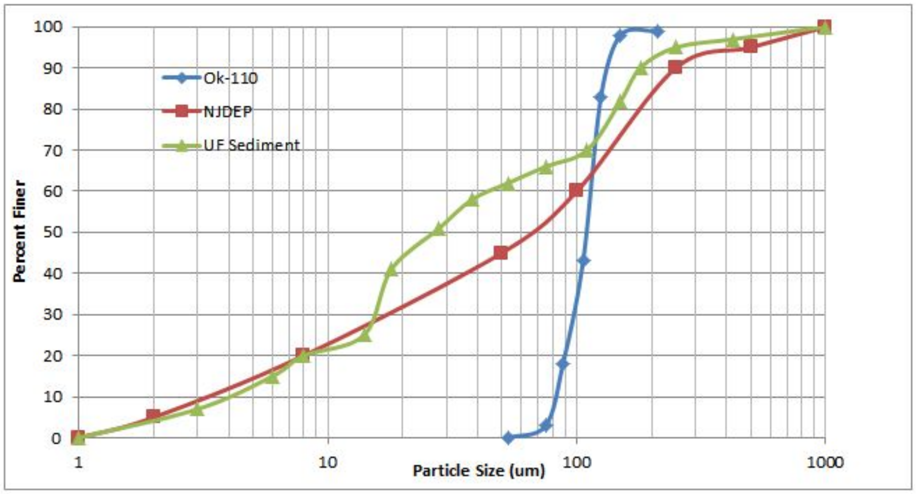


**Figure 1.** Particle size distributions for the test materials, as compared to the NJCAT/NJDEP theoretical distribution.

Tests were conducted to quantify the CDS unit (1.1 cfs design capacity) performance at various flow rates, ranging from 1% up to 125% of the design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC – ASTM Standard Method D3977-97) and particle size distribution analysis.

**Results and Modeling**

Based on the testing data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve for the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation assuming sandy-silt type of inorganic components of SSC. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand).

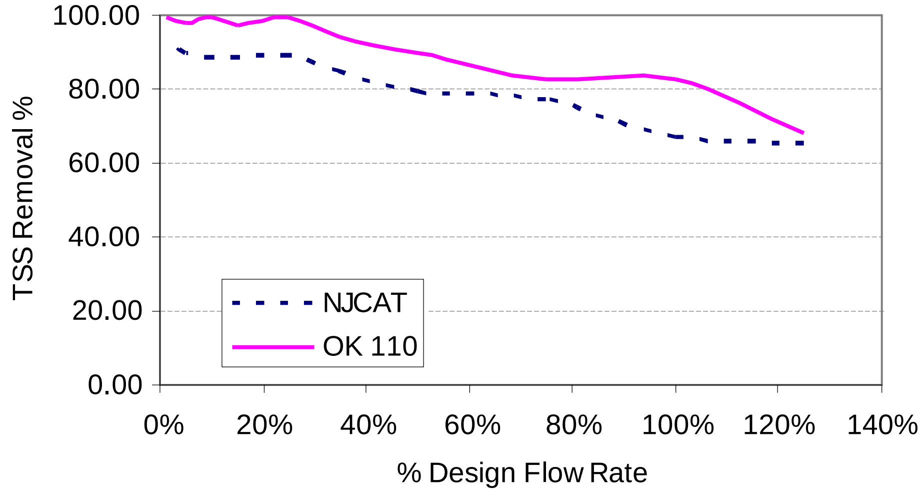


**Figure 2.** CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size ($d_{50}$) of 125 microns (WADOE, 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). Supported by the laboratory data, the model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at 100% of design flow rate, for this particle size distribution ($d_{50}$ = 125 µm).

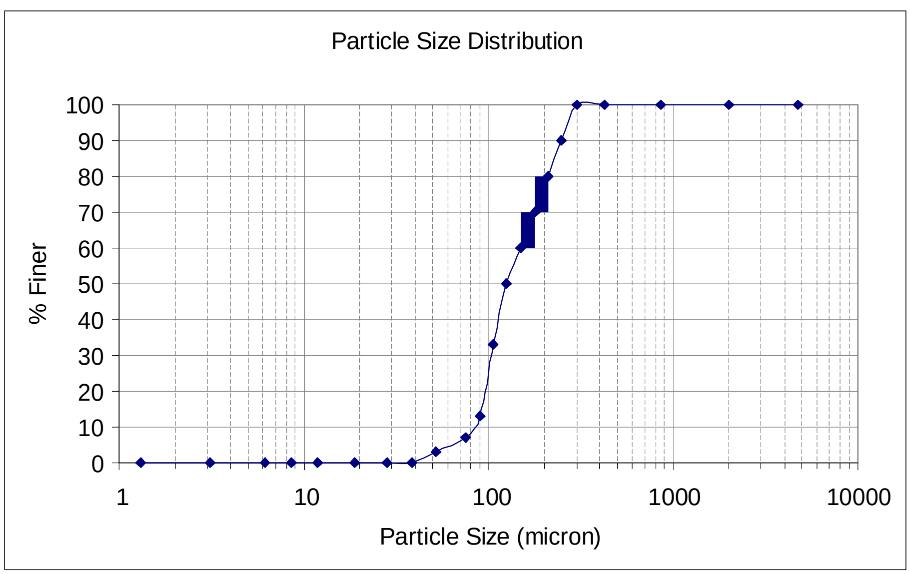


**Figure 3.** PSD with $d_{50}$ = 125 microns, used to model performance for Ecology submittal.

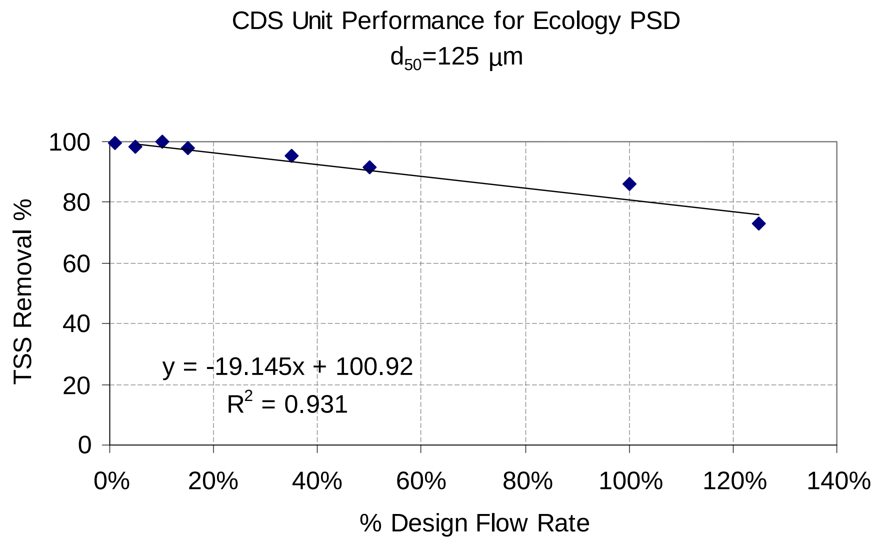


**Figure 4.** Modeled performance for CDS unit with 2400 microns screen, using Ecology PSD.

## References:

New Jersey Department of Environmental Protection (NJDEP). (2003). Total Suspended Solids Laboratory Testing Procedures (December 23, 2003).

