Westwood

Preliminary Stormwater Management Plan for

MINNETONKA FLATS

Prepared for:
Lake West Development, LLC
14525 Highway 7, Suite 265
Minnetonka, MN 55345

Prepared by:
Westwood Professional Services
12701 Whitewater Drive, Suite 300
Minnetonka, MN 55343
(952) 937-5150

Project Number: 0032305.00

Date: 01/18/2024

Contents

Exhibits:

INTRODUCTION

This report summarizes the stormwater management design for the proposed Minnetonka Flats Property. The project location is within the city of Minnetonka, MN, at the southeastern corner of Excelsior Boulevard and CR 101. The proposed project consists of two twenty-unit condominium buildings that share one continuous underground parking garage. The total disturbed area for the project will consist of 1.9 acres of the 5.6 total acres.

REGULATIONS

The proposed project site is located within the City of Minnetonka and Riley Purgatory Bluff Creek Watershed District. The following rules from the City and Watershed apply:

- Limit peak runoff to existing conditions for the 2-, 10-, and 100-year 24-hour storm events and the 100-year, 10-day snowmelt event.
- Provide abstraction for 1.1 inches of runoff from impervious surfaces, or 0.55 inches for restricted sites

EXISTING CONDITIONS

The existing property consists of residential lots that are wooded. Portions of the site drain to an existing wetland on the east side of the property. Portions of the site drain off site to the north and south. The existing conditions map is included as Exhibit 1.

SOIL CONDITIONS

A geotechnical exploration was conducted on site and a report was prepared by NTI, Inc. from May 26, 2015. The soil borings log and geotechnical report are included as **EXHIBIT 3**. The site generally consists of fill soils consisting of sandy clays and silty sands. No groundwater was observed in any of the boring locations. The site soil classification is Hydraulic Soils Group “D” soils.

PROPOSED CONDITIONS

The proposed buildings will cover the northwestern portion of the site. There will be onsite parking on the east side of the buildings with the drive entrance off Spring Lane. Runoff from the disturbed area will be routed through an underground chamber system and an infiltration basin. The underground chamber system will outlet to the existing wetland on the east side of the site. The system will consist of dead storage to be used for on site irrigation. The proposed drainage map is included as Exhibit 2.

The site has been modeled in HydroCAD. The HydroCAD Report for both the existing and proposed condition has been included as Exhibit 4.

RATE CONTROL

Table 1: Peak Runoff Rate North Offsite

Storm Event	Existing Discharge Rate (cfs)	Proposed Discharge Rate (cfs)
2-year (2.87”)	1.74	0.35
10-year (4.27”)	3.04	1.17
100-year (7.41”)	5.94	3.54
10-day snowmelt (7.2”)	3.04	1.17

Table 2: Peak Runoff Rate – South Offsite

Storm Event	Existing Discharge Rate (cfs)	Proposed Discharge Rate (cfs)
2-year (2.87”)	3.84	3.05
10-year (4.27”)	7.13	6.56
100-year (7.41”)	14.71	13.90
10-day snowmelt (7.2”)	7.13	6.56

Table 3: Peak Runoff Rate – East To Wetland

Storm Event	Existing Discharge Rate (cfs)	Proposed Discharge Rate (cfs)
2-year (2.87”)	7.05	5.21
10-year (4.27”)	12.38	10.12
100-year (7.41”)	24.3	19.98
10-day snowmelt (7.2”)	12.38	10.12

VOLUME ABSTRACTION

Table 4 below summarizes the site impervious areas and abstraction volumes.

Table 4: Volume Performance Goal Requirement

	New/Reconstructed Impervious Area (SF)	Required Volume (0.55") (CF)	Volume Abstraction Provided (CF)
Reuse/chambers	45520	2086	6408
Infiltration Basin 9PP	5214	240	1958
Total	50734	2326	8366

The dead storage provided in the chamber system is equal to the irrigation volume required to irrigate the pervious areas of the site at 1.2" per week. The live storage volume provided meets volume requirements and provides rate control. The proposed infiltration basin 9PP has been sized to retain at least 1.1" per acre of increased impervious, the capacity is 1958 cubic feet.

Basin Information						
Basin	Bottom	Top of Berm	EOF	Dead Storage (CF)	Live Storage (CF)	100 YR HWL
Infiltration Basin 9PP	925.75	926.0	925.9	1958	0	926.0

Basin Information					
Basin	Bottom	100 YR HWL	Outlet	Dead Storage (CF) (reuse volume)	Live Storage (CF)
CHAMBERS 1PP	920.5	924.73	922.10	2396	4052

WATER REUSE

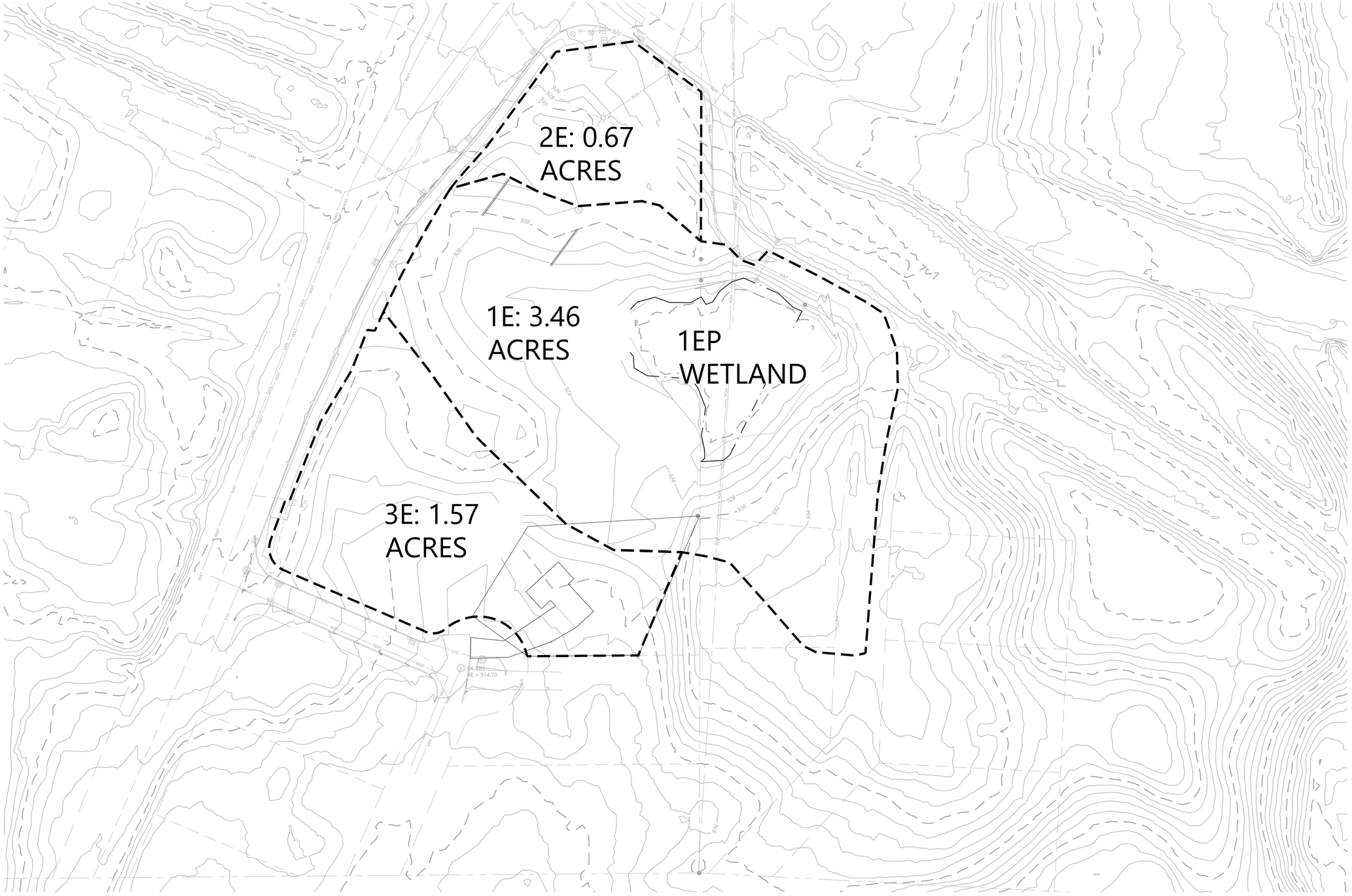
The site will consist of 2.55 acres of pervious space. The underground chamber outlet is proposed such that 2396 cubic feet of dead storage is provided. Irrigation for the site will be provided utilizing the stored volume. The MIDS calculator gave a performance goal volume retention requirement of 2695 cubic feet. The proposed total removed by BMP's is 2695 cubic feet. Exhibit 5 is the MIDS Reuse Calculator Summary.

CONCLUSIONS

The proposed site meets the requirements outlined within the City of Minnetonka and Riley Purgatory Bluff Creek Watershed District for rate and volume control.

Exhibit 1

Existing Drainage Map



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DESIGNED:	CHF
CHECKED:	CHF
DRAWN:	TAS
HORIZONTAL SCALE:	50'
VERTICAL SCALE:	10' OR 5'

INITIAL ISSUE:
REVISIONS:
1
2
3
4
5

PREPARED FOR:

LAKE WEST DEVELOPMENT, LLC
14525 HIGHWAY 7, SUITE 265
MINNETONKA, MN 55345

I HEREBY CERTIFY THAT THIS PLAN WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

CHRISTIAN FROEMKE
DATE: 01/18/24 LICENSE NO. 56208

MINNETONKA FLATS
MINNETONKA, MN

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Westwood Professional Services, Inc.

EXISTING DRAINAGE MAP

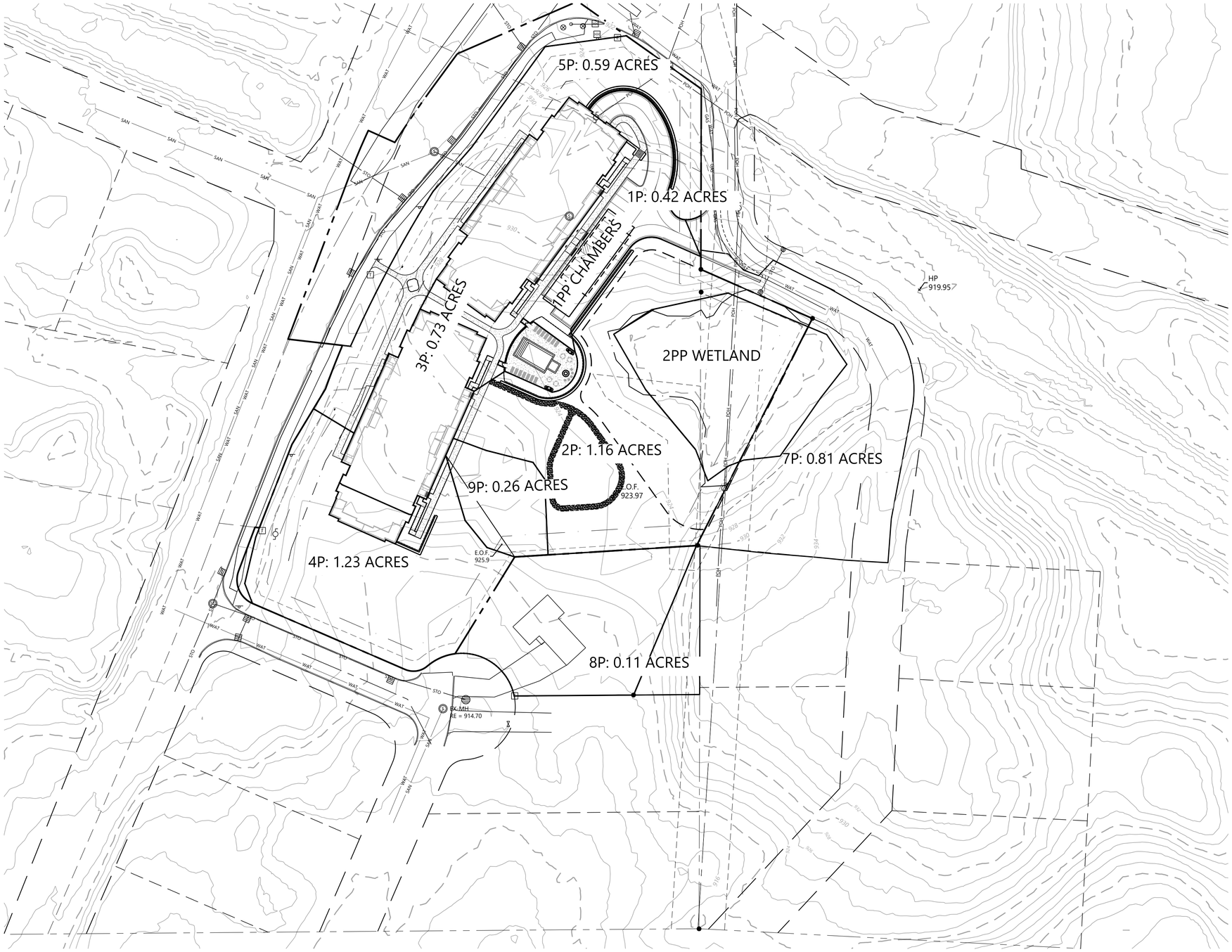
PROJECT NUMBER: 0032305.00

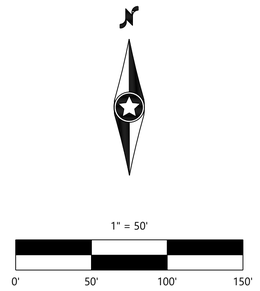
SHEET NUMBER:
OF
DATE:

Exhibit 2

Proposed Drainage Map

Call 48 Hours before digging:
811 or call811.com
Common Ground Alliance





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PROPOSED DRAINAGE MAP

PROJECT NUMBER: 0032305.00

SHEET NUMBER:

OF

DATE:

Exhibit 3

Geotechnical Report

NTI
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Unearthing confidence™

GEOTECHNICAL EXPLORATION AND ENGINEERING REVIEW

Saville Development

Minnetonka

Minnesota

NTI Project No. 15.60938.100

***Prepared For**:*

Landform
105 South Fifth Avenue, Suite 513
Minneapolis, Minnesota 55401

May 26, 2015

Landform
105 South Fifth Avenue, Suite 513
Minneapolis, Minnesota 55401

Attention: Reid Schultz

Subject: Geotechnical Exploration and Engineering Review
Saville Development
Minnetonka, Minnesota
NTI Project No. 15.60938.100

Dear Mr. Schultz,

In accordance to your request and subsequent authorization, Northern Technologies, Inc. (NTI) conducted a Geotechnical Exploration for the above referenced project. Our services included advancement of exploration borings and preparation of an engineering report with recommendations developed from our geotechnical services. Our work was performed in general accordance with our proposal dated March 11, 2015.

Soil samples obtained at the site will be held for 60 days at which time they will be discarded. Please advise us in writing if you wish to have us retain them for a longer period. You will be assessed an additional fee if soil samples are retained beyond 60 days.

We appreciate the opportunity to have been of service on this project. If there are any questions regarding the soils explored or our review and recommendations, please contact us at your convenience at (763) 433-9175.

Northern Technologies, Inc.

Steven D. Gerber, P.E.
Senior Engineer

Ryan M. Benson, P.E.
Principal Engineer/Regional Manager

Contents

GEOTECHNICAL EXPLORATION AND ENGINEERING REVIEW

Saville Development

NTI Project No. 15.60938.100

1.0 EXECUTIVE SUMMARY

We briefly summarize below our geotechnical recommendations for the proposed project. The summary must be read in complete context with our report.

- We conclude you may support the proposed residential buildings upon standard perimeter strip and spread column footings on competent, non-organic natural soil(s) or engineered fill, as recommended within our report.
- Building linear strip footings and interior column footings (if required) may be proportioned on competent non-organic native soils or properly compacted backfill extending to suitable soils, using the maximum net allowable soil bearing pressures of 2,500 pounds per square foot.
- Undocumented, and generally poorly compacted, fill and soft alluvial soils were encountered in several soil borings. These materials are generally unsuitable for support of the proposed structures; however, most, or all, of these materials would be excavated in order to accommodate basements.
- There are wetlands adjacent to the proposed site. While not encountered by our borings, if site development extends to organic soils, our office should be contacted to provide additional recommendations.
- Groundwater was not encountered in our soil borings, although changes in the groundwater elevations should be anticipated over time. In addition, the onsite clay based soils are relatively impervious and therefore have the potential to develop of zones of perched water at varying elevations and locations.
- Overall, the site soils are conducive to movement of groundwater both laterally and vertically. The moisture content of such soils can vary annually and per recent precipitation. Such soils and other regional dependent conditions may produce groundwater entry of project excavations. We direct your attention to other report sections and appendices attachments concerning groundwater issues and subsurface drainage.