Washington State Department of Ecology (WADOE). (2008). Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol—Ecology (TAPE) (Publication Number 02-10-037). Olympia, Washington: Author. Available Online: www.ecy.wa.gov/biblio/0210037.html

# APPENDIX J: CALCULATIONS

BEALS · ASSOCIATES INC.
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| Project ID | Prepared By | Checked By | Date |
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| C-1381 | TML | DPH | 2024.10.11 |

Title: Hydraulic Grade Line Calculations — Storm Event-25 Year

| STRUCTURE | | | | | | PIPE | | | | COEFFICIENTS | | HEAD LOSSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| POA 1 | | | 336.00 | | | | | | | | | | |
| EX-RCP 1 | | SURCHARGED | 336.00 | | | 51 | 24 | 12.44 | 3.96 | | | 0.13 | |
| OCS 1 | 60 | | 341.77 | 346.00 | 3.85 | | | | | 1.00 | 105 | | 0.38 |
| SD 12 | | SURCHARGED | 342.15 | | | 91 | 24 | 12.82 | 4.08 | | | 0.25 | |
| WQU 1 | 48 | | 342.40 | 346.73 | 4.21 | | | | | 2.00 | 180 | | 0.12 |
| SD 10 | | SURCHARGED | 342.52 | | | 70 | 24 | 9.11 | 2.90 | | | 0.10 | |
| DMH 6 | 48 | | 342.61 | 347.59 | 4.92 | | | | | 2.00 | 180 | | 0.06 |
| SD 8 | | SURCHARGED | 342.67 | | | 214 | 18 | 6.93 | 3.92 | | | 0.79 | |
| DMH 4 | 48 | | 343.46 | 347.59 | 3.21 | | | | | 1.71 | 90 | | 0.91 |
| SD 6 | | SURCHARGED | 344.38 | | | 109 | 18 | 6.40 | 3.62 | | | 0.35 | |
| DMH 3 | 48 | | 344.72 | 347.29 | 2.39 | | | | | 2.00 | 180 | | 0.18 |
| SD 5 | | SURCHARGED | 344.90 | | | 130 | 18 | 5.52 | 3.12 | | | 0.31 | |
| DMH 2 | 48 | | 345.21 | 347.29 | 1.95 | | | | | 2.00 | 180 | | 0.13 |
| SD 3 | | SURCHARGED | 345.34 | | | 168 | 18 | 3.57 | 2.02 | | | 0.17 | |
| DMH 1 | 48 | | 345.50 | 347.29 | 1.72 | | | | | 1.89 | 176 | | 0.07 |
| SD 1 | | SURCHARGED | 345.57 | | | 140 | 12 | 1.14 | 1.46 | | | 0.12 | |
| CB 1 | 48 | | 345.69 | 346.94 | 1.25 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 1 | 48 | | 345.50 | 347.29 | 1.60 | | | | | 1.22 | 90 | | 0.18 |
| SD 2 | | SURCHARGED | 345.69 | | | 26 | 12 | 2.55 | 3.25 | | | 0.11 | |
| CB 2 | 48 | | 345.80 | 346.28 | 0.48 | | | | | | | | |
| | | | 345.80 | | | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 2 | 48 | | 345.21 | 347.29 | 1.83 | | | | | 0.64 | 90 | | 0.25 |
| SD 4 | | SURCHARGED | 345.46 | | | 26 | 12 | 2.23 | 2.84 | | | 0.09 | |
| CB 3 | 48 | | 345.55 | 346.28 | 0.73 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 3 | 48 | | 344.72 | 347.29 | 2.41 | | | | | 0.28 | 90 | | 0.15 |
| SD 16 | | SURCHARGED | 344.88 | | | 7 | 12 | 1.15 | 1.47 | | | 0.01 | |
| CB 4 | 48 | | 344.88 | 346.85 | 1.97 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 4 | 48 | | 343.46 | 347.59 | 3.98 | | | | | 0.29 | 110 | | 0.15 |
| SD 7 | | NOT SURCHARGED | 343.61 | | | 29 | 12 | 0.84 | 1.07 | | | 0.01 | |
| CB 5 | 48 | | 344.03 | 346.92 | 2.89 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 6 | 48 | | 342.61 | 347.59 | 4.85 | | | | | 0.55 | 90 | | 0.13 |
| SD 9 | | NOT SURCHARGED | 342.74 | | | 37 | 12 | 3.20 | 4.08 | | | 0.25 | |
| CB 6 | 48 | | 343.50 | 345.92 | 2.42 | | | | | | | | |

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| | | Title | Hydraulic Grade Line Calculations | Storm Event-25 Year | |

| STRUCTURE | | | | | | PIPE | | | | COEFFICIENTS | | HEAD LOSSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| WQU 1 | 48 | | 342.40 | 346.73 | 4.05 | | | | | 0.62 | 101 | | 0.28 |
| SD 11 | | SURCHARGED | 342.68 | | | 72 | 12 | 4.82 | 6.14 | | | 1.13 | |
| DMH 5 | 48 | | 343.81 | 347.00 | 3.19 | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| POND | | | 336.00 | | | | | | | | 0 | | 0.00 |
| EX-RCP 4 | | SURCHARGED | 336.00 | | | 48 | 36 | 43.40 | 6.14 | | | 0.17 | |
| DMH 115 | 72 | | 336.17 | 342.82 | 6.26 | | | | | 1.00 | 166 | | 0.39 |
| SD 151 | | SURCHARGED | 336.56 | | | 83 | 36 | 43.41 | 6.14 | | | 0.30 | |
| DMH 125 | 96 | | 336.86 | 343.44 | 5.75 | | | | | 1.15 | 151 | | 0.83 |
| SD 148 | | SURCHARGED | 337.69 | | | 114 | 24 | 7.06 | 2.25 | | | 0.09 | |
| DMH 124 | 48 | | 337.78 | 343.32 | 5.51 | | | | | 1.00 | 180 | | 0.02 |
| SD 147 | | SURCHARGED | 337.81 | | | 241 | 24 | 7.62 | 2.43 | | | 0.23 | |
| DMH 123 | 48 | | 338.04 | 343.33 | 5.19 | | | | | 1.00 | 150 | | 0.10 |
| SD 146 | | SURCHARGED | 338.14 | | | 81 | 24 | 7.68 | 2.44 | | | 0.08 | |
| DMH 122 | 48 | | 338.22 | 344.33 | 6.09 | | | | | 1.00 | 180 | | 0.02 |
| SD 144 | | NOT SURCHARGED | 338.24 | | | 263 | 24 | 8.29 | 2.64 | | | 0.30 | |
| DMH 105 | 48 | | 338.54 | 346.43 | 7.72 | | | | | 1.00 | 90 | | 0.16 |
| SD 112 | | NOT SURCHARGED | 338.71 | | | 180 | 24 | 8.70 | 2.77 | | | 0.23 | |
| DMH 104 | 48 | | 338.93 | 344.95 | 5.84 | | | | | 1.00 | 75 | | 0.18 |
| EX-RCP 3 | | NOT SURCHARGED | 339.11 | | | 19 | 24 | 8.73 | 2.78 | | | 0.02 | |
| EX CB2 | | | 339.13 | 340.00 | 0.87 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 125 | 96 | | 336.86 | 343.44 | 4.90 | | | | | 1.48 | 119 | | 1.68 |
| SD 150 | | NOT SURCHARGED | 338.54 | | | 52 | 30 | 34.88 | 7.11 | | | 0.32 | |
| OCS 2 | 60 | | 338.86 | 343.93 | 5.07 | | | | | | | | |

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Title: Hydraulic Grade Line Calculations — Storm Event-25 Year