2.0 INTRODUCTION

2.1 Site / Project Description

The proposed Saville Development project is to be constructed as defined within Table 1.

Table 1: Project & Site Description

Item	Description
Building Type	Single family residences, one to two stories in height with basement.
Floor Elevations	Assumed to be within two feet of final proposed grades.
Proposed Maximum Change in Site Elevation	NTI assumes that site grades will remain within approximately 5 feet as compared to the grades encountered during the site exploration.
Site Description	
Location of Project	Southeast corner of County Road 101 and Excelsior Boulevard.
Existing Land Use / Improvements to Parcel	Single family homes and landscaping; wetlands to the east.
Current Ground Cover	Trees and grass.
Topography at Site	There was approximately 11 feet of elevation change between the recently completed borings.

2.2 Scope of Services

The purpose of this report is to present a summary of our geotechnical exploration and provide generalized opinions and recommendations regarding the soil conditions and design parameters for founding of the project. Our "scope of services" was limited to the following:

1. Explore the project subsurface by means of nine standard penetration borings extending to maximum depths of approximately 20 feet below existing grade, and conduct laboratory test(s) on representative samples for characterizing the index and engineering properties of the soils at the project site.

2. Prepare a report presenting our findings from our field exploration, laboratory testing, and engineering recommendations for foundation types, footing depths, allowable bearing capacity, estimated settlements, floor slab support, excavation, engineered fill, backfill, compaction and potential construction difficulties related to excavation, backfilling and drainage.

3.0 EXPLORATION PROGRAM RESULTS

3.1 Exploration Scope

Site geotechnical drilling occurred on April 29 to April 30, 2015 with individual borings advanced at approximate locations as presented on the diagram within the appendices. NTI located the borings relative to existing site features, and determined the approximate elevation of the borings relative to a temporary benchmark (TBM). The TBM was the manhole cover in the adjacent cul-de-sac. NTI assumed an elevation of 100.0 feet.

3.2 Subsurface Conditions

Please refer to the boring logs within the appendices for a detailed description and depths of stratum at each boring. The boreholes were backfilled with auger cuttings, or were abandoned using high solids bentonite or neat cement grout as per appropriate local and state statutes. Minor settlement of the boreholes will occur. Owner is responsible for final closure of the boreholes. Based on results of the current geotechnical exploration, Table 2 provides a general depiction of subsurface conditions at the project site. Additional comment on the evaluation of recovered soil samples is presented within the report attachments.

Table 2: Typical Subsurface Stratigraphy at Project Site [Note 1]

Stratum	Depth to Base of Stratum below existing grade	Material Description	Notes
Surface	3 to 8 inches	Topsoil	
Existing Fill	2 to 6 feet below existing grade, where encountered.	Undocumented fill soils predominantly consisting of sandy lean clay (CL), and clayey sand (SC), as well as silty sand(SM).	Variably compacted.
Alluvial Soils	11 to 12 feet, where encountered	Sandy Lean Clay and Lean Clay (CL) and Sandy Silt (ML)	Soft
Native Glacial Soils	Termination depths of the borings at about 20 feet below the existing grade.	Native soils predominantly composed of sandy lean clay (CL), silty sand (SM), clayey sand (SC).	Rather stiff to stiff clays Medium dense to dense sands
Note 1	Table summary is a generalization of subsurface conditions and may not reflect variation in subsurface strata occurring on site. The general geologic origin of retained soil samples is listed on the boring logs.		

3.3 Groundwater Conditions

The drill crew observed the borings for groundwater depth (if any) during and at the completion of drilling activities. Groundwater, however, was not observed in our soil borings. However, the onsite clay based soils are relatively impervious and are conducive to the development of zones of perched water at varying elevations and locations.

Overall, the site soils are conducive to movement of groundwater both laterally and vertically. The moisture content of such soils can vary annually and per recent precipitation. Such soils and other regional dependent conditions may produce groundwater entry of project excavations. Groundwater may be perched within the sand and silt seams that are underlain by the relatively impermeable clay soils.

3.4 Laboratory Test Program

Our analysis and recommendations of this report are based upon our interpretation of the standard penetration resistance determined while sampling soils, laboratory test results and experience with similar soils from other sites near the project. The results of such tests are summarized on the boring logs or attached test forms.

4.0 ENGINEERING REVIEW AND RECOMMENDATIONS

The following recommendations are based on our present knowledge of the project. We ask that you or your design team notify us immediately if significant changes are made to project size, location or design as we would need to review our current recommendations and provide modified or different recommendations with respect to such change(s).

4.1 Project Scope

We understand the proposed structures will include concrete foundation walls and footings for support of above grade construction. NTI's assumed foundation loads and change in grade is summarized within Table 3. Our assessment of project soils, opinions, and report recommendations are based directly on application of estimated structural loads to site soils.

Table 3: Foundation Loads / Change in Grade / Footing Elevation

Building Element	Load / Condition
Perimeter Strip Footings	3 kips per lineal foot or less
Interior Strip Footings	3 kips per lineal foot or less
Isolated Interior Column Footings	150 kips or less
Exterior Column Footings	150 kips or less
Change in Overall Site Grade (from original ground surface)	5 feet or less

Basement Excavation	Basement floor elevations are assumed to be within approximately 5 to 10 feet below the final proposed exterior grade.

4.2 Site Preparation

Project construction, as proposed, will commence with razing the existing structures, stripping of topsoil, vegetation, and the removal of all existing underground utilities from within the proposed building pads (if encountered).

The undocumented, previously placed fill encountered in the soil borings is not considered suitable for direct support of the foundations. Similarly, the soft alluvial soils are also not suitable for the support of foundations and should be removed. For buildings with basements, this over-excavation will generally be incidental to the basement excavations. While not encountered in our soil borings, there may be organic soils related to the adjacent wetlands encountered during construction. These soils should also be removed from the building areas.

NTI recommends that all existing topsoil, buried organic materials, undocumented fill and any other manmade structures that are encountered be removed from within the building pads.

We recommend that all earthwork improvements and excavations be oversized where fill materials are placed below foundations. The minimum excavation oversize should extend per the requirements outlined in Appendix B. Table 4 provides a summary of excavation necessary to remove unsuitable materials at respective borings.

Table 4: Summary of Soil Correction / Excavation

Boring Number	Existing Ground Elevation (feet, NTI Datum)	Depth (feet)	Estimated Excavation Elevation (feet)	Unsuitable Soil / Material
SB-1	94.4	12.0	82.4	Undocumented Fill/Soft Soils
SB-2	96.0	12.0	84.0	Undocumented Fill/Soft Soils
SB-3	102.0	2.0	100.0	Undocumented Fill
SB-4	95.0	0.6	94.4	Topsoil
SB-5	100.3	11.0	89.3	Undocumented Fill/Soft Soils
SB-6	104.8	2.0	102.8	Undocumented Fill
SB-7	102.5	2.0	100.5	Undocumented Fill
SB-8	93.6	12.0	81.6	Undocumented Fill/Soft Soils
SB-9	99.2	3.5	95.7	Undocumented Fill/Soft Soils

The Geotechnical Engineer of Record or their designated representative should review project excavations to verify removal of unsuitable material(s) and adequate bearing support of exposed soils. All such observations should occur prior to the placement of engineering fill, or construction of footings and floor slabs.

We recommend that native soils at the exposed grade (i.e. base of excavations) be compacted until such materials achieve no less than 98% of the standard proctor maximum dry density (ASTM: D 698-96).

Sidewalls should be benched or sloped to provide safe working conditions and stability for engineered fill placement. Any oversizing that is required should be performed in accordance with the diagram and table included in Appendix A.

Portions of the existing on-site undocumented fill soils have the potential to be re-used as engineered fill for preparation of the building pads when such soils are conditioned and placed as presented within this report. However, due to the undocumented nature of the fill soils there is the potential that zones of organic or debris laden soils may be encountered as well. Any organic or debris laden soils will need to be sorted and are not considered to be suitable for reuse. Additionally, there may be environmental constraints on the use or reuse of the existing fill materials.

Considering that the existing fill soils are not documented, the prediction of the percent of re-usable material is difficult. If the Owner wishes to have a better understanding of the composition of the undocumented fill soils across the site, NTI suggests that a series of test pits be advanced at the site prior to construction.

Any additional fill required for support of site development below the proposed building and structures should consist of non-organic debris free soils of similar composition to the existing native soils. If clean sand materials are utilized as engineered fill they will need to be adequately drained as to not create a "bathtub" effect overlying the native clay based till soils. If not adequately drained there is the potential that groundwater may collect within the void spaces of the sand and result in vertical movements during periods of freeze/thaw.

Placement of structural fill should be observed and tested by an experienced technician or engineer to criteria described in Appendix B. Structural fill with moisture contents outside of the recommended range should be conditioned (dried or wetted) as appropriate prior to placement. Engineered fill for site corrective earthwork and for support of project footings should be tempered for moisture content and placed and compacted as outlined Appendix B.

4.3 Shallow Foundations

The following bearing recommendations are based on our understanding of the project. You should notify us of any changes made to the project size, location, design, or site grades so we can assess how such changes impact our recommendations. We assume foundation elements will impose maximum vertical loads as previously noted within this report.

In our opinion, you may support the proposed structures by founding strip footings and interior column footings on competent, non-organic native soils, or engineered fill, providing such construction complies with the criteria established within this report. Design of footings may be based on the Table 5 maximum net allowable soil bearing pressures.

Table 5: Recommended Maximum Net Allowable Soil Bearing Pressure - Conventional Shallow Foundation Construction

Location	Criteria
Perimeter Strip Footings, Perimeter Columns: Perimeter strip footings and perimeter column footing supported on documented fill or competent native soils below depth of frost penetration. **Interior Strip Footings:** Interior strip footings supported on documented fill or competent native soils at a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for sand cushion). **Interior Column Footings:** Supported on documented fill or competent native soils a depth that provides no less than 6 inches of clearance between the top of footing and underside of floor slab (for sand cushion).	Maximum 2,500 psf (All foundations)

1. Maximum net allowable soil bearing pressure recommendations predicated on footing design and construction complying with recommendations presented within this report. To minimize local failure of supporting soils, it is our opinion footing construction should comply with the International Building Code (IBC) requirements.

Foundations in unheated appurtenant areas, such as stoops, canopies, and garages, should be based at least 5 feet below the proposed finished grade for frost protection. Footings below structures anticipated to be heated (greater than 60 degrees F) in winter should be constructed at least 3.5 feet below proposed finished grade.

Continuous strip footings under bearing walls should be at least 1 foot wider than the walls they support. Interior footings should be based at least 1.5 feet below design floor elevation.

4.4 Bearing Factor of Safety and Estimate of Settlement

We estimate that the native soils, or properly compacted backfill, will provide a nominal 3 factor of safety against localized bearing failure when construction complies with report criteria and recommendations and the structural design of the foundations uses the Table 5 maximum net allowable soil bearing recommendation(s).

We estimate that footings loaded per report recommendations may experience long term, total settlement of approximately 1/2 to 1 inch. Differential settlement will be on the order of 25 to 50 percent of total settlement. Generally, the greatest differential settlement occurs between lightly loaded and heavily loaded footings, particularly if heavily loaded footings are located adjacent to lightly loaded strip footings. Most of the settlement will occur on first loading, as the structure is erected.

Furthermore, total and differential movement of footings and floor slabs could be significantly greater than the above estimates if you support construction on frozen soils, the moisture content of the bearing soils significantly changes from in-situ conditions, and snow or ice lenses are incorporated into site earthwork.

4.5 Subsurface Drainage

NTI considers the installation of a subsurface drain system at the base of foundation walls to be a preferred practice of construction. The subsurface drain system will help to limit moisture accumulation within granular soils placed below interior floors. You should also consider placement of a separate subsurface drainage system exterior to perimeter foundation walls.

As a general guideline, subsurface drainage consists of a geotextile and coarse drainage encased slotted or perforated pipe extending to sump basin(s) We recommend that exterior drainage be separated from interior drainage to reduce risk of cross flow and moisture infiltration below structure interior. The project Architect and/or Structural Engineer of Record should determine actual need for subsurface drainage.

4.6 Utilities

Utility trenches should be backfilled in 6-inch maximum depth loose lifts. It is especially important that you compact trench backfill of underground utilities to minimize future settlement of green space and pavement areas. Any abandoned underground pipes, left in place, should be fully grouted.

Please refer to Appendix B for compaction specifications.

The stability of embankments along utility excavations is dependent on soil strength, site geometry, moisture content, and any surcharge load for excavated soils and equipment. Cautionary comment on excavation stability is provided within other report sections.

We herein note that the Contractor is solely responsible for assessing the stability of and executing underground utility and project excavations using safe methods. Contractor is also responsible for naming the "competent individual" as per Subpart P of 29 CFR 1926.6 (Federal Register - OSHA).

4.7 Slab-on-Grade Floors

The floor slabs should be constructed directly over documented engineered fill or non-organic, competent native glacial soil as described in the Site Preparation section. For this option, the design of the floor slab may be based on an estimated modulus of subgrade reaction (k) of 150 pci.

The final 6 inches of fill below the concrete floor slabs should consist of pit run or processed sand (sand cushion) with 100 percent material passing the 1 inch sieve, no more than 40 percent passing the No. 40 sieve and no more than 5 percent material passing the No. 200 U.S. Sieve.

The moisture content of the sand cushion should be within plus or minus 2 percent of the optimum moisture content determined by the standard Proctor test.

All interior at-grade floors with impervious or near impervious surfacing such as, but not limited to, paint, hardening agent, vinyl tile, ceramic tile, or wood flooring, should include provision for installation of a vapor barrier system. Historically, vapor barrier systems can consist of many different types of synthetic membrane, and can be placed either below sand cushion materials or at the underside of the concrete floor.

All such issues are contentious and have both positive and negative aspects associated with long term performance of the floor. Overall, we recommend you install some form of vapor barrier below the project floor [for at-grade and basement construction, as appropriate].

We recommend that you isolate floor slabs from other building components by placement of a nominal ½ inch thick expansion joint between the floor and walls, and/or columns. This construction must also apply a compatible sealant after curing of the floor slab to reduce moisture penetration though the expansion joint. As a minimum, you should install a bond breaker to isolate and reduce binding of building components.

4.8 Exterior Backfill

Exterior wall backfill placement and associated final grading adjacent to the buildings can significantly impact the performance of a structure. ***We understand the proposed structures will include a below grade level with foundation walls that retain soils.***

NTI recommends that the exterior backfill for below grade foundation walls shall consist of either onsite or imported non organic debris free granular soils with less than 12 percent passing the number 200 sieve. If the onsite clays are reused as backfill around the basements, we recommend that at least the two feet adjacent to the wall be backfilled with free draining granular soils.

The final 1.5 to 2.0 feet of exterior backfill within lawn areas should consist of clay and topsoil while exterior backfill below sidewalks and pavements should consist of a free draining aggregate base as recommended for the respective construction. Backfill should be tempered for correct moisture content, then placed and compacted in individual lifts of exterior backfill per criteria presented within Appendix B.

Placement of exterior backfill against below-grade earth retaining foundation walls should be limited until lateral restraint of the foundation walls has been installed to the satisfaction of the Structural Engineer. Final grading of exterior backfill should provide sufficient grade for positive drainage away from the structure.

Foundation walls will experience lateral loading from retained soils. This lateral loading may be modeled as an equivalent fluid pressure applied to the foundation wall providing such complies with geometric conditions which support such modeling. We recommend using granular backfill designed to the Table 6 “at-rest” equivalent fluid pressure for design of respective below grade foundations.