| STRUCTURE | | | | | | PIPE | | | | COEFFICIENTS | | HEAD LOSSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| | | | | | | | | | | | | | 0.00 |
| DMH 125 | 96 | | 336.86 | 343.44 | 5.67 | | | | | 1.82 | 164 | | 0.91 |
| SD 133 | | SURCHARGED | 337.77 | | | 15 | 36 | 33.51 | 4.74 | | | 0.03 | |
| PMF 1 | 96 | | 337.80 | 343.44 | 5.52 | | | | | 1.00 | 180 | | 0.12 |
| SD 152 | | SURCHARGED | 337.92 | | | 10 | 36 | 33.53 | 4.74 | | | 0.02 | |
| WQU 2 | 96 | | 337.94 | 343.47 | 4.71 | | | | | 1.71 | 135 | | 0.82 |
| SD 131 | | NOT SURCHARGED | 338.76 | | | 22 | 36 | 29.40 | 4.16 | | | 0.04 | |
| DMH 113 | 60 | | 338.79 | 343.28 | 4.41 | | | | | 2.00 | 180 | | 0.08 |
| SD 129 | | NOT SURCHARGED | 338.87 | | | 86 | 36 | 28.02 | 3.96 | | | 0.13 | |
| DMH 112 | 60 | | 339.00 | 343.28 | 4.21 | | | | | 2.00 | 180 | | 0.07 |
| SD 127 | | NOT SURCHARGED | 339.07 | | | 85 | 30 | 26.66 | 5.43 | | | 0.31 | |
| DMH 111 | 60 | | 339.43 | 343.28 | 3.67 | | | | | 2.00 | 180 | | 0.18 |
| SD 153 | | SURCHARGED | 339.61 | | | 35 | 24 | 24.88 | 7.92 | | | 0.36 | |
| DMH 126 | 72 | | 339.97 | 343.27 | 2.57 | | | | | 2.00 | 180 | | 0.73 |
| SD 125 | | SURCHARGED | 340.70 | | | 45 | 24 | 15.78 | 5.02 | | | 0.19 | |
| DMH 110 | 48 | | 340.89 | 343.28 | 1.87 | | | | | 1.85 | 163 | | 0.52 |
| SD 122 | | SURCHARGED | 341.41 | | | 84 | 24 | 13.15 | 4.19 | | | 0.24 | |
| DMH 109 | 60 | | 341.65 | 344.37 | 2.33 | | | | | 1.88 | 162 | | 0.39 |
| SD 119 | | NOT SURCHARGED | 342.04 | | | 54 | 24 | 11.64 | 3.71 | | | 0.12 | |
| DMH 108 | 48 | | 342.16 | 345.23 | 2.79 | | | | | 1.00 | 124 | | 0.28 |
| SD 105 | | SURCHARGED | 342.44 | | | 150 | 24 | 12.17 | 3.87 | | | 0.37 | |
| DMH 101 | 48 | | 342.81 | 347.00 | 4.00 | | | | | 1.69 | 169 | | 0.19 |
| SD 102 | | SURCHARGED | 343.00 | | | 122 | 12 | 2.44 | 3.11 | | | 0.49 | |
| DMH 100 | 48 | | 343.49 | 347.88 | 4.19 | | | | | 0.78 | 131 | | 0.20 |
| SD 101 | | NOT SURCHARGED | 343.69 | | | 13 | 12 | 0.58 | 0.74 | | | 0.00 | |
| CB 100 | 48 | | 344.30 | 347.31 | 3.01 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 100 | 48 | | 343.49 | 347.88 | 4.02 | | | | | 1.25 | 117 | | 0.37 |
| SD 100 | | NOT SURCHARGED | 343.86 | | | 58 | 12 | 1.67 | 2.13 | | | 0.11 | |
| CB 112 | 48 | | 343.96 | 346.40 | 2.44 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 100 | 48 | | 343.49 | 347.88 | 4.35 | | | | | 0.14 | 96 | | 0.05 |
| EX-RCP 2 | | NOT SURCHARGED | 343.53 | | | 75 | 12 | 0.21 | 0.27 | | | 0.00 | |
| EX CB1 | 48 | | 343.53 | 345.70 | 2.17 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 101 | 48 | | 342.81 | 347.00 | 4.10 | | | | | 0.28 | 118 | | 0.10 |
| SD 104 | | NOT SURCHARGED | 342.90 | | | 18 | 12 | 0.38 | 0.48 | | | 0.00 | |
| CB 101 | 48 | | 343.69 | 346.83 | 3.14 | | | | | | | | |

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| STRUCTURE | | | | | | PIPE | | | | COEFFICIENTS | | HEAD LOSSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| | | | | | | | | | | | | | 0.00 |
| DMH 109 | 60 | | 341.65 | 344.37 | 2.56 | | | | | 0.36 | 120 | | 0.16 |
| SD 121 | | SURCHARGED | 341.81 | | | 25 | 12 | 0.95 | 1.21 | | | 0.02 | |
| CB 110 | 48 | | 341.83 | 344.13 | 2.30 | | | | | | | | |
| DMH 109 | 60 | | 341.65 | 344.37 | 2.66 | | | | | 0.11 | 98 | | 0.06 |
| SD 120 | | NOT SURCHARGED | 341.71 | | | 4 | 12 | 0.82 | 1.04 | | | 0.00 | |
| CB 111 | 48 | | 341.71 | 344.28 | 2.57 | | | | | | | | |
| DMH 110 | 48 | | 340.89 | 343.28 | 2.39 | | | | | 1.00 | 90 | | 0.00 |
| SD 123 | | SURCHARGED | 340.89 | | | 13 | 12 | 3.16 | 4.02 | | | 0.09 | |
| DCB 100 | 72 | | 340.97 | 342.92 | 1.95 | | | | | | | | |
| DMH 111 | 60 | | 339.43 | 343.28 | 3.85 | | | | | 1.00 | 90 | | 0.00 |
| SD 126 | | NOT SURCHARGED | 339.43 | | | 13 | 12 | 2.51 | 3.19 | | | 0.05 | |
| DCB 101 | 72 | | 340.05 | 342.92 | 2.87 | | | | | | | | |
| DMH 112 | 60 | | 339.00 | 343.28 | 4.28 | | | | | 1.00 | 90 | | 0.00 |
| SD 128 | | NOT SURCHARGED | 339.00 | | | 13 | 12 | 2.51 | 3.19 | | | 0.05 | |
| DCB 102 | 72 | | 340.05 | 342.92 | 2.87 | | | | | | | | |
| DMH 113 | 60 | | 338.79 | 343.28 | 4.44 | | | | | 0.13 | 90 | | 0.05 |
| SD 130 | | NOT SURCHARGED | 338.84 | | | 13 | 12 | 2.53 | 3.22 | | | 0.05 | |
| DCB 103 | 72 | | 340.06 | 342.92 | 2.86 | | | | | | | | |
| WQU 2 | 96 | | 337.94 | 343.47 | 5.12 | | | | | 1.16 | 29 | | 0.42 |
| SD 132 | | NOT SURCHARGED | 338.35 | | | 57 | 12 | 5.33 | 6.79 | | | 1.09 | |
| DCB 104 | 72 | | 340.50 | 342.92 | 2.42 | | | | | | | | |

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| STRUCTURE | | | | | | PIPE | | | | COEFFICIENTS | | HEAD LOSSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| DMH 111 | 60 | | 339.43 | 343.28 | 3.35 | | | | | 0.80 | 119 | | 0.50 |
| SD 149 | | SURCHARGED | 339.93 | | | 157 | 24 | 10.43 | 3.32 | | | 0.28 | |
| DMH 120 | 48 | | 340.22 | 343.03 | 2.63 | | | | | 1.73 | 167 | | 0.18 |
| SD 143 | | SURCHARGED | 340.40 | | | 150 | 18 | 4.94 | 2.80 | | | 0.28 | |
| DMH 119 | 48 | | 340.68 | 345.60 | 4.59 | | | | | 1.47 | 102 | | 0.33 |
| SD 142 | | SURCHARGED | 341.01 | | | 168 | 18 | 4.07 | 2.30 | | | 0.21 | |
| DMH 102 | 48 | | 341.22 | 346.19 | 4.92 | | | | | 2.00 | 180 | | 0.05 |
| SD 141 | | SURCHARGED | 341.27 | | | 111 | 12 | 1.95 | 2.48 | | | 0.28 | |
| DMH 118 | 48 | | 341.56 | 346.38 | 4.72 | | | | | 2.00 | 180 | | 0.11 |
| SD 140 | | SURCHARGED | 341.66 | | | 51 | 12 | 0.85 | 1.08 | | | 0.02 | |
| DMH 103 | 48 | | 341.69 | 346.29 | 4.56 | | | | | 1.00 | 110 | | 0.04 |
| SD 111 | | SURCHARGED | 341.73 | | | 66 | 12 | 0.86 | 1.10 | | | 0.03 | |
| CB 106 | 48 | | 341.76 | 343.92 | 2.16 | | | | | | | | |
| DMH 120 | 48 | | 340.22 | 343.03 | 2.48 | | | | | 1.10 | 112 | | 0.33 |
| SD 124 | | SURCHARGED | 340.55 | | | 84 | 18 | 6.44 | 3.65 | | | 0.27 | |
| DCB 105 | 72 | | 340.82 | 341.70 | 0.88 | | | | | | | | |
| DMH 119 | 48 | | 340.68 | 345.60 | 4.76 | | | | | 1.28 | 154 | | 0.16 |
| SD 106 | | NOT SURCHARGED | 340.84 | | | 28 | 12 | 1.19 | 1.52 | | | 0.03 | |
| CB 103 | 48 | | 342.21 | 345.38 | 3.17 | | | | | | | | |
| DMH 102 | 48 | | 341.22 | 346.19 | 4.82 | | | | | 0.94 | 90 | | 0.15 |
| SD 107 | | NOT SURCHARGED | 341.37 | | | 21 | 12 | 2.33 | 2.97 | | | 0.08 | |
| CB 104 | 48 | | 342.29 | 345.38 | 3.09 | | | | | | | | |
| DMH 119 | 48 | | 340.68 | 345.60 | 4.84 | | | | | 0.36 | 90 | | 0.08 |
| SD 109 | | NOT SURCHARGED | 340.76 | | | 21 | 12 | 1.15 | 1.46 | | | 0.02 | |
| CB 105 | 48 | | 342.56 | 345.77 | 3.21 | | | | | | | | |
| | | | 342.56 | | | | | | | | | | |

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Title: Hydraulic Grade Line Calculations — Storm Event-25 Year

| STRUCTURE | | | | | | PIPE | | | | COEFFICIENTS | | HEAD LOSSES | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STRUCTURE I.D | DIAMETER (INCHES) | SURCHARGE | DEPTH OF FLOW | RIM/FLOOD ELEV. | FREEBOARD (FT) | LENGTH (FT) | DIAM. (IN.) | FLOW (CFS) | VELOCITY (FPS) | CORRECTION FACTOR FOR RELATIVE FLOW (Cq) | CHANGE IN DIRECTION | FRICTION LOSS (FT) | MINOR LOSS (FT) |
| DMH 101 | 48 | | 342.81 | 347.00 | 4.19 | | | | | 1.34 | 90 | | |
| SD 118 | | SURCHARGED | 342.81 | | | 78 | 18 | 9.40 | 5.32 | | | 0.53 | |
| DMH 107 | 48 | | 343.34 | 346.57 | 2.65 | | | | | 1.67 | 166 | | 0.58 |
| SD 116 | | SURCHARGED | 343.92 | | | 123 | 18 | 3.64 | 2.06 | | | 0.13 | |
| DMH 106 | 48 | | 344.05 | 346.02 | 1.87 | | | | | 1.19 | 145 | | 0.10 |
| SD 113 | | SURCHARGED | 344.15 | | | 94 | 12 | 1.37 | 1.74 | | | 0.12 | |
| CB 107 | 48 | | 344.27 | 345.76 | 1.49 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 107 | 48 | | 343.34 | 346.57 | 2.18 | | | | | 1.10 | 90 | | 1.05 |
| SD 117 | | SURCHARGED | 344.39 | | | 51 | 18 | 6.18 | 3.50 | | | 0.15 | |
| DCB 109 | 72 | | 344.54 | 345.12 | 0.58 | | | | | | | | |
| | | | | | | | | | | | | | |
| DMH 106 | 48 | | 344.05 | 346.02 | 1.84 | | | | | 1.36 | 136 | | 0.14 |
| SD 115 | | SURCHARGED | 344.18 | | | 14 | 12 | 2.37 | 3.01 | | | 0.05 | |
| CB 108 | 48 | | 344.23 | 345.72 | 1.49 | | | | | | | | |
| | | | | | | | | | | | | | |
| DET 1 | | | 340.44 | | | | | | | | 0 | | |
| SD 202 | | SURCHARGED | 340.44 | | | 97 | 24 | 18.00 | 5.73 | | | 0.52 | |
| DMH 202 | 48 | | 340.96 | 347.85 | 5.41 | | | | | 1.18 | 92 | | 1.48 |
| SD 201 | | SURCHARGED | 342.44 | | | 86 | 18 | 12.52 | 7.09 | | | 1.04 | |
| DMH 201 | 48 | | 343.48 | 345.30 | 0.37 | | | | | 1.17 | 78 | | 1.44 |
| SD 200 | | SURCHARGED | 344.93 | | | 216 | 18 | 8.49 | 4.81 | | | 1.20 | |
| DMH 200 | 48 | | 346.13 | 346.90 | 0.77 | | | | | | | | |

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **EX-RCP 2**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ $Q = \frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.07 sf |
| $R_h$ | 0.09 ft |
| $S_e$ | 0.014 ft/ft |
| Q | 0.21 cfs |
| Pipe Dia. | 12 in |
| Theta | 90.09 |
| Wet Perim | 0.79 ft |
| Velocity | 2.96 ft/s |

**Percent of full depth** = 9.11%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **EX-RCP 3**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ $Q = \frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 1.44 sf |
| $R_h$ | 0.48 ft |
| $S_e$ | 0.007 ft/ft |
| Q | 8.82 cfs |
| Pipe Dia. | 24 in |
| Theta | 172.21 |
| Wet Perim | 3.01 ft |
| Velocity | 6.15 ft/s |

**Percent of full depth** = 45.68%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 7**

Mannings Equation $V = \frac{1.49}{n} R_h^{2/3} S_e^{1/2}$ $Q = \frac{1.49}{n} A R_h^{2/3} S_e^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.15 sf |
| $R_h$ | 0.15 ft |
| $S_e$ | 0.025 ft/ft |
| Q | 0.84 cfs |
| Pipe Dia. | 12 in |
| Theta | 120.10 |
| Wet Perim | 1.05 ft |
| Velocity | 5.45 ft/s |

**Percent of full depth** = 19.59%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 9**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ $Q = \frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.79 sf |
| $R_h$ | 0.25 ft |
| $S_e$ | 0.004 ft/ft |
| Q | 2.44 cfs |
| Pipe Dia. | 12 in |
| Theta | 0.00 |
| Wet Perim | 3.14 ft |
| Velocity | 3.11 ft/s |

**Percent of full depth** = 100.00%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 100**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.31 sf |
| $R_h$ | 0.22 ft |
| $S_e$ | 0.014 ft/ft |
| Q | 1.68 cfs |
| Pipe Dia. | 12 in |
| Theta | 160.65 |
| Wet Perim | 1.40 ft |
| Velocity | 5.42 ft/s |

**Percent of full depth** = 39.35%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 101**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.23 sf |
| $R_h$ | 0.19 ft |
| $S_e$ | 0.004 ft/ft |
| Q | 0.59 cfs |
| Pipe Dia. | 12 in |
| Theta | 141.18 |
| Wet Perim | 1.23 ft |
| Velocity | 2.56 ft/s |

**Percent of full depth** = 29.24%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 104**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.17 sf |
| $R_h$ | 0.16 ft |
| $S_e$ | 0.004 ft/ft |
| Q | 0.39 cfs |
| Pipe Dia. | 12 in |
| Theta | 125.01 |
| Wet Perim | 1.09 ft |
| Velocity | 2.27 ft/s |

**Percent of full depth** = 21.69%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 106**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.15 sf |
| $R_h$ | 0.15 ft |
| $S_e$ | 0.052 ft/ft |
| Q | 1.19 cfs |
| Pipe Dia. | 12 in |
| Theta | 119.74 |
| Wet Perim | 1.04 ft |
| Velocity | 7.81 ft/s |

**Percent of full depth** = 19.44%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 107**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.22 sf |
| $R_h$ | 0.18 ft |
| $S_e$ | 0.068 ft/ft |
| Q | 2.33 cfs |
| Pipe Dia. | 12 in |
| Theta | 139.45 |
| Wet Perim | 1.22 ft |
| Velocity | 10.45 ft/s |

**Percent of full depth** = 28.39%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 109**

Mannings Equation $V = \frac{1.49}{n} R_h^{2/3} S_e^{1/2}$ Q= $\frac{1.49}{n} A R_h^{2/3} S_e^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.12 sf |
| $R_h$ | 0.13 ft |
| $S_e$ | 0.090 ft/ft |
| Q | 1.15 cfs |
| Pipe Dia. | 12 in |
| Theta | 109.99 |
| Wet Perim | 0.96 ft |
| Velocity | 9.39 ft/s |

**Percent of full depth** = 15.59%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 112**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 2.39 sf |
| $R_h$ | 0.60 ft |
| $S_e$ | 0.002 ft/ft |
| Q | 8.66 cfs |
| Pipe Dia. | 24 in |
| Theta | 129.70 |
| Wet Perim | 4.02 ft |
| Velocity | 3.61 ft/s |

**Percent of full depth** = 76.22%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 119**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 1.19 sf |
| $R_h$ | 0.43 ft |
| $S_e$ | 0.019 ft/ft |
| Q | 11.65 cfs |
| Pipe Dia. | 24 in |
| Theta | 158.13 |
| Wet Perim | 2.76 ft |
| Velocity | 9.76 ft/s |