Table 6: Estimate of Equivalent Fluid Weight of Retained Soils

Type of Retained Soil		Friction Angle (deg.)	"At Rest" Condition (pcf)	"Active" Condition (pcf)	"Passive" Condition (pcf)
Unit Weight of Equivalent Fluid *	Sand (SP, SP-SM) – (120 pcf)	32	55	40	--
	On site, inorganic soils (CL, SM, ML)	26	70	50	300

* The recommendations for equivalent fluid weight are based solely on assumed conditions with respect to sloping ground and/or surcharge loads and do not include a factor of safety. Design professional is cautioned that actual loads imparted to the structure will be dependent on soil conditions, site geometric considerations and surcharge loads imparted to the structure.

In order to use the sand parameters for design, the granular backfill should extend 2 feet laterally from the wall plus one foot horizontally for each foot vertically of backfill.

To calculate the resistance to sliding, a value of 0.35 should be used as the ultimate coefficient of friction between the footing and the underlying sandy soil. Due to strain incompatibility, passive resistance to sliding should not be included in conjunction with friction. Passive resistance within the seasonal frost zone should be ignored.

Exterior backfill of at-grade non earth retaining foundations walls should consist of native, non-organic, debris free soils. Placement of exterior backfill against at-grade non earth retaining foundation walls should be performed concurrent with interior backfill to minimize differential loading, rotation and/or movement of the wall system.

A draintile installed behind the base of walls that extend below adjacent grade is recommended to prevent hydrostatic loading on the walls. The drain tile should be sloped to provide positive gravity drainage or to a sump pit and pump.

The drain line should be surrounded by clean, free-draining granular material having less than 5 percent passing the No. 200 sieve. The free-draining aggregate should be encapsulated in a filter fabric. The granular fill should extend to within 2 feet of final grade vertically and at least 2 feet laterally from the wall, where it should be capped with compacted clay to reduce infiltration of surface water into the drain system.

4.9 Surface Drainage

You should maintain positive drainage during and after construction of project and eliminate ponding of water on site soils. We recommend that you include provisions within construction documents for positive drainage of site. You should install sumps at critical areas around project excavations to assist in removal of seepage and runoff from site.

We understand sidewalks, curbing, pavements, and green space will direct drainage away from the structures. We recommend that you provide a 5 percent gradient within 10 feet of the building for drainage from lawn, and 2 percent minimum gradient from the building for drainage of sidewalks and pavements. All pavements should drain to on-site storm collection, municipal collection system, or roadside ditching.

Roof runoff should be directed away from buildings by a system of rain gutters, down spouts and splash pads.

4.10 Pavement Construction

We assume project traffic will generally consist of automobile and light trucks, with occasional delivery vehicles. Our pavement recommendations are predicated on separation of this traffic.

The resulting subgrade following site grading should first be scarified and re-compacted to a depth of 12 inches. A proof roll test should then be performed to determine soft or unstable subgrade areas. If rutting or localized unstable subgrade areas are observed, those areas should be subcut, moisture-conditioned, and re-compacted or removed to a stable depth. Excavations for soil corrections (if any) in paved areas should allow for a 2 foot oversize beyond the edges of the pavement. Consideration should be made to grading the upper foot, or more, of the pavement subgrades with the onsite granular soils.

The proof roll should be performed with a tandem axle dump truck loaded to gross capacity (at least 20 tons). Acceptance criteria of the proof roll shall be limited to rut formation no more than one inch (1”) depth (front or rear axles) and no pumping (rolling) observed during the visual inspection. Proof roll tests should be observed by an experienced technician or geotechnical engineer prior to placement of the aggregate base course to verify the subgrade will provide adequate pavement support.

If fill is required in paved areas, we recommend that it consist of soils similar in composition to the existing native soils. Individual lifts of engineered fill in proposed paved areas should be tempered for moisture content, placed and compacted as listed in the Compaction Guidelines table in Appendix B.

Estimates of minimum thicknesses for new pavement sections for this project have been based on the procedures outlined in the MnDOT Pavement Design Manual using soil parameters based on soil types. The following minimum thicknesses were estimated based upon our estimated traffic loading, limited soils information, variation across the project area, and experience with similar projects and soil conditions. The performance of stabilometer or similar tests, were beyond the scope of this report; however, they may be performed, upon request, for an additional fee. We estimate that a properly prepared subgrade would have an average stabilometer R-value of 20 for fine grained soils (CL, ML) or 30 for granular soils (SC, SM).

For a 20-year design pavement life and light commercial traffic volumes, Table 6 presents our thickness recommendations for flexible (bituminous) pavement.

Table 7: Recommended Flexible Pavement Thickness Design Alternative

Pavement Section	Fine Grained Soils CL, ML	Coarse Grained Soils SM, SC
Bituminous Wear Course (inches)	2.0	1.5
Bituminous Base Course (inches)	2.0	2.0
Class 5 or 7 Aggregate Base (inches)	6.0	6.0

We recommend rigid Portland cement concrete pavements be constructed in areas where point loads and turning stresses are more likely to damage the pavement. Based on the performance of concrete pavements at similar sites, we recommend the concrete pavement design alternative listed in Table 7.

Table 8: Recommended Rigid Pavement Thickness Design Alternative

Pavement Section	Fine Grained Soils CL, ML	Coarse Grained Soils SM, SC
Unreinforced Concrete (inches)	6.0	5.0
Class 5 or 7 Aggregate Base (inches)	6.0	6.0

Pavement recommendations assume the subgrade soils and aggregate section below paved surfaces will drain to subsurface piping for eventual discharge into storm sewer, or above grade to ditching, or similar acceptable systems. Lack of surface and subsurface drainage will significantly reduce the capacity and longevity of the pavement systems indicated above.

We recommend pavements receive annual maintenance, as a minimum, to correct damages to the pavement structure, clean and infill cracks which develop, and repair or resurface areas which exhibit reduced subgrade performance. The lack of maintenance can lead to moisture infiltration of the pavement structure and softening of the subgrade soils. This, in turn, can degrade the performance of the pavement system and result in poorly performing pavements with shortened life expectancy.

4.11 Stormwater Infiltration

It is our understanding that the project may incorporate infiltration of stormwater. Table 8 provides an estimate of the infiltration rates for the soils encountered by our geotechnical exploration program.

Table 9: Estimated Infiltration Rates for Subsurface Soil at Project [Note 1]

Soil Type	Estimated Cumulative Infiltration Rate (inches / hr)
Silty Sand (SM)	0.45
Silt (ML)	0.2
Sandy Lean Clay (CL) & Clayey Sand (SC)	0.06

Note 1 All findings are approximate based on correlation of on-site soils to the *Minnesota Stormwater Manual*, or other published literature. We recommend further assessment of soil infiltration rate using "*Double-Ring Infiltrometer"* evaluation, or other similar approved methods.

5.0 FROST CONSIDERATIONS

The silty sand and silt soils on this site are highly frost susceptible and small amounts of groundwater, or infiltrated surface water, can be detrimental to the performance of the slabs and pavements. Exterior slabs and pavements should be expected to heave. If frost action needs to be eliminated in critical areas, then we recommend the use of structurally supported exterior slabs (e.g., as structural stoops in front of building doors), as is common practice in the state of Minnesota. It is our opinion that placing non-frost susceptible material in large areas under exterior pavements and sidewalks would be exceedingly expensive and an unusual design and construction procedure in Minnesota.

A transition area between structurally supported slabs or non-frost susceptible materials should be constructed at a 3H:1V back slope to reduce the potential differential frost movements in the slabs or pavements. Draintile should be installed around the foundation perimeter and finger drains should be installed about catch basins and across low points in the pavement grades.

Non-frost susceptible fill should consist of sand or gravel with less than 5% material passing the number 200 sieve, and at least 50% retained on the number 40 sieve.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Excavation Stability

Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations. Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Also, contractors should comply with local, state, and federal safety regulations including current OSHA excavation and trench safety standards. Temporary shoring must be designed in accordance with applicable regulatory requirements.

6.2 Engineered Fill & Winter Construction

The Geotechnical Engineer of Record or their designated representative should observe and evaluate excavations to verify removal of uncontrolled fills, topsoil and/or unsuitable material(s), and adequacy of bearing support of exposed soils. Such observation should occur prior to construction of foundations or placement of engineered fill supporting excavations.

Engineered fill should be approved by the Geotechnical Engineer of Record prior to placement. In addition, the engineered fill should be tempered for correct moisture content and then place and compact individual lifts of engineered fill to criteria established within the appendices attachment.

Frozen soil should never be used as engineered fill or backfill nor should you support foundations on frozen soils. Moisture freezing within the soil matrix of fine grained and/or cohesive soils produces ice lenses. Such soils gain moisture from capillary action and, with continued growth, heave with formation of ice lenses within the soil matrix. Foundations constructed on frozen soils have the potential to settle once ice lenses thaw.

You should protect excavations and foundations from freezing conditions or accumulation of snow, and remove frozen soils, snow, and ice from within excavations, fill section or from below proposed foundations. Replacement soils should consist of similar materials as those removed from the excavation with moisture content, placement and compaction conforming to report criteria.

7.0 CLOSURE

As the widely spaced, small diameter borings provide only a limited amount of data regarding the existing fill, the existing fill may contain soft zones, debris or significantly greater amounts of unsuitable materials than could be reasonably inferred from the boring information. Unsuitable materials may not be discovered during construction and may remain buried within the fill below the slabs and pavements, resulting in greater than anticipated settlements of the slabs and pavements. These risks cannot be eliminated without completely removing the fill, but can be reduced by thorough exploration and testing during site preparation and construction.

Our conclusions and recommendations are predicated on observation and testing of the earthwork directed by Geotechnical Engineer of Record. Our opinions are based on data assumed representative of the site. However, the area coverage of borings in relation to the entire project is very small. For this and other reasons, we do not warrant conditions below the depth of our borings, or that the strata logged from our borings are necessarily typical of the site. Deviations from our recommendations by plans, written specifications, or field applications shall relieve us of responsibility unless our written concurrence with such deviations has been established.

The scope of services for this project does not include either specifically or by implication any environmental or biological assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of Landform for specific application to the proposed Saville Development project in Minnetonka, Minnesota. Northern Technologies, Inc. has endeavored to comply with generally accepted geotechnical engineering practice common to the local area. Northern Technologies, Inc. makes no other warranty, expressed or implied.

Northern Technologies, Inc.

Steven D. Gerber, P.E.
Senior Engineer

Ryan M. Benson, P.E.
Regional Manager/Principal Engineer

SDG/rmb

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a Duly Licensed Professional Engineer under the Laws of the State of Minnesota.

Steven D. Gerber
Date: 05/26/2015 Reg. No. 45928

APPENDIX A

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

FIELD EXPLORATION PROCEDURES

GENERAL NOTES

WATER LEVEL SYMBOL

DESCRIPTIVE TERMINOLOGY

RELATIVE PROPORTIONS

PARTICLE SIZES

CLASSIFICATION of SOILS for ENGINEERING PURPOSES

EXCAVATION OVERSIZE

GEOTECHNICAL EVALUATION OF RECOVERED SOIL SAMPLES

We visually examined recovered soil samples to estimate distribution of grain sizes, plasticity, consistency, moisture condition, color, presence of lenses and seams, and apparent geologic origin. We then classified the soils according using the Unified Soil Classification System (ASTM D2488). A chart describing this classification system and general notes explaining soil sampling procedures are presented within appendices attachments.

The stratification depth lines between soil types on the logs are estimated based on the available data. Insitu, the transition between type(s) may be distinct or gradual in either the horizontal or vertical directions. The soil conditions have been established at our specific boring locations only. Variations in the soil stratigraphy may occur between and around the borings, with the nature and extent of such change not readily evident until exposed by excavation. These variations must be properly assessed when utilizing information presented on the boring logs.

We request that you, your design team or contractors contact NTI immediately if local conditions differ from those assumed by this report, as we would need to review how such changes impact our recommendations. Such contact would also allow us to revise our recommendations as necessary to account for the changed site conditions.

FIELD EXPLORATION PROCEDURES

Soil Sampling – Standard Penetration Boring:

Soil sampling was performed according to the procedures described by ASTM D-1586. Using this procedure, a 2 inch O.D. split barrel sampler is driven into the soil by a 140 pound weight falling 30 inches. After an initial set of six inches, the number of blows required to drive the sampler an additional 12 inches is recorded (known as the penetration resistance (i.e. “N-value”) of the soil at the point of sampling. The N-value is an index of the relative density of cohesionless soils and an approximation of the consistency of cohesive soils.

Soil Sampling – Power Auger Boring:

The boring(s) was/were advanced with a 6 inch nominal diameter continuous flight auger. As a result, samples recovered from the boring are disturbed, and our determination of the depth, extend of various stratum and layers, and relative density or consistency of the soils is approximate.

Soil Classification:

Soil samples were visually and manually classified in general conformance with ASTM D-2488 as they were removed from the sampler(s). Representative fractions of soil samples were then sealed within respective containers and returned to the laboratory for further examination and verification of the field classification. In addition, select samples were submitted for laboratory tests. Individual sample information, identification of sampling methods, method of advancement of the samples and other pertinent information concerning the soil samples are presented on boring logs and related report attachments.

GENERAL NOTES

DRILLING and SAMPLING SYMBOLS		*LABORATORY TEST SYMBOLS*	
SYMBOL	**DEFINITION**	**SYMBOL**	**DEFINITION**
C.S.	Continuous Sampling	W	Moisture content-percent of dry weight
P.D.	2-3/8" Pipe Drill	D	Dry Density-pounds per cubic foot
C.O.	Cleanout Tube	LL, PL	Liquid and plastic limits determined in accordance with ASTM D 423 and D 424
3 HSA	3 ¼" I.D. Hollow Stem Auger	Q_U	Unconfined compressive strength-pounds per square foot in accordance with ASTM D 2166-66
4 FA	4" Diameter Flight Auger		
6 FA	6" Diameter Flight Auger		
2 ½ C	2 ½" Casing		
4 C	4" Casing		
D.M.	Drilling Mud	Pq	Penetrometer reading-tons/square foot
J.W.	Jet Water	S	Torvane reading-tons/square foot
H.A.	Hand Auger	G	Specific Gravity – ASTM D 854-58
NXC	Size NX Casing	SL	Shrinkage limit – ASTM 427-61
BXC	Size BX Casing	Ph	Hydrogen ion content-meter method
AXC	Size AX casing	O	Organic content-combustion method
SS	2" O.D. Split Spoon Sample	M.A.	Grain size analysis
2T	2" Thin Wall Tube Sample	C*	One dimensional consolidation
3T	3" Thin Wall Tube Sample	Q_C	Triaxial Compression
		* See attached data Sheet and/or graph	

WATER LEVEL SYMBOL

Water levels shown on the boring logs were determined at the time and under the conditions indicated. In sand, the indicated levels can be considered relatively reliable for most site conditions. In clay soils, it is not possible to determine the ground water level within the normal scope of a test boring investigation, except where lenses or layers of more pervious water bearing soil are present; and then a long period of time may be necessary to reach equilibrium. Therefore, the position of the water level symbol for cohesive or mixed soils may not indicate the true level of the ground water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

RELATIVE DENSITY		*CONSISTENCY*	
TERM	**N_{60} Value** (corrected)	**TERM**	**N_{60} Value** (corrected)
Very Loose	0 – 4	Soft	0-4
Loose	5 – 8	Medium	5-8
Medium Dense	9 – 16	Rather Stiff	9 – 15
Dense	16 – 30	Stiff	16 – 30
Very Dense	Over 30	Very Stiff	Over 30

RELATIVE PROPORTIONS

TERMS	**RANGE**
Trace	0 – 5%
A little	5 – 15%
Some	15 – 30%

PARTICLE SIZES

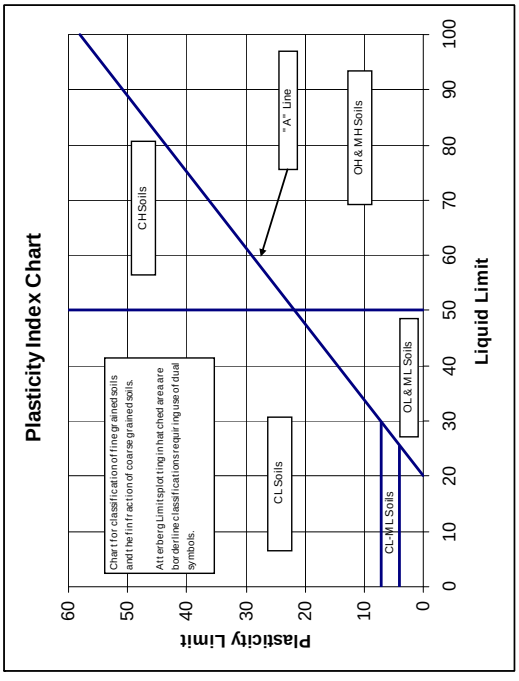
MATERIAL	**DESCRIPTION**	**U.S. SIEVE SIZE**
Boulders		Over 3"
Gravel	Coarse	3" to ¾"
	Medium	¾" to #4
Sand	Coarse	#4 to #10
	Medium	#10 to #40
	Fine	#40 to #200
Silt and Clay	Determined by Hydrometer Test	