**Percent of full depth** = 38.00%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 120**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.27 sf |
| $R_h$ | 0.21 ft |
| $S_e$ | 0.004 ft/ft |
| Q | 0.75 cfs |
| Pipe Dia. | 12 in |
| Theta | 152.30 |
| Wet Perim | 1.33 ft |
| Velocity | 2.73 ft/s |

**Percent of full depth** = 34.91%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 126**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.45 sf |
| $R_h$ | 0.27 ft |
| $S_e$ | 0.012 ft/ft |
| Q | 2.51 cfs |
| Pipe Dia. | 12 in |
| Theta | 167.50 |
| Wet Perim | 1.68 ft |
| Velocity | 5.61 ft/s |

**Percent of full depth** = 56.92%

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Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 127**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 4.91 sf |
| $R_h$ | 0.63 ft |
| $S_e$ | 0.002 ft/ft |
| Q | 18.32 cfs |
| Pipe Dia. | 30 in |
| Theta | 0.00 |
| Wet Perim | 7.85 ft |
| Velocity | 3.73 ft/s |

**Percent of full depth** = 100.00%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 128**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.45 sf |
| $R_h$ | 0.27 ft |
| $S_e$ | 0.012 ft/ft |
| Q | 2.51 cfs |
| Pipe Dia. | 12 in |
| Theta | 167.50 |
| Wet Perim | 1.68 ft |
| Velocity | 5.61 ft/s |

**Percent of full depth** = 56.92%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 129**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 5.77 sf |
| $R_h$ | 0.91 ft |
| $S_e$ | 0.002 ft/ft |
| Q | 27.59 cfs |
| Pipe Dia. | 36 in |
| Theta | 117.30 |
| Wet Perim | 6.35 ft |
| Velocity | 4.79 ft/s |

**Percent of full depth** = 81.56%

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Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 130**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ $Q = \frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.45 sf |
| $R_h$ | 0.27 ft |
| $S_e$ | 0.012 ft/ft |
| Q | 2.53 cfs |
| Pipe Dia. | 12 in |
| Theta | 166.96 |
| Wet Perim | 1.68 ft |
| Velocity | 5.62 ft/s |

**Percent of full depth** = 57.21%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 131**

Mannings Equation $V = \frac{1.49}{n} R_h^{2/3} S_e^{1/2}$ Q= $\frac{1.49}{n} A R_h^{2/3} S_e^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 2.06 sf |
| $R_h$ | 0.56 ft |
| $S_e$ | 0.029 ft/ft |
| Q | 29.39 cfs |
| Pipe Dia. | 36 in |
| Theta | 140.90 |
| Wet Perim | 3.69 ft |
| Velocity | 14.29 ft/s |

**Percent of full depth** = 29.10%

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Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 132**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 0.79 sf |
| $R_h$ | 0.25 ft |
| $S_e$ | 0.004 ft/ft |
| Q | 2.44 cfs |
| Pipe Dia. | 12 in |
| Theta | 0.00 |
| Wet Perim | 3.14 ft |
| Velocity | 3.11 ft/s |

**Percent of full depth** = 100.00%

| BEALS • ASSOCIATES INC. | Project ID<br>C-1381 | Prepared By<br>TML | Checked By<br>DPH | Date<br>10.11.24 |
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Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 144**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 2.30 sf |
| $R_h$ | 0.59 ft |
| $S_e$ | 0.002 ft/ft |
| Q | 8.26 cfs |
| Pipe Dia. | 24 in |
| Theta | 135.94 |
| Wet Perim | 3.91 ft |
| Velocity | 3.59 ft/s |

**Percent of full depth** = 73.30%

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| Project ID | Prepared By | Checked By | Date |
|---|---|---|---|
| C-1381 | TML | DPH | 10.11.24 |

Title 25-Year Hydraulic Grade Line Calculations

Purpose Calculate the flow in a pipe using Manning's equation
25-Year Storm

Calculations **SD 150**

Mannings Equation $V = \frac{1.49}{n} R_h{}^{2/3} S_e{}^{1/2}$ Q= $\frac{1.49}{n} A R_h{}^{2/3} S_e{}^{1/2}$

| | |
|---|---|
| n | 0.012 |
| A | 2.16 sf |
| $R_h$ | 0.59 ft |
| $S_e$ | 0.035 ft/ft |
| Q | 34.87 cfs |
| Pipe Dia. | 30 in |
| Theta | 169.28 |
| Wet Perim | 3.69 ft |
| Velocity | 16.12 ft/s |

**Percent of full depth** = 44.06%

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| Project ID | Prepared By | Checked By | Date |
|---|---|---|---|
| C-1381 | TML | DPH | 2024.10.11 |

Title Worksheet for Storm Drain Design
Storm Event-25 Year

IDF Curve for Boston MA

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Discharge | | | | | | | Pipe Data | | | | | Vertical Control | |
| Inlet No. | Connected Outlet Pipe | Drainage Area (Acres) | Coefficient c | CA | Tc or Pipe Flow Time (min) | Total Tc (min) | Rainfall Intensity (i) (in./hr) | Design Discharge (cfs) | Length (ft) | Slope (ft/ft) | Diameter (in) | Full-Flow Capacity (cfs) | Full-Flow Velocity (ft/s) | Start Invert | End Invert |
| CB 107 | SD 113 | 0.17 | 0.83 | 0.14 | 6.00 | 6.00 | 9.83 | 1.37 | 94 | 0.004 | 12 | 2.95 | 3.75 | 342.34 | 341.96 |
| CB 108 | SD 115 | 0.42 | 0.57 | 0.24 | 6.00 | 6.00 | 9.83 | 2.37 | 14 | 0.024 | 12 | 7.22 | 9.19 | 342.30 | 341.96 |
| DMH 106 | SD 116 | 0.59 | 0.64 | 0.38 | 0.42 | 6.42 | 9.58 | 3.64 | 123 | 0.004 | 18 | 8.61 | 4.87 | 341.86 | 341.37 |
| DCB 109 | SD 117 | 0.77 | 0.82 | 0.63 | 6.00 | 6.00 | 9.83 | 6.18 | 51 | 0.003 | 18 | 6.91 | 3.91 | 341.12 | 340.99 |
| DMH 107 | SD 118 | 1.36 | 0.74 | 1.01 | 0.42 | 6.84 | 9.32 | 9.40 | 78 | 0.003 | 18 | 6.93 | 3.92 | 340.89 | 340.69 |
| EX CB1 | EX-RCP 2 | 0.17 | 0.13 | 0.02 | 6.00 | 6.00 | 9.83 | 0.21 | 75 | 0.014 | 12 | 5.49 | 6.98 | 343.20 | 342.15 |
| CB 112 | SD 100 | 0.78 | 0.22 | 0.17 | 6.00 | 6.00 | 9.83 | 1.67 | 58 | 0.014 | 12 | 5.55 | 7.07 | 342.98 | 342.15 |
| CB 100 | SD 101 | 0.06 | 0.95 | 0.06 | 6.00 | 6.00 | 9.83 | 0.58 | 13 | 0.004 | 12 | 2.91 | 3.70 | 343.97 | 343.92 |
| DMH 100 | SD 102 | 1.01 | 0.25 | 0.25 | 0.18 | 6.18 | 9.72 | 2.44 | 122 | 0.008 | 12 | 4.12 | 5.25 | 342.04 | 341.07 |
| CB 101 | SD 104 | 0.05 | 0.85 | 0.04 | 6.00 | 6.00 | 9.83 | 0.38 | 18 | 0.004 | 12 | 2.88 | 3.67 | 343.42 | 343.35 |
| CB 102 | SD 103 | 0.04 | 0.95 | 0.04 | 6.00 | 6.00 | 9.83 | 0.35 | 10 | 0.004 | 12 | 3.00 | 3.82 | 343.42 | 343.38 |
| DMH 101 | SD 105 | 2.46 | 0.54 | 1.33 | 0.33 | 7.17 | 9.12 | 12.17 | 150 | 0.002 | 24 | 12.24 | 3.89 | 340.59 | 340.33 |
| DMH 108 | SD 119 | 2.46 | 0.54 | 1.33 | 0.64 | 7.81 | 8.73 | 11.64 | 54 | 0.019 | 24 | 40.50 | 12.89 | 340.23 | 339.20 |
| CB 110 | SD 121 | 0.15 | 0.65 | 0.10 | 6.00 | 6.00 | 9.83 | 0.95 | 25 | 0.004 | 12 | 2.91 | 3.71 | 340.63 | 340.53 |
| CB 111 | SD 120 | 0.14 | 0.58 | 0.08 | 6.00 | 6.00 | 9.83 | 0.82 | 4 | 0.005 | 12 | 3.20 | 4.07 | 340.78 | 340.76 |
| DMH 109 | SD 122 | 2.75 | 0.55 | 1.51 | 0.07 | 7.88 | 8.69 | 13.15 | 84 | 0.011 | 24 | 30.45 | 9.69 | 339.10 | 338.20 |
| DCB 100 | SD 123 | 0.39 | 0.83 | 0.32 | 6.00 | 6.00 | 9.83 | 3.16 | 13 | 0.012 | 12 | 4.98 | 6.33 | 339.50 | 339.35 |
| DMH 110 | SD 125 | 3.14 | 0.59 | 1.83 | 0.14 | 8.03 | 8.60 | 15.78 | 45 | 0.020 | 24 | 41.94 | 13.35 | 338.10 | 337.19 |
| CB 106 | SD 111 | 0.14 | 0.64 | 0.09 | 6.00 | 6.00 | 9.83 | 0.86 | 66 | 0.004 | 12 | 2.91 | 3.70 | 340.50 | 340.24 |
| DMH 103 | SD 140 | 0.14 | 0.64 | 0.09 | 0.30 | 6.30 | 9.65 | 0.85 | 51 | 0.004 | 12 | 2.90 | 3.70 | 340.14 | 339.94 |
| CB 105 | SD 109 | 0.13 | 0.92 | 0.12 | 6.00 | 6.00 | 9.83 | 1.15 | 21 | 0.090 | 12 | 13.86 | 17.65 | 342.35 | 340.44 |
| DMH 118 | SD 141 | 0.26 | 0.78 | 0.20 | 0.23 | 6.53 | 9.51 | 1.95 | 111 | 0.004 | 12 | 2.92 | 3.71 | 339.84 | 339.40 |
| CB 104 | SD 107 | 0.25 | 0.94 | 0.24 | 6.00 | 6.00 | 9.83 | 2.33 | 21 | 0.068 | 12 | 12.12 | 15.43 | 341.96 | 340.50 |
| DMH 102 | SD 142 | 0.52 | 0.85 | 0.44 | 0.50 | 7.02 | 9.21 | 4.07 | 168 | 0.003 | 18 | 6.99 | 3.95 | 339.30 | 338.86 |
| CB 103 | SD 106 | 0.13 | 0.93 | 0.12 | 6.00 | 6.00 | 9.83 | 1.19 | 28 | 0.052 | 12 | 10.53 | 13.40 | 341.96 | 340.50 |
| DMH 119 | SD 143 | 0.65 | 0.87 | 0.56 | 0.71 | 7.73 | 8.78 | 4.94 | 150 | 0.008 | 18 | 12.22 | 6.91 | 338.76 | 337.56 |
| DCB 105 | SD 124 | 0.81 | 0.81 | 0.66 | 6.00 | 6.00 | 9.83 | 6.44 | 84 | 0.003 | 18 | 6.97 | 3.94 | 337.78 | 337.56 |
| DMH 120 | SD 149 | 1.46 | 0.84 | 1.22 | 0.36 | 8.09 | 8.56 | 10.43 | 157 | 0.002 | 24 | 12.20 | 3.88 | 337.46 | 337.19 |
| DMH 126 | SD 153 | 4.59 | 0.66 | 3.05 | 0.67 | 8.77 | 8.15 | 24.88 | 35 | 0.002 | 24 | 12.22 | 3.89 | 337.09 | 337.03 |

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| Project ID | Prepared By | Checked By | Date |
|---|---|---|---|
| C-1381 | TML | DPH | 2024.10.11 |

Title Worksheet for Storm Drain Design
Storm Event-25 Year

IDF Curve for Boston MA

| | | Discharge | | | | | | | Pipe Data | | | | | Vertical Control | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet No. | Connected Outlet Pipe | Drainage Area (Acres) | Coefficient c | CA | Tc or Pipe Flow Time (min) | Total Tc (min) | Rainfall Intensity (i) (in./hr) | Design Discharge (cfs) | Length (ft) | Slope (ft/ft) | Diameter (in) | Full-Flow Capacity (cfs) | Full-Flow Velocity (ft/s) | Start Invert | End Invert |
| DCB 101 | SD 126 | 0.27 | 0.95 | 0.26 | 6.00 | 6.00 | 9.83 | 2.51 | 13 | 0.012 | 12 | 5.07 | 6.46 | 339.50 | 339.35 |
| DMH 111 | SD 127 | 4.86 | 0.68 | 3.31 | 0.15 | 8.92 | 8.06 | 26.66 | 85 | 0.002 | 30 | 21.64 | 4.41 | 336.93 | 336.79 |
| DCB 102 | SD 128 | 0.27 | 0.95 | 0.26 | 6.00 | 6.00 | 9.83 | 2.51 | 13 | 0.012 | 12 | 5.07 | 6.46 | 339.50 | 339.35 |
| DMH 112 | SD 129 | 5.13 | 0.69 | 3.56 | 0.32 | 9.24 | 7.86 | 28.02 | 86 | 0.002 | 36 | 36.32 | 5.14 | 336.69 | 336.54 |
| DCB 103 | SD 130 | 0.28 | 0.92 | 0.26 | 6.00 | 6.00 | 9.83 | 2.53 | 13 | 0.012 | 12 | 5.07 | 6.46 | 339.50 | 339.35 |
| DMH 113 | SD 131 | 5.41 | 0.71 | 3.82 | 0.28 | 9.51 | 7.70 | 29.40 | 22 | 0.029 | 36 | 147.72 | 20.90 | 336.44 | 335.80 |
| DCB 104 | SD 132 | 0.63 | 0.87 | 0.54 | 6.00 | 6.00 | 9.83 | 5.33 | 57 | 0.004 | 12 | 2.94 | 3.74 | 339.50 | 339.27 |
| WQU 2 | SD 152 | 6.04 | 0.72 | 4.36 | 0.02 | 9.53 | 7.68 | 33.53 | 10 | 0.077 | 36 | 240.72 | 34.05 | 334.30 | 333.50 |
| PMF 1 | SD 133 | 6.04 | 0.72 | 4.36 | 0.01 | 9.54 | 7.68 | 33.51 | 15 | 0.089 | 36 | 258.12 | 36.52 | 333.40 | 332.10 |
| EX CB2 | EX-RCP 3 | 1.35 | 0.66 | 0.89 | 6.00 | 6.00 | 9.83 | 8.73 | 19 | 0.006 | 24 | 23.64 | 7.53 | 337.24 | 337.12 |
| DMH 104 | SD 112 | 1.35 | 0.66 | 0.89 | 0.04 | 6.04 | 9.81 | 8.70 | 180 | 0.002 | 24 | 12.19 | 3.88 | 337.02 | 336.71 |
| DMH 105 | SD 144 | 1.35 | 0.66 | 0.89 | 0.77 | 6.82 | 9.34 | 8.29 | 263 | 0.002 | 24 | 12.16 | 3.87 | 336.61 | 336.16 |
| DMH 122 | SD 146 | 1.35 | 0.66 | 0.89 | 1.13 | 7.95 | 8.65 | 7.68 | 81 | 0.023 | 24 | 44.57 | 14.19 | 336.06 | 334.20 |
| DMH 123 | SD 147 | 1.35 | 0.66 | 0.89 | 0.10 | 8.04 | 8.59 | 7.62 | 241 | 0.002 | 24 | 12.13 | 3.86 | 335.02 | 334.61 |
| DMH 124 | SD 148 | 1.35 | 0.66 | 0.89 | 1.04 | 9.08 | 7.96 | 7.06 | 114 | 0.002 | 24 | 12.30 | 3.92 | 334.51 | 334.31 |
| DMH 125 | SD 151 | 11.12 | 0.79 | 8.80 | 0.49 | 9.57 | 7.66 | 43.41 | 83 | 0.003 | 36 | 44.65 | 6.32 | 332.00 | 331.78 |
| DMH 115 | EX-RCP 4 | 11.12 | 0.79 | 8.80 | 0.22 | 9.79 | 7.53 | 43.40 | 48 | 0.000 | 36 | 17.75 | 2.51 | 331.68 | 331.66 |
| OCS 2 | SD 150 | 3.73 | 0.95 | 3.55 | 6.00 | 6.00 | 9.83 | 34.88 | 52 | 0.035 | 30 | 99.21 | 20.21 | 336.50 | 334.70 |

| BEALS • ASSOCIATES INC. | Project ID | Prepared By | Checked By | Date |
|---|---|---|---|---|
| | C-1381 | TML | DPH | 2024.10.11 |