CLASSIFICATION of SOILS for ENGINEERING PURPOSES

ASTM Designation D-2487 and D2488 (Unified Soil Classification System)

Major Divisions			Group Symbol	Typical Name	Classification Criteria	
Course Grained Soils More than 50% retained on No. 200 sieve *	Gravels 50% or more of coarse fraction retained on No. 4 sieve.	Clean Gravels	**GW**	Well –graded gravels and gravel-sand mixtures, little or no fines.	Cu = D60 / D10 greater than 4. Cz = (D30)2 / (D10 x D60) between 1 & 3.	
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines.	Not meeting both criteria for GW materials.	
		Gravels with Fines	**GM**	Silty gravels, gravel-sand-silt mixtures.	Atterberg limits below "A" line, or P.I. less than 4.	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			GC	Clayey gravels, gravel-sand-clay mixtures.	Atterberg limits above "A" line with P.I. greater than 7.	
	Sands More than 50% of coarse fraction passes No 4 sieve.	Clean Sands	**SW**	Well-graded sands and gravelly sands, little or no fines.	Cu = D60 / D10 greater than 6. Cz = (D30)2 / (D10 x D60) between 1 & 3.	
			SP	Poorly-graded sands and gravelly sands, little or no fines.	Not meeting both criteria for SW materials.	
		Sands with Fines	**SM**	Silty sands, sand-silt mixtures.	Atterberg limits below "A" line, or P.I. less than 4.	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols.
			SC	Clayey sands, sand-clay mixtures.	Atterberg limits above "A" line with P.I. > 7.	
Fine Grained Soils More than 50% passes No. 200 sieve *	Silts and Clays Liquid Limit of 50% or less		**ML**	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands.		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.		
			OL	Organic silts and organic silty clays of low plasticity.		
	Silts and Clays Liquid Limit greater than 50%.		**MH**	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.		
			CH	Inorganic clays of high plasticity, fat clays.		
			OH	Organic clays of medium to high plasticity.		
	Highly Organic Soils		**Pt**	Peat, muck and other highly organic soils.		

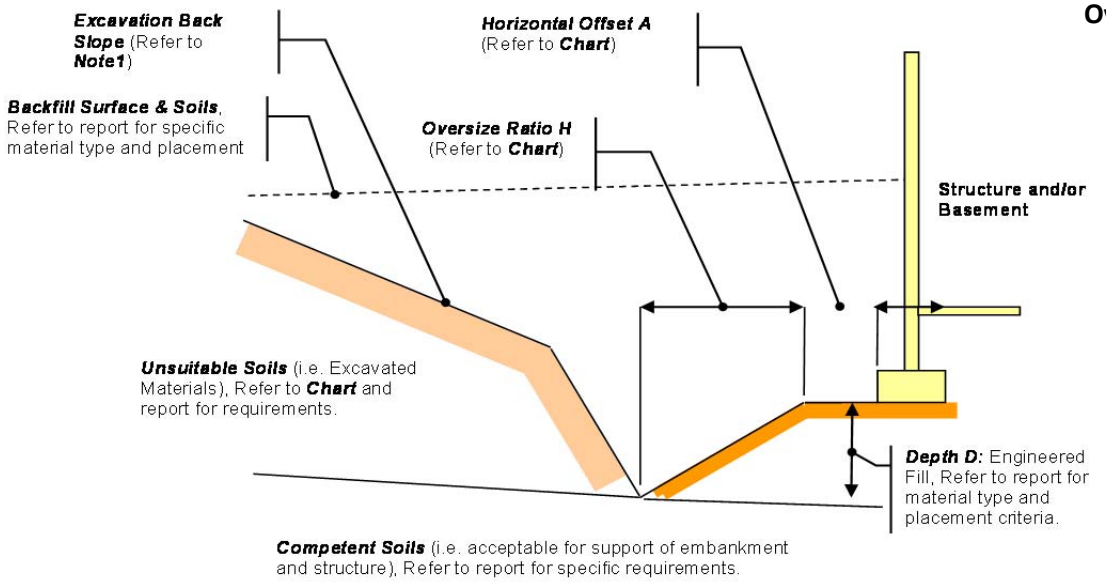
Classification on basis of percentage of fines.
Less than 5% passing No. 200 Sieve: GW, GP, SW, SP
More than 12% passing No. 200 Sieve: GM, GC, SM, SC
From 5% to 12% passing No. 200 Sieve: Borderline Classification requiring use of duel symbols.



EXCAVATION OVERSIZE

Excavation oversize facilitates distribution of load induced stress within supporting soils. Unless otherwise superseded by report specific requirements, all construction should conform to the minimum oversize and horizontal offset requirements as presented within the diagram and associated chart.

Figure 1: Excavation Oversize



Definitions

Oversize Ratio H: The ratio of the horizontal distance divided by the engineered fill depth (i.e. # Horizontal / Depth D). Refer to Chart for specific requirements.

Horizontal Offset A: The horizontal distance between the outside edge of footing or critical position and the crest of the engineered fill section. Refer to Chart for specific requirements.

Note 1: Excavation depth and sidewall inclination should not exceed those specified in local, state or federal regulations including those defined by Subpart P of Chapter 27, 29 CFR Part 1926 (of Federal Register). Excavations may need to be widened and sloped, or temporarily braced, to maintain or develop a safe work environment. Contractor is solely responsible for assessing stability under "means and methods".

Condition	*Unsuitable Soil Type*	*Horizontal Offset A*	*Oversize Ratio H*
Foundation Unit Load equal to or less than 3,000 psf.	SP, SM soils, CL & CH soils with cohesion greater than 1,000 psf	2 feet or width of footing, whichever is greater	Equal to or greater than one (1) times Depth D
Foundation Unit Load greater than 3,000 psf	SP, SM soils, CL & CH soils with cohesion less than 1,000 psf	5 feet or width of footing, whichever is greater	Equal to or greater than one (1) times Depth D
Foundation Unit Load equal to or less than 3,000 psf.	Topsoil or Peat	2 feet or width of footing, whichever is greater	Equal to or greater than two (2) times Depth D
Foundation Unit Load greater than 3,000 psf	Topsoil or Peat	5 feet or width of footing, whichever is greater	Equal to or greater than two (3) times Depth D

APPENDIX B

GROUNDWATER ISSUES

PLACEMENT and COMPACTION OF ENGINEERED FILL

GROUNDWATER ISSUES

The following presents additional comment and soil specific issues related to measurement of groundwater conditions at your project site.

Note that our groundwater measurements, or lack thereof, will vary depending on the time allowed for equilibrium to occur in the borings. Extended observation time was not available during the scope of the field exploration program and, therefore, groundwater measurements as noted on the borings logs may or may not accurately reflect actual conditions at your site.

Seasonal and yearly fluctuations of the ground water level, if any, occur. Perched groundwater may be present within sand and silt lenses bedded within cohesive soil formations. Groundwater typically exists at depth within cohesive and cohesionless soils.

Documentation of the local groundwater surface and any perched groundwater conditions at the project site would require installation of temporary piezometers and extended monitoring due to the relatively low permeability exhibited by the site soils. We have not performed such groundwater evaluation due to the scope of services authorized for this project.

We anticipate that a system of sump pits and pumps located outside of the foundation areas would be suitable for control if perched groundwater were to be encountered. NTI cautions that such seepage may be heavy and will vary based on seasonal and annual precipitation, and ground related impacts in the vicinity of the project.

PLACEMENT and COMPACTION OF ENGINEERED FILL

Unless otherwise superseded within the body of the Geotechnical Exploration Report, the following criteria shall be utilized for placement of engineered fill on project. This includes, but is not limited to earthen fill placement to improve site grades, fill placed below structural footings, fill placed interior of structure, and fill placed as backfill of foundations.

Engineered fill placed for construction, if necessary should consist of natural, non-organic, competent soils native to the project area. Such soils may include, but are not limited to gravel, sand, or clays with Unified Soil Classification System (ASTM D2488) classifications of GW, SP, or SM. Use of silt or clayey silt as project fill will require additional review and approval of project Geotechnical Engineer of Record. Such soils have USCS classifications of ML, MH, ML-CL, MH-CH. Use of topsoil, marl, peat, other organic soils construction debris and/or other unsuitable materials as fill is not allowed. Such soils have USCS classifications of OL, OH, Pt.

Engineered fill, classified as clay, should be tempered such that the moisture content at the time of placement is equal to and no more than 3 percent above the optimum content for as defined by the appropriate proctor test. Likewise, engineered fill classified as gravel or sand should be tempered such that the moisture content at the time of placement is within 3 percent of the optimum content.

All engineered fill for construction should be placed in individual 8 inch maximum depth lifts. Each lift of fill should be compacted by large vibratory equipment until the in-place soil density is equal to or greater than the criteria established within the following tabulation.

	Compaction Criteria (% respective Proctor) [1]	
Type of Construction	**Clay**	**Sand or Gravel**
General Embankment Fill	Min. 95	Min. 95
Engineered Fill below Foundations	Min. 98	Min. 98
Engineered Fill below Floor Slabs	Min. 98	Min. 98
Engineered Fill placed as Pavement Aggregate Base	NA	Min. 100
Engineered Fill placed to within 3 feet of pavement aggregate base	Min. 95	Min. 95
Engineered Fill placed within 3 feet of pavement aggregate base	Min. 100	Min. 100
Note 1 Unless otherwise required, compaction shall be based on the Standard Proctor Test (ASTM D698).		

Density tests should be taken during engineered fill placement to document earthwork has achieved necessary compaction of the material(s). Recommendations for interior fill placement and backfill of foundation walls are presented within other sections of this report.

APPENDIX C

SOIL BORING DIAGRAM

SOIL BORING LOGS

N

Boring Location Diagram
Saville Development
Minnetonka, Minnesota
NTI Project #: 15.60938.100

NOTE: Boring locations are approximate.

NTI
NORTHERN TECHNOLOGIES, INC.

Northern Technologies, Inc.
1408 Northland Drive, Suite 107
Mendota Heights, MN 55120
Telephone: 651-389-4191

BORING NUMBER SB-1

CLIENT Landform
PROJECT NAME Saville Development
PROJECT NUMBER 15.60938.100
PROJECT LOCATION Minnetonka, MN
DATE STARTED 4/30/15 **COMPLETED** 4/30/15
GROUND ELEVATION 94.4 ft **HOLE SIZE** "6 1/2" inches
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No ground water observed.
LOGGED BY BH **CHECKED BY** SDG
AT END OF DRILLING ---
NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (8 Inches)	AU 1	0	1-2-3 (5)							
		SANDY LEAN CLAY, (CL) brown to dark brown, moist, soft to medium, trace gravel (Fill)	SS 2	78	1-1-2 (3)			18				
5			SS 3	78	1-2-4 (6)							
		LEAN CLAY WITH SAND, (CL) brown, moist, soft, trace gravel, iron oxide staining (Alluvial)	SS 4	100	4-3-1 (4)			29				
10			SS 5	89	2-1-2 (3)							
		CLAYEY SAND, (SC) brown, fine to medium grained, moist, medium dense to dense, trace gravel, iron oxide staining (Glacial Till)	SS 6	89	2-3-3 (6)							
15			AU 7	0	3-4-4 (8)			13				37
20			SS 8	89	9-9-8 (17)							

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

Northern Technologies, Inc.
1408 Northland Drive, Suite 107
Mendota Heights, MN 55120
Telephone: 651-389-4191

BORING NUMBER SB-2

CLIENT Landform
PROJECT NAME Saville Development
PROJECT NUMBER 15.60938.100
PROJECT LOCATION Minnetonka, MN
DATE STARTED 4/30/15 **COMPLETED** 4/30/15
GROUND ELEVATION 96 ft **HOLE SIZE** "6 1/2" inches
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No ground water observed.
LOGGED BY BH **CHECKED BY** SDG
AT END OF DRILLING ---
NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (8 Inches)	AU 1									
		SANDY LEAN CLAY, (CL) dark brown, moist, soft to medium, trace gravel, trace organics and fine roots (Alluvial))	SS 2	44	1-2-2 (4)			29				
5			SS 3	67	3-3-7 (10)	2.25						
		SANDY SILT, (ML) gray, moist, medium, iron oxide staining (Alluvial))	SS 4	78	2-2-3 (5)			22				
10		LEAN CLAY, (CL) gray, moist, medium to rather stiff, trace gravel, iron oxide staining, occasional silt lenses (Alluvial))	SS 5	78	2-3-2 (5)							
		SANDY LEAN CLAY, (CL) gray, moist, medium, trace gravel (Glacial Till)	SS 6	67	2-5-6 (11)							
15			SS 7	67	3-6-6 (12)			36				
20			SS 8	72	1-3-6 (9)							

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

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Telephone: 651-389-4191

BORING NUMBER SB-3

CLIENT Landform **PROJECT NAME** Saville Development

PROJECT NUMBER 15.60938.100 **PROJECT LOCATION** Minnetonka, MN

DATE STARTED 4/29/15 **COMPLETED** 4/29/15 **GROUND ELEVATION** 102 ft **HOLE SIZE** "6 1/2" inches

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No ground water observed.

LOGGED BY BH **CHECKED BY** SDG **AT END OF DRILLING** ---

NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac) **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		AGGREGATE BASE (3 Inches)										
		SILTY SAND, (SM) light brown, fine to medium grained, moist, trace gravel (Fill)	SS 1	11	1-2-2 (4)							
		CLAYEY SAND, (SC) brown, fine to medium grained, moist, loose to medium dense, trace gravel, iron oxide staining (Glacial Till)	SS 2	100	3-3-5 (8)							
5			SS 3	100	4-5-6 (11)			11				39
			SS 4	100	5-5-6 (11)							
		SANDY LEAN CLAY, (CL) brown, moist, rather stiff, trace gravel, iron oxide staining (Glacial Till)										
10			SS 5	100	8-6-6 (12)			16				
			SS 6	100	6-7-5 (12)	2						
15			SS 7	100	6-6-7 (13)							
20		NOTE: Color Change to gray at 19.5 feet.	SS 8	100	4-5-5 (10)			16				

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

Northern Technologies, Inc.
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Mendota Heights, MN 55120
Telephone: 651-389-4191

BORING NUMBER SB-4

CLIENT Landform
PROJECT NAME Saville Development
PROJECT NUMBER 15.60938.100
PROJECT LOCATION Minnetonka, MN
DATE STARTED 4/30/15 **COMPLETED** 4/30/15
GROUND ELEVATION 95 ft **HOLE SIZE** "6 1/2" inches
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No ground water observed.
LOGGED BY BH **CHECKED BY** SDG
AT END OF DRILLING ---
NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (7 Inches)	AU 1									
		CLAYEY SAND, (SC) brown to dark brown, fine to medium grained, moist, loose to medium dense, trace gravel, iron oxide staining (Glacial Till)	SS 2	22	2-3-3 (6)			18				
5			SS 3	44	3-5-6 (11)							
		NOTE: Trace organics and fine roots above 6 feet.	SS 4	56	3-2-3 (5)	.5						
10			SS 5	44	3-4-5 (9)			14				
			SS 6	56	3-4-5 (9)							
15			SS 7	56	2-4-5 (9)			14				39
20			SS 8	67	4-7-10 (17)							
		Borehole backfilled with auger cuttings. Bottom of borehole at 21.0 feet.										

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BORING NUMBER SB-5

CLIENT Landform **PROJECT NAME** Saville Development

PROJECT NUMBER 15.60938.100 **PROJECT LOCATION** Minnetonka, MN

DATE STARTED 4/29/15 **COMPLETED** 4/29/15 **GROUND ELEVATION** 100.3 ft **HOLE SIZE** "6 1/2" inches

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No ground water observed.