2 Park Plaza, Suite 200, Boston, MA 02116
Phone: 617-242-1120

Title Worksheet for Storm Drain Design
Storm Event-25 Year

IDF Curve for Boston MA

| | | Discharge | | | | | | | Pipe Data | | | | | Vertical Control | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Inlet No. | Connected Outlet Pipe | Drainage Area (Acres) | Coefficient c | CA | Tc or Pipe Flow Time (min) | Total Tc (min) | Rainfall Intensity (i) (in./hr) | Design Discharge (cfs) | Length (ft) | Slope (ft/ft) | Diameter (in) | Full-Flow Capacity (cfs) | Full-Flow Velocity (ft/s) | Start Invert | End Invert |
| CB 1 | SD 1 | 0.13 | 0.89 | 0.12 | 6.00 | 6.00 | 9.83 | 1.14 | 140 | 0.005 | 12 | 3.41 | 4.34 | 343.52 | 342.76 |
| CB 2 | SD 2 | 0.28 | 0.93 | 0.26 | 6.00 | 6.00 | 9.83 | 2.55 | 26 | 0.004 | 12 | 2.87 | 3.66 | 342.86 | 342.76 |
| DMH 1 | SD 3 | 0.41 | 0.91 | 0.38 | 0.54 | 6.54 | 9.50 | 3.57 | 168 | 0.004 | 18 | 8.62 | 4.88 | 342.66 | 341.99 |
| CB 3 | SD 4 | 0.25 | 0.92 | 0.23 | 6.00 | 6.00 | 9.83 | 2.23 | 26 | 0.034 | 12 | 8.48 | 10.79 | 342.86 | 341.99 |
| DMH 2 | SD 5 | 0.66 | 0.91 | 0.60 | 0.57 | 7.11 | 9.16 | 5.52 | 130 | 0.004 | 18 | 8.64 | 4.89 | 341.89 | 341.37 |
| CB 4 | SD 16 | 0.13 | 0.92 | 0.12 | 6.00 | 6.00 | 9.83 | 1.15 | 7 | 0.061 | 12 | 11.48 | 14.62 | 343.43 | 343.00 |
| DMH 3 | SD 6 | 0.79 | 0.92 | 0.72 | 0.44 | 7.56 | 8.89 | 6.40 | 109 | 0.003 | 18 | 6.91 | 3.91 | 341.27 | 340.99 |
| CB 5 | SD 7 | 0.18 | 0.48 | 0.09 | 6.00 | 6.00 | 9.83 | 0.84 | 29 | 0.025 | 12 | 7.35 | 9.35 | 343.78 | 343.04 |
| DMH 4 | SD 8 | 0.96 | 0.84 | 0.81 | 0.47 | 8.02 | 8.60 | 6.93 | 214 | 0.003 | 18 | 6.99 | 3.95 | 340.89 | 340.33 |
| CB 6 | SD 9 | 0.37 | 0.87 | 0.33 | 6.00 | 6.00 | 9.83 | 3.20 | 37 | 0.004 | 12 | 2.97 | 3.78 | 342.50 | 342.35 |
| DMH 6 | SD 10 | 1.34 | 0.85 | 1.13 | 0.90 | 8.92 | 8.05 | 9.11 | 70 | 0.003 | 24 | 14.87 | 4.73 | 340.23 | 340.05 |
| DMH 5 | SD 11 | 0.52 | 0.95 | 0.49 | 6.00 | 6.00 | 9.83 | 4.82 | 72 | 0.032 | 12 | 8.34 | 10.62 | 342.40 | 340.05 |
| WQU 1 | SD 12 | 1.85 | 0.87 | 1.62 | 0.25 | 9.17 | 7.90 | 12.82 | 91 | 0.002 | 24 | 12.31 | 3.92 | 339.95 | 339.79 |
| OCS 1 | EX-RCP 1 | 1.85 | 0.87 | 1.62 | 0.39 | 9.56 | 7.67 | 12.44 | 51 | 0.010 | 24 | 29.18 | 9.29 | 331.44 | 330.94 |
| DMH 200 | SD 200 | 0.91 | 0.95 | 0.86 | 6.00 | 6.00 | 9.83 | 8.49 | 216 | 0.008 | 18 | 12.47 | 7.05 | 342.90 | 341.10 |
| DMH 201 | SD 201 | 1.38 | 0.95 | 1.32 | 0.51 | 6.51 | 9.52 | 12.52 | 86 | 0.010 | 18 | 13.48 | 7.63 | 337.60 | 336.76 |
| DMH 202 | SD 202 | 1.93 | 0.95 | 1.83 | 0.19 | 6.00 | 9.83 | 18.00 | 97 | 0.002 | 24 | 11.97 | 3.81 | 336.66 | 336.50 |

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Phone: 617-242-1120

**Infiltration System 1**

| Required Recharge |
|---|
| HSG B = 0.35 Inches of Runoff |

**Recharge Volume**

=4,142 CF

**Base Surface Area**

=2,800 SF

**Duration**

=1.0 Days (24-hour storm, system must drain within 72-hour period)

**Infiltration Rate 'R'**

=(Recharge Volume/(Area x Duration)
=4,142 CF / (2800 SF x 1.0 Day)
=1.48 Ft/Day

| Specific Yield Values 'Sy' | |
|---|---|
| Coarse Gravel | 0.23 |
| Medium Gravel | 0.24 |
| Fine Gravel | 0.25 |
| Coarse Sand | 0.27 |
| Medium Sand | 0.28 |
| Fine Sand | 0.23 |
| Silt | 0.08 |
| Clay | 0.03 |

| Hydraulic Conductivity Values (ft/day) 'K' | | |
|---|---|---|
| Material | Average | Range |
| Fine Gravel | 1476 | 1181-3280 |
| Medium Gravel | 886 | 689-1181 |
| Coarse Gravel | 492 | 328-689 |
| Coarse Sand | 148 | 65-328 |
| Medium Sand | 39 | 16-65 |
| Fine Sand | 9 | 3-16 |
| Silt | 0.3 | 0.03-3 |
| Clay | 0.0007 | <0.03 |
| S & G Mix | 172 | 16-328 |
| S & G Glacial Till | - - | <100 |
| Glacial Till | - - | <10 |

# APPENDIX K: SIGNED WAIVERS

# Form R:
## Franklin Planning Board
## Subdivision Waiver Request

**Prepared by:** Devin P. Howe, P.E.

**Signed:** DocuSigned by: Dean Atkins 1179CE34461B410...

**Subdivision:** N/A

**Date:** October 8, 2024

**Nature of Waiver:** Culverts shall be designed to accommodate a fifty-year-frequency storm; underground storm drains, catch basins and related installations shall be designed to accommodate a twenty-five-year-frequency storm with a design velocity of between 2.5 feet and 10.0 feet per second. In high volume conditions [greater than 15 cubic feet per second (CFS)], the maximum design velocity shall not exceed eight feet per second.

**Subdivision Rules and Regulation Reference:**
Chapter 300 Secton 11 - Stormwater Management, B.(1)

**Reason the waiver is requested:**
Underground storm drains, catch basins, and related installations have been designed to accomodate a 25-year storm utilizing a hydraulic grade line with calculations provided as an attachment to the Stormwater Management Report. The design velocities vary between 0.3 feet per second and 7.1 feet per second. Due to constraints from existing outfall locations, and to limit excessive pipe trenches, the slopes of various pipes were designed to provide a full flow design velocity of at least 2.5 feet per second.

**Alternatives to granting the waiver:**
Underground storm drains, catch basins, and related installations have been designed to accomodate a 25-year storm utilizing a hydraulic grade line with calculations provided as an attachment to the Stormwater Management Report. The design velocities vary between 0.3 feet per second and 7.1 feet per second. Due to constraints from existing outfall locations, and to limit excessive pipe trenches, the slopes of various pipes were designed to provide a full flow design velocity of at least 2.5 feet per second.

**Impact of waiver denial on the project:**
Denial of the waiver may result in the elimination of the subsurface infiltration system due to limitations from seasonal high groundwater, and will also result in additional costs related to requiring deeper trenching for the drainage pipes and structures.

**Reasons this waiver is in the best interests of the Town and consistent with the intent and purpose of the Subdivision Control Law:**
The proposed project is a private development that does not require operation and maintenance from the Town. The project is to be maintained privately, and any maintenance of the pipes would be the requirement of the property owner and not the Town. For this reason, we believe this request is appropriate and consistent with the intent and purpose of the Subdivision Control Law.

# Form R:
## Franklin Planning Board
## Subdivision Waiver Request

**Prepared by:** Devin P. Howe, P.E. **Signed:** DocuSigned by: Dean Atkins 1179CE34461B410...

**Subdivision:** N/A

**Date:** October 8, 2024

**Nature of Waiver:** The drainage pipe shall be reinforced concrete, with bell and spigot gasketed joints. The pipe shall be Class III in accordance with ASTM C-76. The gaskets shall be O-ring type in accordance with ASTM C-443. The minimum diameter shall be 12 inches. The pipe shall be laid in undisturbed trenches below the grade of pipes, starting with the downstream end on a firm bedding. All bells shall be facing upstream. Reference bench marks shall be clearly marked to enable the Department of Public Works Director to check the grade and invert elevations. The joints of all concrete pipes shall include a pre-molded neoprene continuous O-ring flexible compression gasket. No backfilling of pipes or culverts shall be done until the installation has been inspected and approved by the Department of Public Works Director. Backfilling shall be in layers not exceeding 12 inches, with each layer compacted by an appropriately sized plate vibrator, regardless of the method of final compaction at the subbase or gravel base level. The minimum cover is 42 inches above the top of the pipe.

**Subdivision Rules and Regulation Reference:**

Chapter 300 Secton 11 - Stormwater Management, B.(2)

**Reason the waiver is requested:**

A waiver has been requested to this requirement to allow class ductile iron or HDPE pipe where noted on the plans. Ductile iron pipe will be utilized for roof drains, and HDPE pipe will be utilized for other typical drainage pipe. These materials are typical of private developments and are of acceptable strength and durability for a project such as the proposed one. HDPE pipes require at least 2' of cover, and at least approximately 2.5' of cover has been provided for all pipes.

**Alternatives to granting the waiver:**

Provide Class III Reinforced Concrete Pipe (RCP) at all locations and provide at least 42 inches of cover above the top of the pipe.

**Impact of waiver denial on the project:**

Denial of the waiver would result in significant additional costs due to labor and material.

**Reasons this waiver is in the best interests of the Town and consistent with the intent and purpose of the Subdivision Control Law:**

The proposed project is a private development that does not require operation and maintenance from the Town. The project is to be maintained privately, and any maintenance of the pipes would be the requirement of the property owner and not the Town. Furthermore, the pipes that would be utilized for the project are of sufficient strength with cover depths less than 42 inches. For this reason, we believe this request is appropriate and consistent with the intent and purpose of the Subdivision Control Law.

# Form R:
## Franklin Planning Board
## Subdivision Waiver Request

**Prepared by:** Devin P. Howe, P.E.

**Signed:** DocuSigned by: Dean Atkins 1179CE34461B410...

**Subdivision:** N/A

**Date:** October 8, 2024

**Nature of Waiver:**

Catch basins shall have a minimum sump of 48 inches. They shall have a base of precast concrete plates, four inches thick, laid flat with a twelve-inch weep hole in the center.

**Subdivision Rules and Regulation Reference:**

Chapter 300 Secton 11 - Stormwater Management, B.(3)(c)

**Reason the waiver is requested:**

A waiver has been requested to this requirement such that there is not a 12" weep hole in the center.

**Alternatives to granting the waiver:**

Include the 12" weep hole in the center.

**Impact of waiver denial on the project:**

Denial of the waiver would result in the project not complying with the MassDEP regulations that require at least 44% TSS removal prior to infiltrating stormwater. Inclusion of the 12" weepholes would infiltrate stormwater where 0% TSS removal has been achieved prior to infiltration.

**Reasons this waiver is in the best interests of the Town and consistent with the intent and purpose of the Subdivision Control Law:**

A waiver would allow the project to enhance water quality treatment prior to infiltrating stormwater. For this reason, we believe this request is in the best interests of the Town and is appropriate and consistent with the intent and purpose of the Subdivision Control Law.

# Form R:
## Franklin Planning Board
## Subdivision Waiver Request

**Prepared by:** Devin P. Howe, P.E.

**Signed:** DocuSigned by: Dean Atkins 1179CE34461B410...

**Subdivision:** N/A

**Date:** October 8, 2024

**Nature of Waiver:**

Drain manholes shall have a four-inch-thick concrete base. At least one row of blocks shall be set on the base to allow the construction of a brick table within the manhole. Arched inverts of 1/2 the pipe diameter shall be sloped upward to the sides of the manhole. The tops of the main drain lines entering and leaving a manhole shall be matched.

**Subdivision Rules and Regulation Reference:**

Chapter 300 Secton 11 - Stormwater Management, B.(3)(d)

**Reason the waiver is requested:**

Drain manholes may require bases greater than 4" based on manufacturer requirements. Additionally, a hydraulic grade line has been utilized to size the pipes, and the calculations did not include a brick table within manholes. Manholes have been designed to not have brick tables nor the top of the main drain lines being matched across manholes.

**Alternatives to granting the waiver:**

Require 4" concrete bases, require the construction of brick tables within manholes, and require the tops (crowns) of drain lines to be matched.

**Impact of waiver denial on the project:**

Requiring this waiver may result in structurally deficient manholes as well as unnecessary costs where the project has been designed and documented to not require the brick table features. Additionally, matching the crown of the pipes would result in a deeper drainage system that may necessitate the removal of the subsurface infiltration system due to seasonal high groundwater elevations as well as add additional costs.

**Reasons this waiver is in the best interests of the Town and consistent with the intent and purpose of the Subdivision Control Law:**

A waiver would allow the project to install manholes with bases of appropriate sizes per manufacturers recommendations. Additionally, the project is a private development where the drainage system would not cause undue nuisances to adjoining properties. For this reason, we believe this request is in the best interests of the Town and is appropriate and consistent with the intent and purpose of the Subdivision Control Law.

# Form R:
## Franklin Planning Board
## Subdivision Waiver Request

**Prepared by:** Devin P. Howe, P.E.

**Signed:** DocuSigned by: Dean Atkins 1179CE34461B410...

**Subdivision:** N/A

**Date:** October 8, 2024

**Nature of Waiver:**

No more than four pipe openings shall be allowed in any one manhole. Four-foot-diameter manholes will be used for drains up to 30 inches in diameter. Five-foot-diameter manholes are necessary for pipe diameters between 36 and 48 inches. All flows into a manhole shall be in the same direction (no reverse flows allowed), with a maximum angle between the main and any connecting line of 90°. All connecting lines shall have bricked inverts rounded into the direction of flow.

**Subdivision Rules and Regulation Reference:**

Chapter 300 Secton 11 - Stormwater Management, B.(3)(e)

**Reason the waiver is requested:**

There is one drainage structure where the angle between the main and the connecting line is 79 degrees. Additionally, the applicant is requesting to not need bricked inverts rounded in the direction of flow. As has been documented in the Stormwater Management Report, hydraulic grade line calculations have been provided that consider the angles of pipes into a structure and take into account not utilizing bricked inverts rounded into the direction of flow. These calculations document that an angle less than 90 degree is acceptable and bricked inverts are unnecessary.

**Alternatives to granting the waiver:**

An alternative to granting the waiver would be to require an additional manhole between DCB 104 and DMH 114 as well as require bricked inverts in all 34 manholes.

**Impact of waiver denial on the project:**

Denying the waiver would result in additional unnecessary costs that do not have a notable impact on the project.

**Reasons this waiver is in the best interests of the Town and consistent with the intent and purpose of the Subdivision Control Law:**

The project is a private development where the drainage system would not cause undue nuisances to adjoining properties. For this reason, we believe this request is in the best interests of the Town and is appropriate and consistent with the intent and purpose of the Subdivision Control Law.

# APPENDIX L: OPERATION AND MAINTENANCE CONTROL PLAN

# AVAILABLE UNDER SEPARATE COVER