LOGGED BY BH **CHECKED BY** SDG **AT END OF DRILLING** ---

NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac) **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (6 Inches)										
		CLAYEY SAND, (SC) brown to dark brown, fine to medium grained, moist, loose, trace organics and fine roots (Fill)	AU 1									
			SS 2	33	2-2-3 (5)			22				
5			SS 3	33	2-2-4 (6)							
		SANDY LEAN CLAY, (CL) brown to gray, moist, soft, trace gravel, iron oxide staining (Alluvial)	SS 4	56	1-2-2 (4)	.75						
10			SS 5	78	1-1-1 (2)			32				
		SILTY SAND, (SM) gray, fine to medium grained, moist, medium dense to dense, trace gravel (Glacial Till)	SS 6	56	4-5-5 (10)							
15			SS 7	67	3-5-6 (11)							
20			SS 8	44	5-7-10 (17)			11				

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

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BORING NUMBER SB-6

CLIENT Landform **PROJECT NAME** Saville Development

PROJECT NUMBER 15.60938.100 **PROJECT LOCATION** Minnetonka, MN

DATE STARTED 4/30/15 **COMPLETED** 4/30/15 **GROUND ELEVATION** 104.8 ft **HOLE SIZE** "6 1/2" inches

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No ground water observed.

LOGGED BY BH **CHECKED BY** SDG **AT END OF DRILLING** ---

NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac) **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (2 Inches)										
		SILTY SAND, (SM) brown, fine to medium grained, moist, trace gravel, occasional clay (CL) pieces (Fill)	AU 1									
		SANDY LEAN CLAY, (CL) brown, moist, medium, trace gravel (Glacial Till)	SS 2	67	2-3-5 (8)							
5		CLAYEY SAND, (SC) brown, fine to medium grained, moist, medium dense to dense, trace gravel (Glacial Till)	SS 3	78	4-6-9 (15)							
			SS 4	78	8-11-11 (22)			11				39
10			SS 5	67	6-6-9 (15)							
			SS 6	78	5-7-13 (20)							
15			SS 7	56	8-12-8 (20)							
		NOTE: Sand (SP) lense at 15.5 feet. CLAYEY SAND, (SC) brown, fine to coarse grained, moist, dense, trace gravel (Glacial Till)										
20			SS 8	67	10-12-13 (25)			16				

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

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Telephone: 651-389-4191

BORING NUMBER SB-7

CLIENT Landform **PROJECT NAME** Saville Development

PROJECT NUMBER 15.60938.100 **PROJECT LOCATION** Minnetonka, MN

DATE STARTED 4/29/15 **COMPLETED** 4/29/15 **GROUND ELEVATION** 102.5 ft **HOLE SIZE** "6 1/2" inches

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No ground water observed.

LOGGED BY BH **CHECKED BY** SDG **AT END OF DRILLING** ---

NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac) **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (3 Inches)										
		CLAYEY SAND, (SC) brown, fine to medium grained, moist, trace gravel, trace organics and fine roots (Fill)	AU 1									
		SANDY SILT, (ML) gray, moist, rather stiff to stiff, trace gravel, iron oxide staining (Glacial Till)	SS 2	44	5-5-7 (12)			19				
5			SS 3	56	6-8-9 (17)							
			SS 4	78	6-8-10 (18)							
		SILTY SAND, (SM) brown to gray, fine to medium grained, moist, medium dense to very dense, little gravel (Glacial Till) NOTE: Hard drilling due to gravel at 9.5 feet.										
10			SS 5	67	8-20-15 (35)			9				12
			AU 6	0	4-4-6 (10)							
		SANDY LEAN CLAY, (CL) brown to gray, fine to medium grained, moist, medium dense, trace gravel (Glacial Till)										
15			SS 7	44	4-4-6 (10)	1.75		21				
20			SS 8	56	3-4-5 (9)							

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

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BORING NUMBER SB-8

CLIENT Landform
PROJECT NAME Saville Development
PROJECT NUMBER 15.60938.100
PROJECT LOCATION Minnetonka, MN
DATE STARTED 4/30/15 **COMPLETED** 4/30/15
GROUND ELEVATION 93.6 ft **HOLE SIZE** "6 1/2" inches
DRILLING CONTRACTOR NTI
GROUND WATER LEVELS:
DRILLING METHOD 3 1/4 in H.S.A
AT TIME OF DRILLING --- No ground water observed.
LOGGED BY BH **CHECKED BY** SDG
AT END OF DRILLING ---
NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (2 Inches)										
		SANDY LEAN CLAY, (CL) brown, moist, soft, trace gravel (Glacial Till)	AU 1	0	0-1-3 (4)							
			SS 2	33	0-1-1 (2)			16				
5			SS 3	56	1-1-1 (2)							
		NOTE: Buried topsoil at 5.5 feet..										
		SANDY LEAN CLAY, (CL) gray, moist, soft to medium (Alluvial)	SS 4	56	2-2-2 (4)			16				
10			SS 5	44	2-3-3 (6)							
		SANDY LEAN CLAY, (CL) gray, moist, rather stiff, trace gravel (Till)	SS 6	22	5-7-7 (14)	.75						
15		NOTE: Color change to brown at 14.5 feet.	SS 7	67	5-6-6 (12)			13				
20			SS 8	56	5-8-6 (14)							

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

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BORING NUMBER SB-9

CLIENT Landform **PROJECT NAME** Saville Development

PROJECT NUMBER 15.60938.100 **PROJECT LOCATION** Minnetonka, MN

DATE STARTED 4/30/15 **COMPLETED** 4/30/15 **GROUND ELEVATION** 99.2 ft **HOLE SIZE** "6 1/2" inches

DRILLING CONTRACTOR NTI **GROUND WATER LEVELS:**

DRILLING METHOD 3 1/4 in H.S.A **AT TIME OF DRILLING** --- No ground water observed.

LOGGED BY BH **CHECKED BY** SDG **AT END OF DRILLING** ---

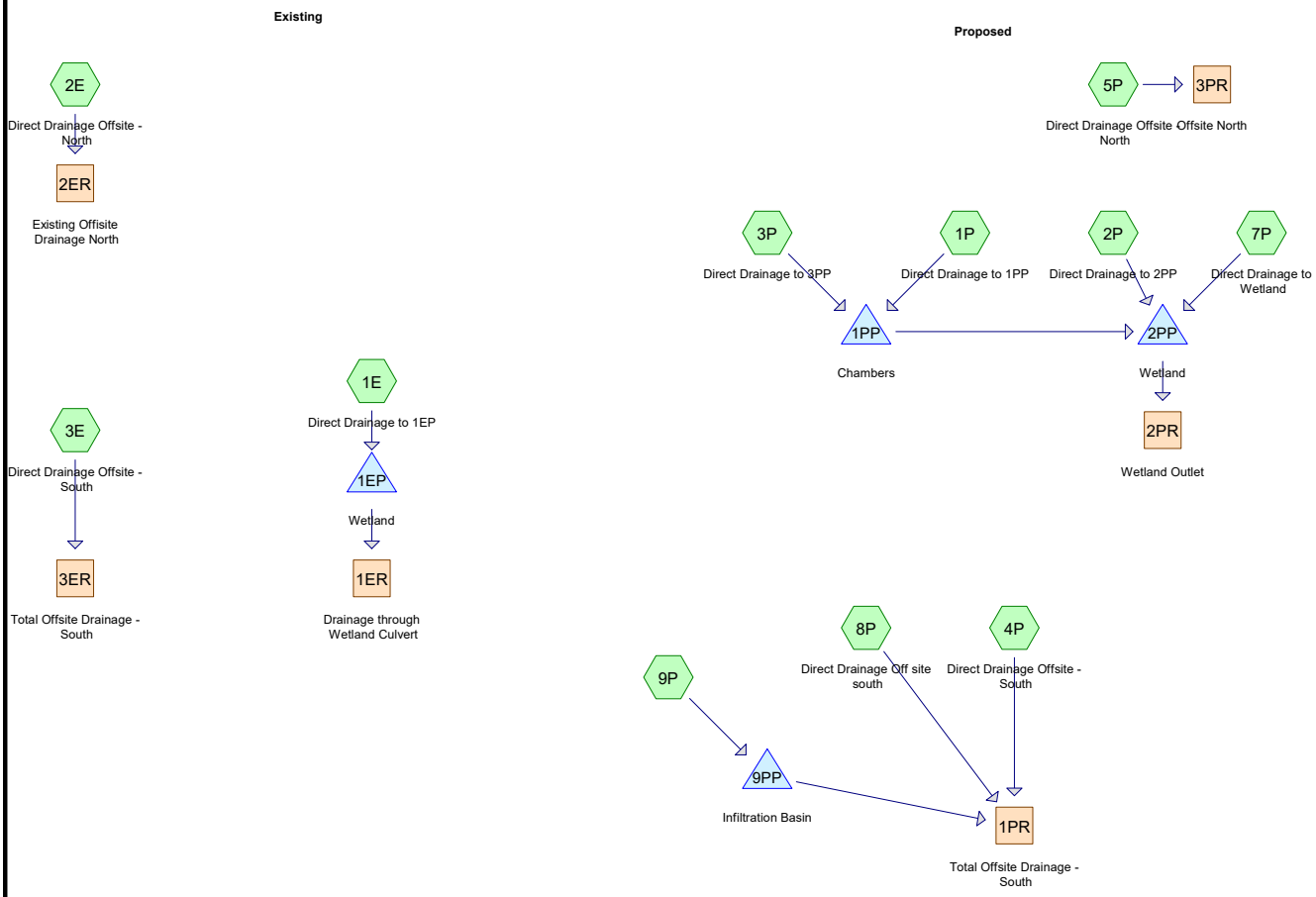
NOTES BM Elev = 913.8 (Based off of Man Hole Cover in Cul De Sac) **AFTER DRILLING** ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES
0		TOPSOIL (7 Inches)										
		SANDY LEAN CLAY, (CL) dark brown, moist, trace gravel, occasional brick debris, trace organics and fine roots (Fill)	AU 1									
			SS 2	44	2-2-2 (4)							
		SANDY LEAN CLAY, (CL) brown, moist, rather stiff, trace gravel, iron oxide staining (Glacial Till)										
5			SS 3	56	4-4-6 (10)			13				
			SS 4	11	3-5-6 (11)							
10			SS 5	100	4-6-7 (13)	3.0						
		CLAYEY SAND, (SC) brown to gray, fine to medium grained, moist, dense, trace gravel, iron oxide staining (Glacial Till)										
			SS 6	89	6-9-8 (17)			11				36
		SANDY LEAN CLAY, (CL) gray, moist, rather stiff to stiff, trace gravel (Glacial Till)										
15			SS 7	100	6-7-9 (16)							
20			SS 8	89	5-6-7 (13)			14				

Borehole backfilled with auger cuttings.
Bottom of borehole at 21.0 feet.

Exhibit 4

HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for 240118 Minnetonka Flats Ponding
Prepared by Westwood Professional Services, Printed 1/18/2024
HydroCAD® 10.20-2d s/n 02351 © 2021 HydroCAD Software Solutions LLC

240118 Minnetonka Flats Ponding

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 YR	MSE 24-hr	3	Default	24.00	1	2.87	2
2	10 YR	MSE 24-hr	3	Default	24.00	1	4.28	2
3	100 YR	MSE 24-hr	3	Default	24.00	1	7.40	2
4	Snowmelt	MSE 24-hr	3	Default	24.00	1	4.28	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.120	98	(9P)
0.520	84	50-75% Grass cover, Fair, HSG D (2E)
0.169	79	<50% Grass cover, Poor, HSG B (9P)
0.640	61	>75% Grass cover, Good, HSG B (1P, 5P)
2.260	80	>75% Grass cover, Good, HSG D (2P, 4P)
0.450	98	Impervious (1E, 2E, 3E)
0.395	98	Paved parking, HSG A (1P, 2P, 5P)
0.100	98	Roofs, HSG A (4P)
0.730	98	Unconnected roofs, HSG A (3P)
1.430	82	Woods/grass comb., Fair, HSG D (3E)
0.110	72	Woods/grass comb., Good, HSG C (8P)
0.811	79	Woods/grass comb., Good, HSG D (7P)
3.300	86	Woods/grass comb., Poor, HSG D (1E)
11.035	**84**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.225	HSG A	1P, 2P, 3P, 4P, 5P
0.809	HSG B	1P, 5P, 9P
0.110	HSG C	8P
8.321	HSG D	1E, 2E, 2P, 3E, 4P, 7P
0.570	Other	1E, 2E, 3E, 9P
11.035		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	0.120	0.120		9P
0.000	0.000	0.000	0.520	0.000	0.520	50-75% Grass cover, Fair	2E
0.000	0.169	0.000	0.000	0.000	0.169	<50% Grass cover, Poor	9P
0.000	0.640	0.000	2.260	0.000	2.900	>75% Grass cover, Good	1P, 2P, 4P, 5P
0.000	0.000	0.000	0.000	0.450	0.450	Impervious	1E, 2E, 3E
0.395	0.000	0.000	0.000	0.000	0.395	Paved parking	1P, 2P, 5P
0.100	0.000	0.000	0.000	0.000	0.100	Roofs	4P
0.730	0.000	0.000	0.000	0.000	0.730	Unconnected roofs	3P
0.000	0.000	0.000	1.430	0.000	1.430	Woods/grass comb., Fair	3E
0.000	0.000	0.110	0.811	0.000	0.921	Woods/grass comb., Good	7P, 8P
0.000	0.000	0.000	3.300	0.000	3.300	Woods/grass comb., Poor	1E
1.225	**0.809**	**0.110**	**8.321**	**0.570**	**11.035**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	1EP	920.74	920.38	49.0	0.0073	0.025	0.0	15.0	0.0
2	2PP	920.74	920.38	49.0	0.0073	0.025	0.0	15.0	0.0

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Direct Drainage to 1EP Runoff Area=3.460 ac 4.62% Impervious Runoff Depth>1.62"
Flow Length=268' Slope=0.0500 '/' Tc=15.8 min CN=87 Runoff=7.05 cfs 0.468 af

Subcatchment 1P: Direct Drainage to 1PP Runoff Area=0.415 ac 75.90% Impervious Runoff Depth>1.78"
Tc=10.0 min CN=89 Runoff=1.11 cfs 0.062 af

Subcatchment 2E: Direct Drainage Offsite - Runoff Area=0.670 ac 22.39% Impervious Runoff Depth>1.63"
Flow Length=167' Slope=0.0840 '/' Tc=8.8 min CN=87 Runoff=1.74 cfs 0.091 af

Subcatchment 2P: Direct Drainage to 2PP Runoff Area=1.160 ac 2.59% Impervious Runoff Depth>1.15"
Flow Length=222' Slope=0.0400 '/' Tc=14.8 min CN=80 Runoff=1.71 cfs 0.111 af

Subcatchment 3E: Direct Drainage Offsite - Runoff Area=1.570 ac 8.92% Impervious Runoff Depth>1.34"
Flow Length=340' Slope=0.0530 '/' Tc=5.3 min CN=83 Runoff=3.84 cfs 0.176 af

Subcatchment 3P: Direct Drainage to 3PP Runoff Area=0.730 ac 100.00% Impervious Runoff Depth>2.64"
Tc=10.0 min CN=98 Runoff=2.59 cfs 0.160 af

Subcatchment 4P: Direct Drainage Offsite - Runoff Area=1.230 ac 8.13% Impervious Runoff Depth>1.21"
Flow Length=300' Slope=0.0600 '/' Tc=4.8 min CN=81 Runoff=2.78 cfs 0.124 af

Subcatchment 5P: Direct Drainage Offsite - Runoff Area=0.590 ac 8.47% Impervious Runoff Depth>0.41"
Flow Length=75' Slope=0.0530 '/' Tc=5.6 min CN=64 Runoff=0.35 cfs 0.020 af

Subcatchment 7P: Direct Drainage to Runoff Area=0.811 ac 0.00% Impervious Runoff Depth>1.09"
Flow Length=150' Slope=0.0930 '/' Tc=7.7 min CN=79 Runoff=1.49 cfs 0.074 af

Subcatchment 8P: Direct Drainage Off site Runoff Area=0.110 ac 0.00% Impervious Runoff Depth>0.73"
Tc=0.0 min CN=72 Runoff=0.16 cfs 0.007 af

Subcatchment 9P: Runoff Area=0.289 ac 41.52% Impervious Runoff Depth>1.63"
Tc=10.0 min CN=87 Runoff=0.71 cfs 0.039 af

Reach 1ER: Drainage through Wetland Culvert Inflow=0.12 cfs 0.088 af
Outflow=0.12 cfs 0.088 af

Reach 1PR: Total Offsite Drainage - South Inflow=3.05 cfs 0.160 af
Outflow=3.05 cfs 0.160 af

Reach 2ER: Existing Offisite Drainage North Inflow=1.74 cfs 0.091 af
Outflow=1.74 cfs 0.091 af

Reach 2PR: Wetland Outlet Inflow=0.02 cfs 0.009 af
Outflow=0.02 cfs 0.009 af

Reach 3ER: Total Offsite Drainage - South Inflow=3.84 cfs 0.176 af
Outflow=3.84 cfs 0.176 af

Reach 3PR: Offsite North Inflow=0.35 cfs 0.020 af
Outflow=0.35 cfs 0.020 af

Pond 1EP: Wetland Peak Elev=920.96' Storage=0.396 af Inflow=7.05 cfs 0.468 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=0.12 cfs 0.088 af

Pond 1PP: Chambers Peak Elev=922.92' Storage=0.093 af Inflow=3.70 cfs 0.222 af
Outflow=2.60 cfs 0.165 af

Pond 2PP: Wetland Peak Elev=920.85' Storage=0.341 af Inflow=5.21 cfs 0.350 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=0.02 cfs 0.009 af

Pond 9PP: Infiltration Basin Peak Elev=925.99' Storage=463 cf Inflow=0.71 cfs 0.039 af
Discarded=0.00 cfs 0.003 af Primary=0.60 cfs 0.029 af Outflow=0.60 cfs 0.032 af

Total Runoff Area = 11.035 ac Runoff Volume = 1.333 af Average Runoff Depth = 1.45"
83.73% Pervious = 9.240 ac 16.27% Impervious = 1.795 ac

Summary for Subcatchment 1E: Direct Drainage to 1EP

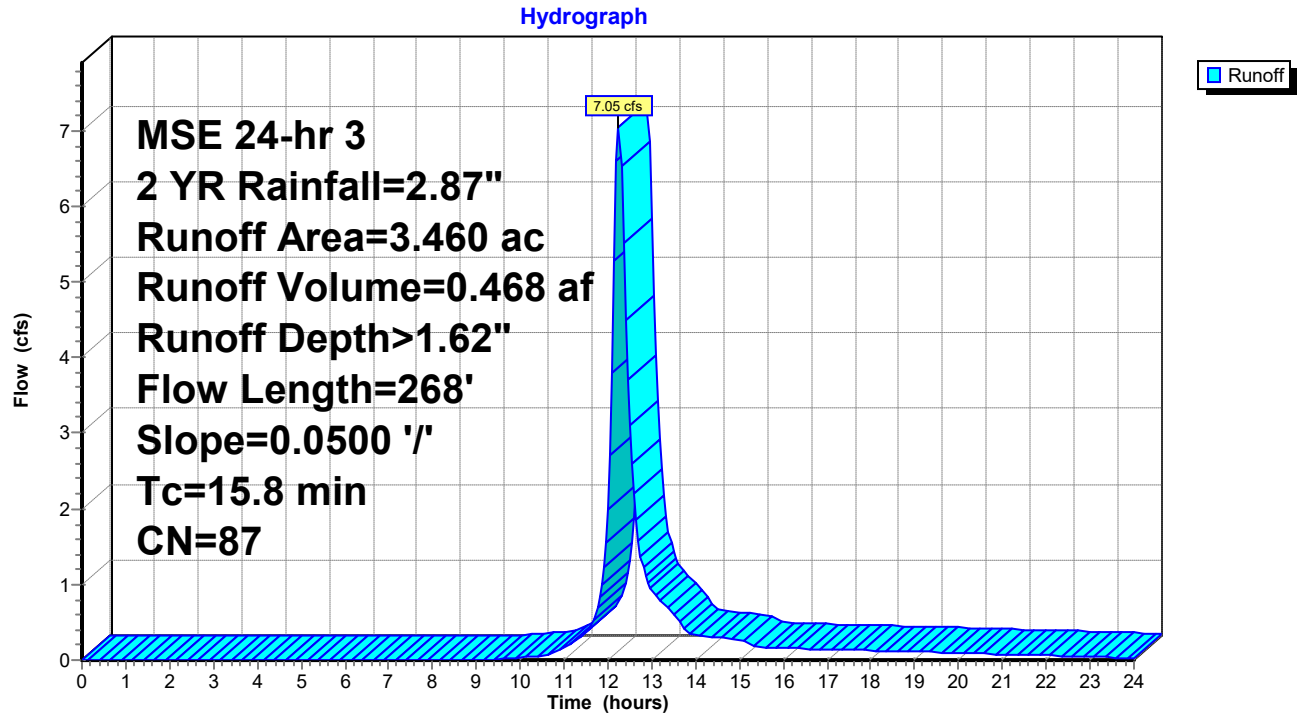
Runoff = 7.05 cfs @ 12.25 hrs, Volume= 0.468 af, Depth> 1.62"
Routed to Pond 1EP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

	Area (ac)	CN	Description
	3.300	86	Woods/grass comb., Poor, HSG D
*	0.160	98	Impervious
	3.460	87	Weighted Average
	3.300		95.38% Pervious Area
	0.160		4.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	268	0.0500	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 1E: Direct Drainage to 1EP



Summary for Subcatchment 1P: Direct Drainage to 1PP

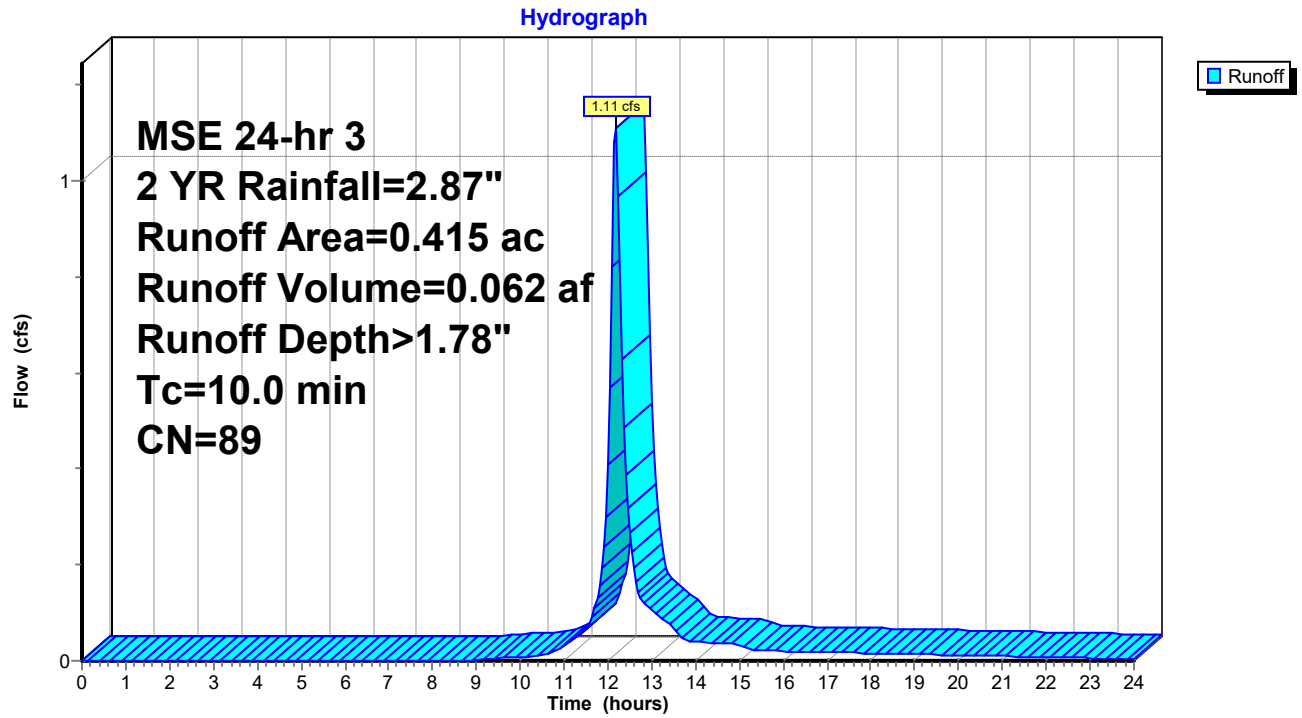
Runoff = 1.11 cfs @ 12.18 hrs, Volume= 0.062 af, Depth> 1.78"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
0.315	98	Paved parking, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.415	89	Weighted Average
0.100		24.10% Pervious Area
0.315		75.90% Impervious Area

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

Subcatchment 1P: Direct Drainage to 1PP



Summary for Subcatchment 2E: Direct Drainage Offsite - North

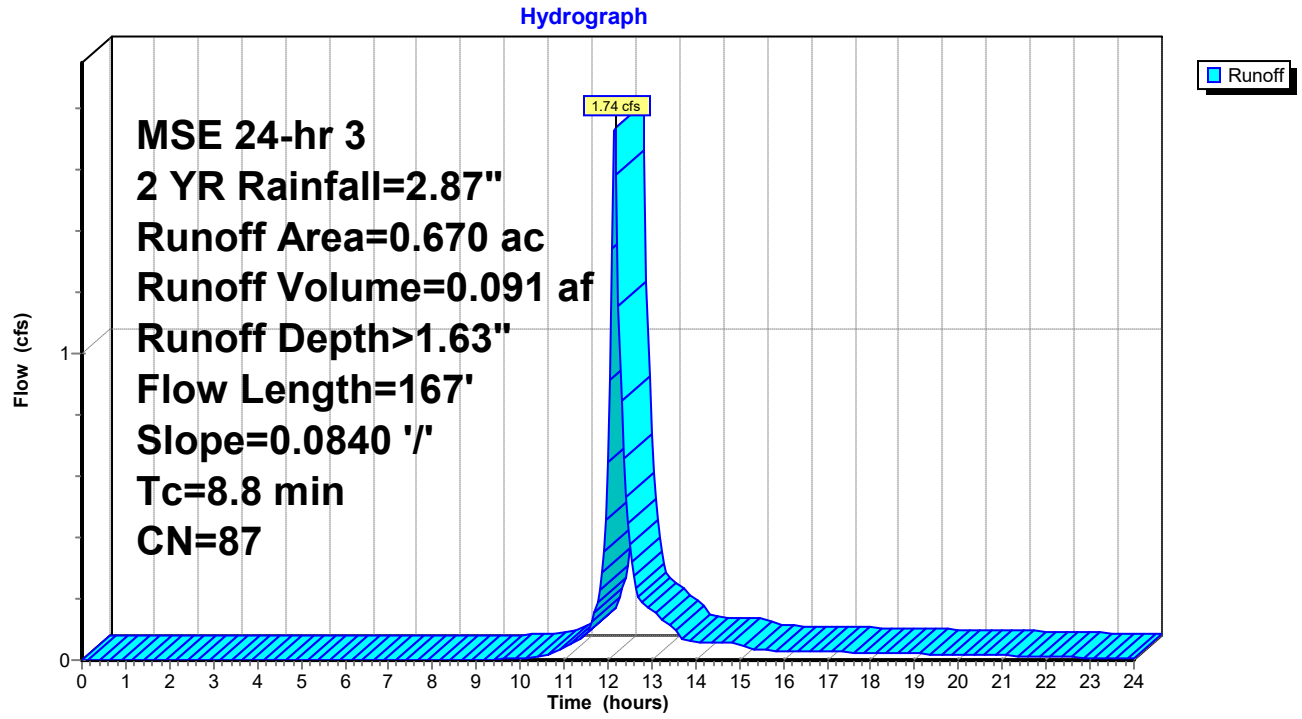
Runoff = 1.74 cfs @ 12.16 hrs, Volume= 0.091 af, Depth> 1.63"
Routed to Reach 2ER : Existing Offisite Drainage North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

	Area (ac)	CN	Description
*	0.150	98	Impervious
	0.520	84	50-75% Grass cover, Fair, HSG D
	0.670	87	Weighted Average
	0.520		77.61% Pervious Area
	0.150		22.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	167	0.0840	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2E: Direct Drainage Offsite - North



Summary for Subcatchment 2P: Direct Drainage to 2PP

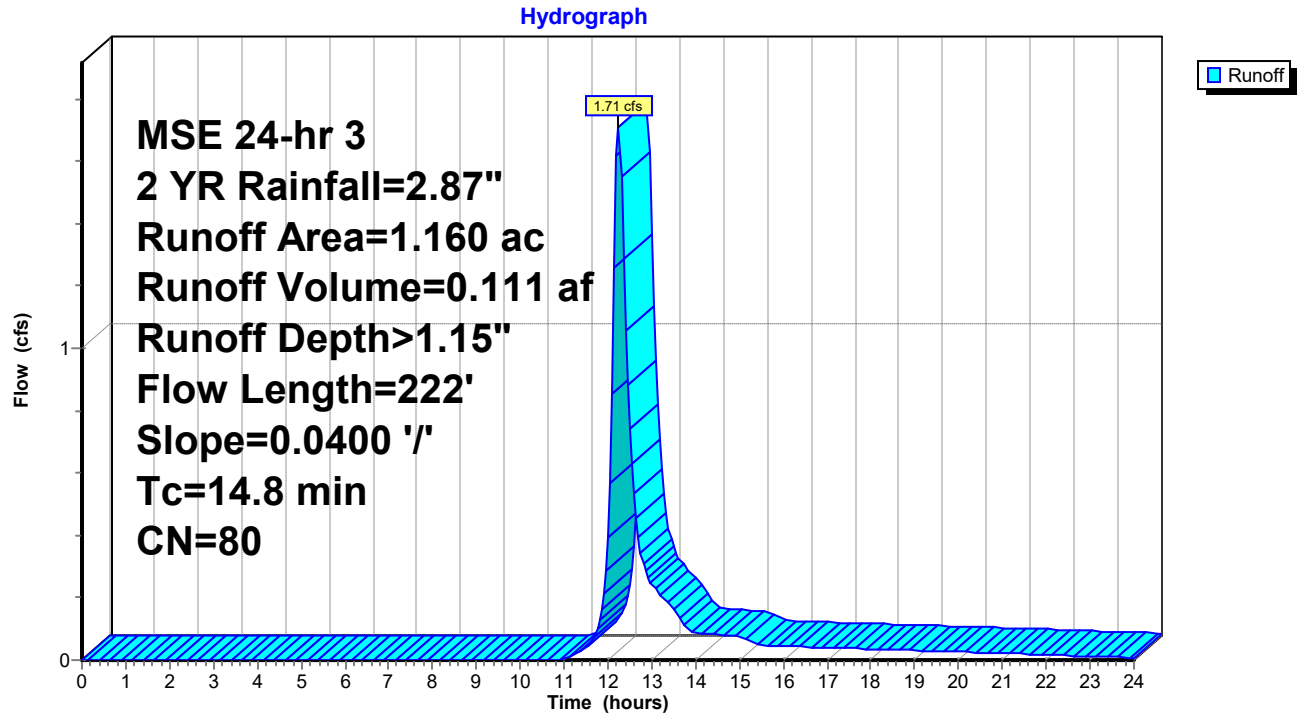
Runoff = 1.71 cfs @ 12.24 hrs, Volume= 0.111 af, Depth> 1.15"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.030	98	Paved parking, HSG A
1.160	80	Weighted Average
1.130		97.41% Pervious Area
0.030		2.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	222	0.0400	0.25		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2P: Direct Drainage to 2PP



Summary for Subcatchment 3E: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

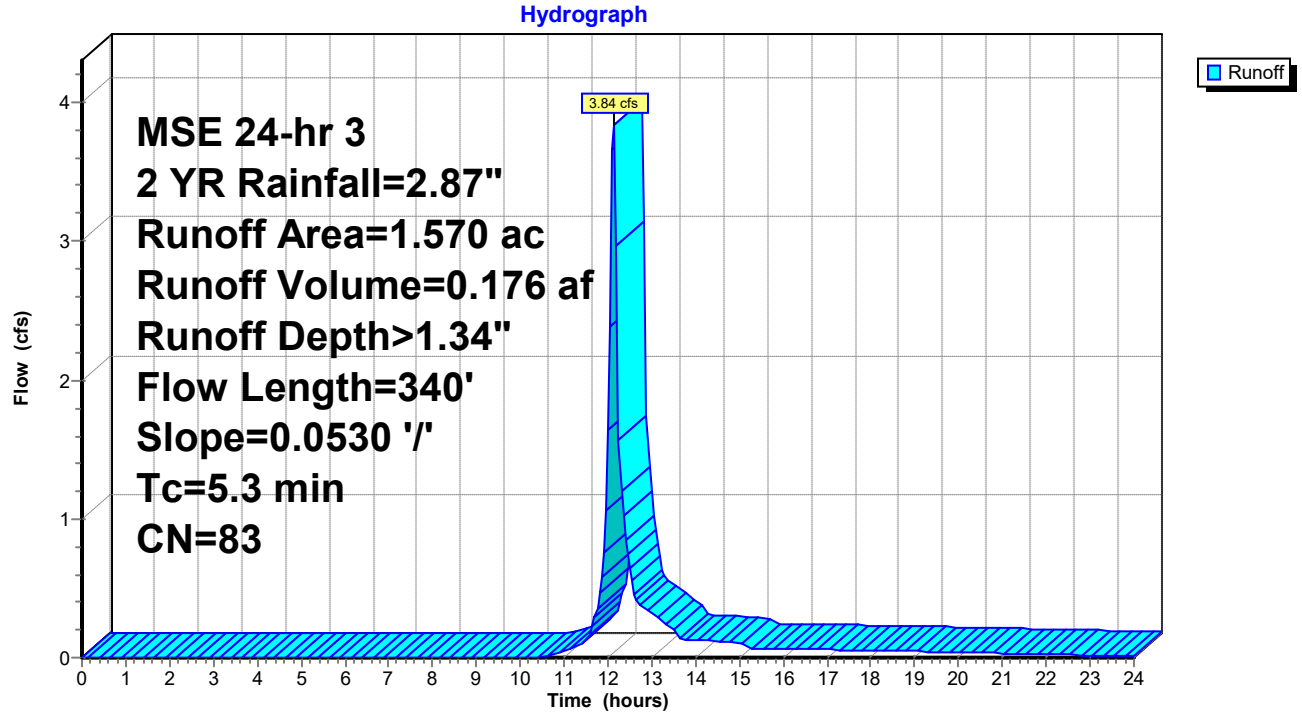
Runoff = 3.84 cfs @ 12.13 hrs, Volume= 0.176 af, Depth> 1.34"
Routed to Reach 3ER : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

	Area (ac)	CN	Description
	1.430	82	Woods/grass comb., Fair, HSG D
*	0.140	98	Impervious
	1.570	83	Weighted Average
	1.430		91.08% Pervious Area
	0.140		8.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	340	0.0530	1.07		**Lag/CN Method,**

Subcatchment 3E: Direct Drainage Offsite - South



Summary for Subcatchment 3P: Direct Drainage to 3PP

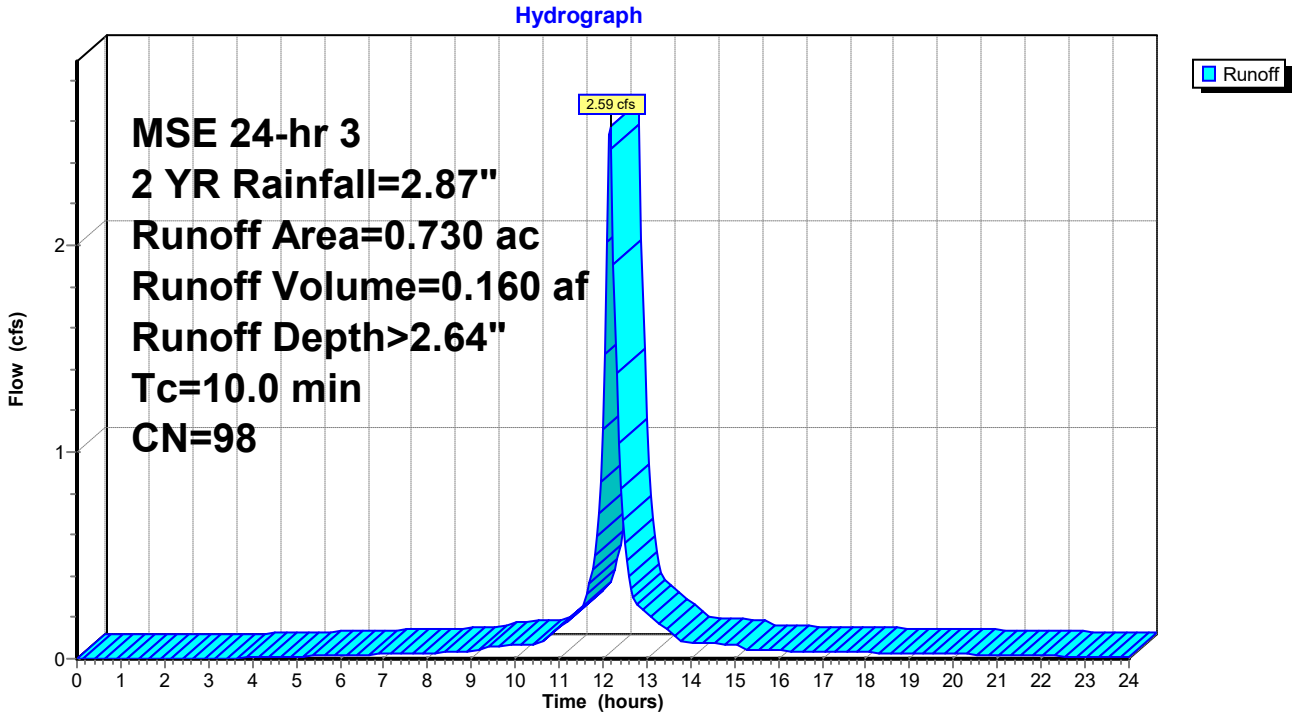
Runoff = 2.59 cfs @ 12.17 hrs, Volume= 0.160 af, Depth> 2.64"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
0.730	98	Unconnected roofs, HSG A
0.730		100.00% Impervious Area
0.730		100.00% Unconnected

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

Subcatchment 3P: Direct Drainage to 3PP



Summary for Subcatchment 4P: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

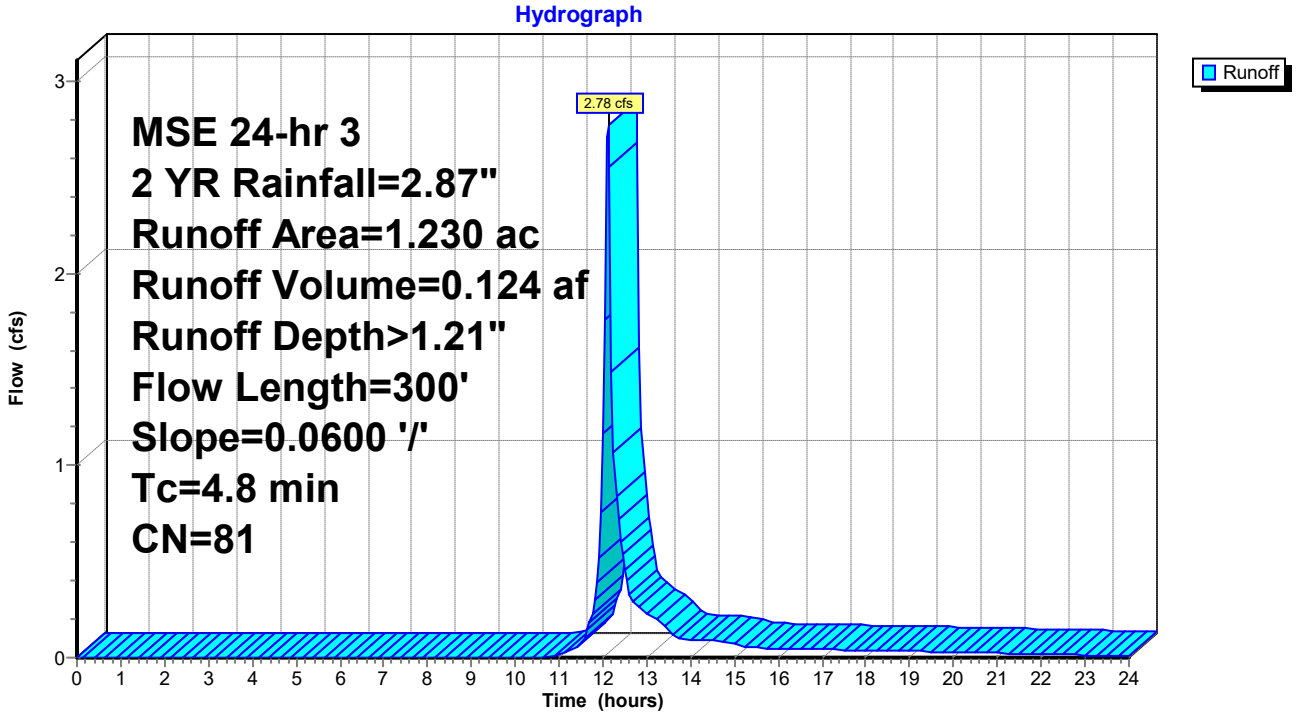
Runoff = 2.78 cfs @ 12.12 hrs, Volume= 0.124 af, Depth> 1.21"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.100	98	Roofs, HSG A
1.230	81	Weighted Average
1.130		91.87% Pervious Area
0.100		8.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0600	1.04		**Lag/CN Method,**

Subcatchment 4P: Direct Drainage Offsite - South



Summary for Subcatchment 5P: Direct Drainage Offsite - North

[49] Hint: Tc<2dt may require smaller dt

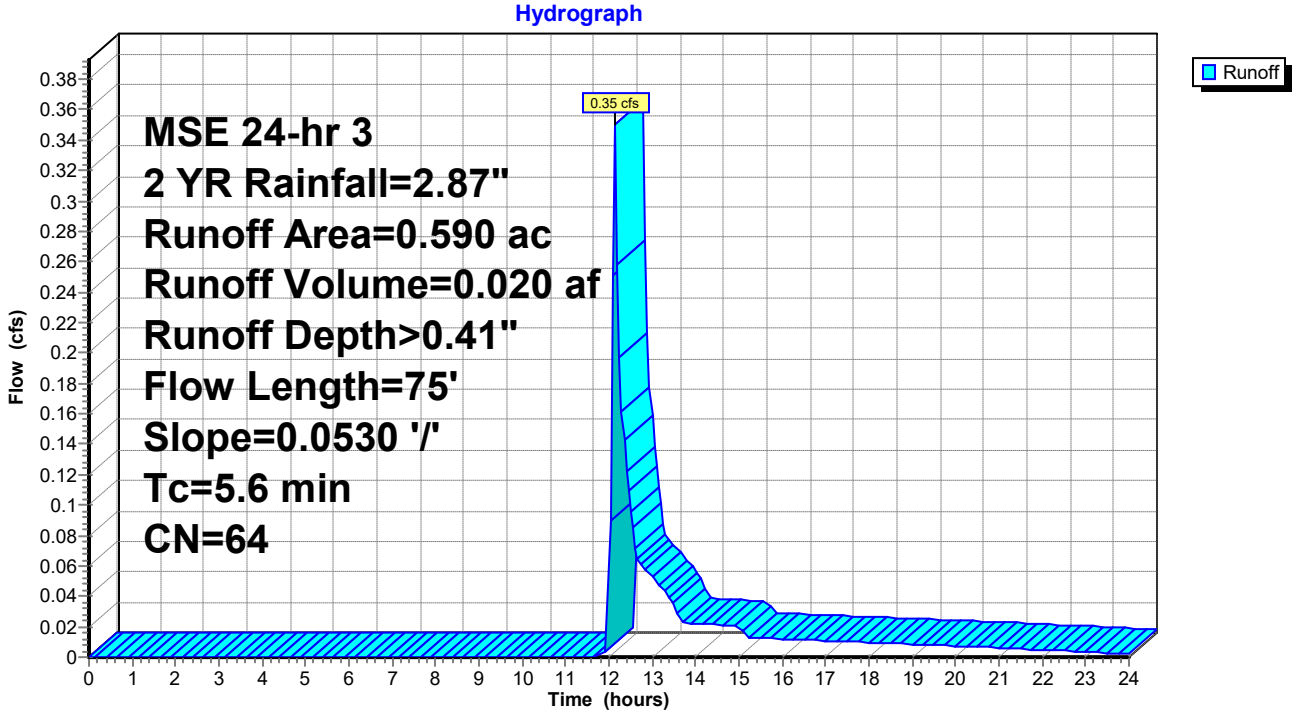
Runoff = 0.35 cfs @ 12.15 hrs, Volume= 0.020 af, Depth> 0.41"
Routed to Reach 3PR : Offsite North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
0.540	61	>75% Grass cover, Good, HSG B
0.050	98	Paved parking, HSG A
0.590	64	Weighted Average
0.540		91.53% Pervious Area
0.050		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	75	0.0530	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 5P: Direct Drainage Offsite - North



Summary for Subcatchment 7P: Direct Drainage to Wetland

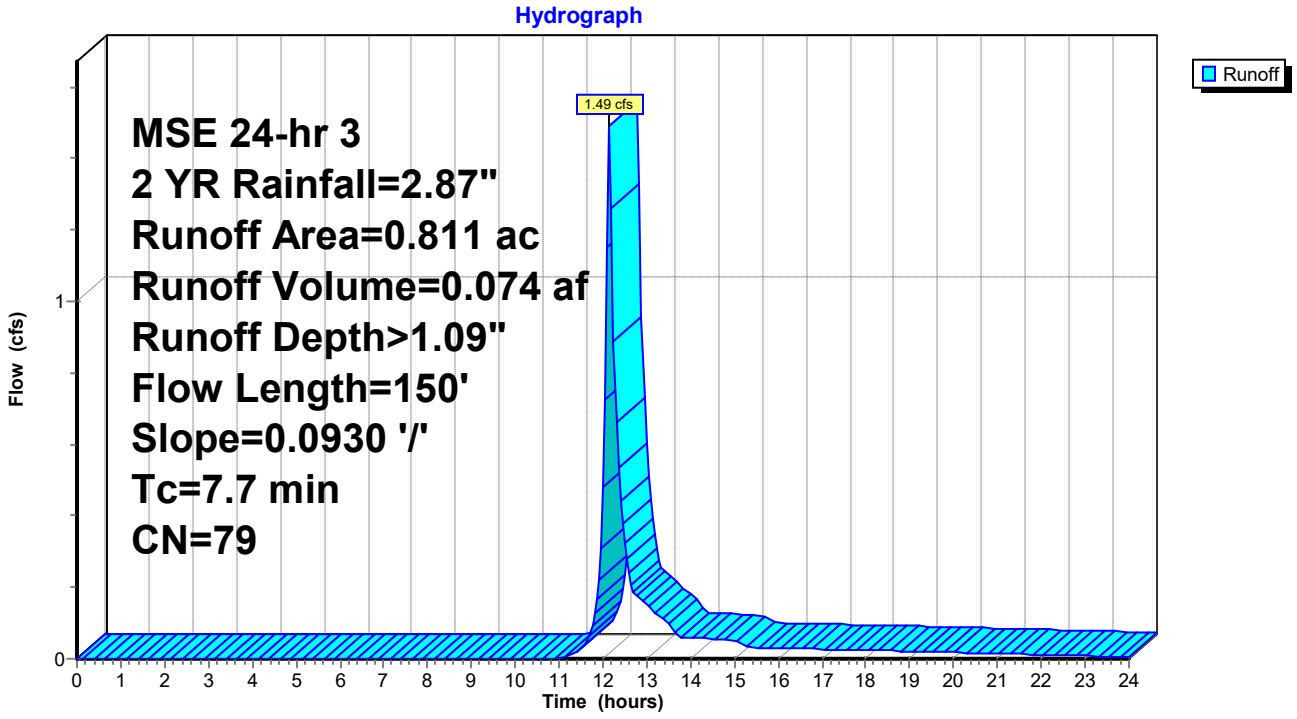
Runoff = 1.49 cfs @ 12.15 hrs, Volume= 0.074 af, Depth> 1.09"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
0.811	79	Woods/grass comb., Good, HSG D
0.811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	150	0.0930	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 7P: Direct Drainage to Wetland



Summary for Subcatchment 8P: Direct Drainage Off site south

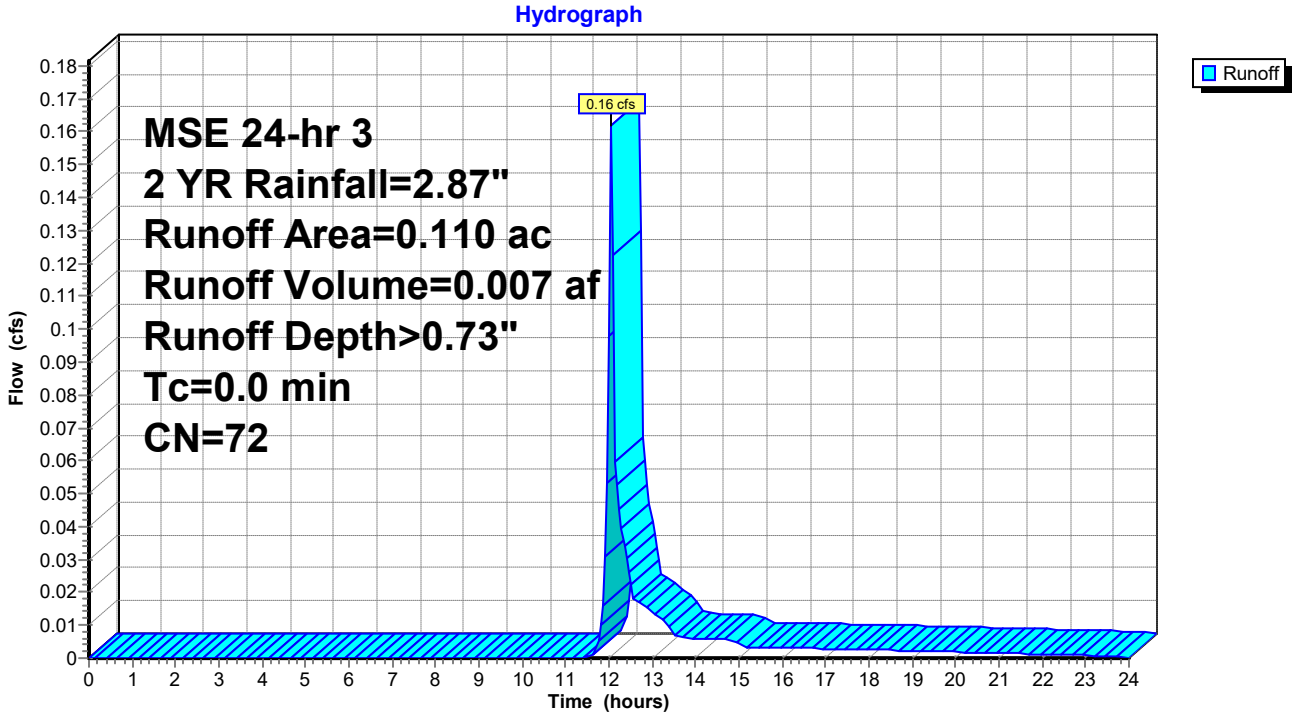
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.16 cfs @ 12.06 hrs, Volume= 0.007 af, Depth> 0.73"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

Area (ac)	CN	Description
0.110	72	Woods/grass comb., Good, HSG C
0.110		100.00% Pervious Area

Subcatchment 8P: Direct Drainage Off site south



Summary for Subcatchment 9P:

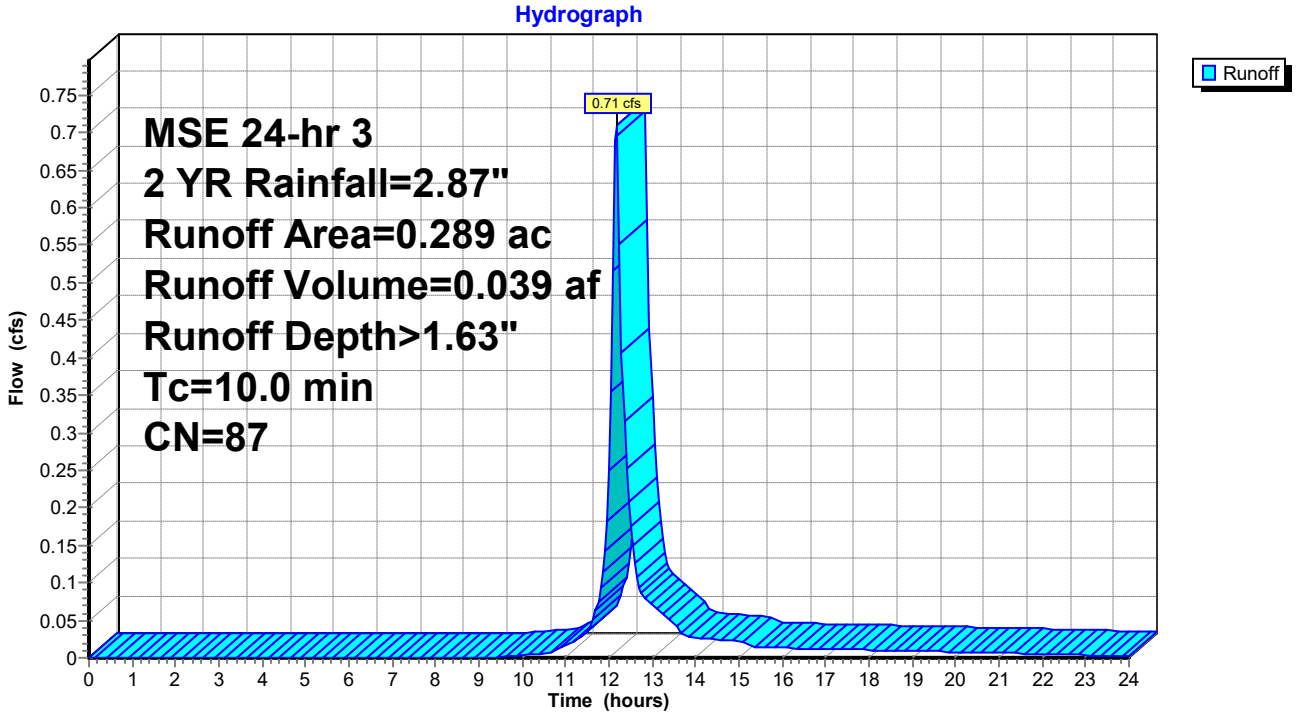
Runoff = 0.71 cfs @ 12.18 hrs, Volume= 0.039 af, Depth> 1.63"
Routed to Pond 9PP : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 2 YR Rainfall=2.87"

	Area (ac)	CN	Description
*	0.120	98	
	0.169	79	<50% Grass cover, Poor, HSG B
	0.289	87	Weighted Average
	0.169		58.48% Pervious Area
	0.120		41.52% Impervious Area

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

Subcatchment 9P:



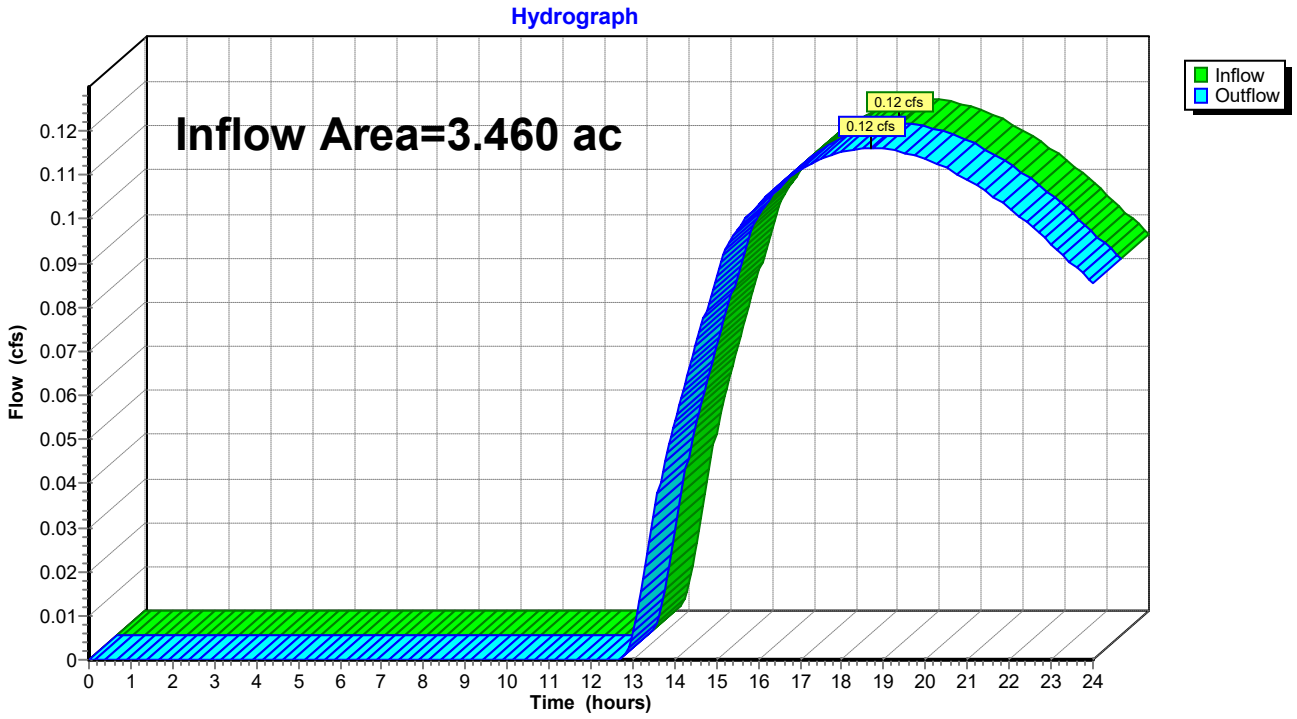
Summary for Reach 1ER: Drainage through Wetland Culvert

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 0.30" for 2 YR event
Inflow = 0.12 cfs @ 18.69 hrs, Volume= 0.088 af
Outflow = 0.12 cfs @ 18.69 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1ER: Drainage through Wetland Culvert



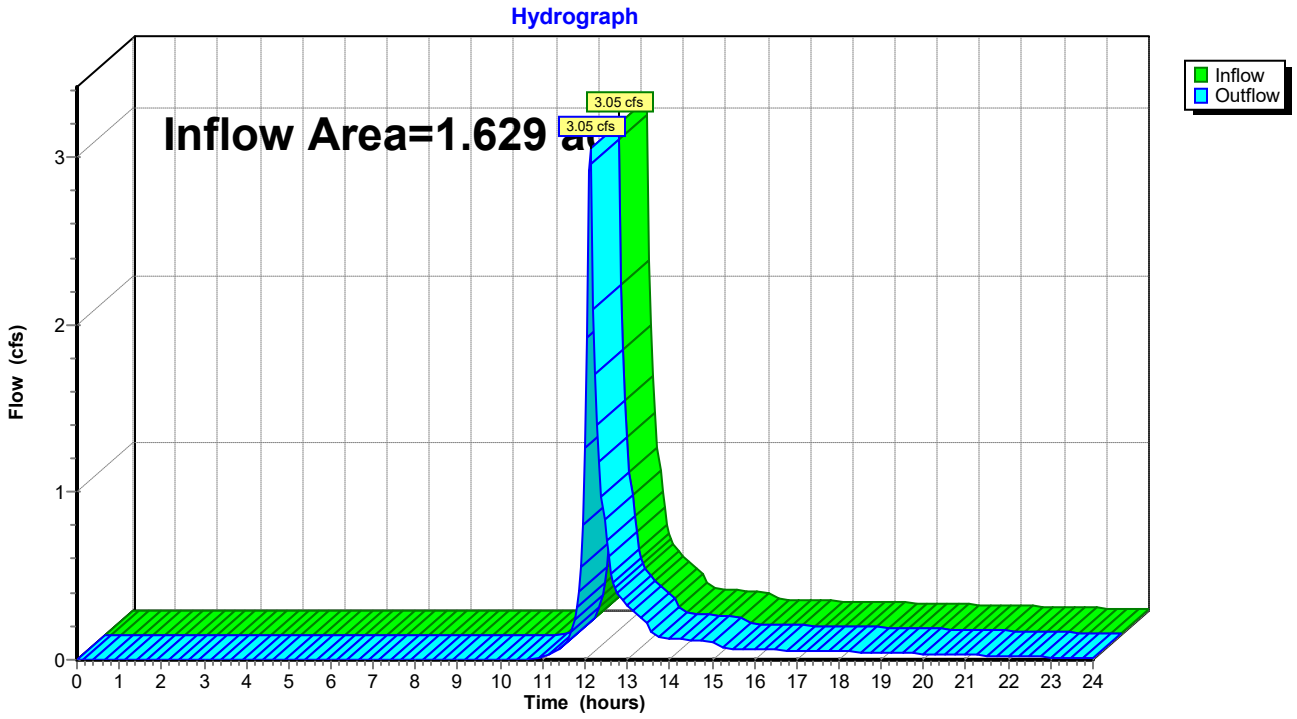
Summary for Reach 1PR: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.629 ac, 13.51% Impervious, Inflow Depth > 1.18" for 2 YR event
Inflow = 3.05 cfs @ 12.13 hrs, Volume= 0.160 af
Outflow = 3.05 cfs @ 12.13 hrs, Volume= 0.160 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1PR: Total Offsite Drainage - South



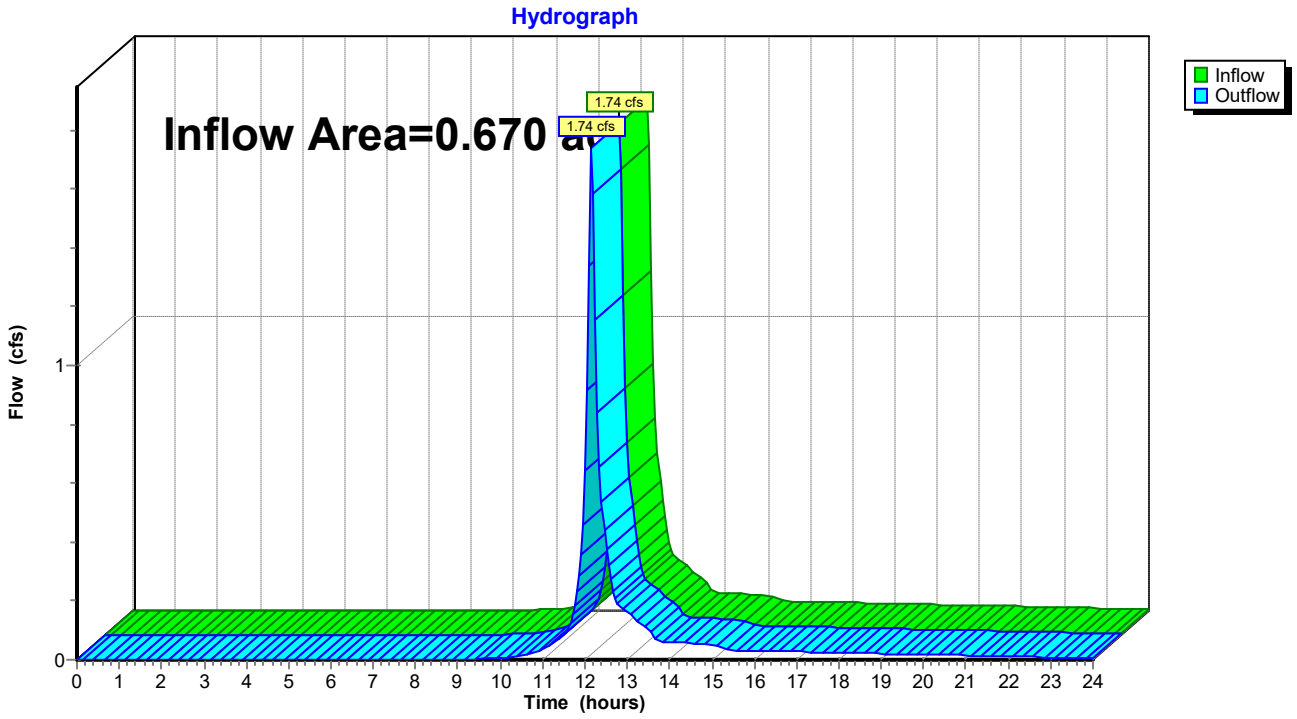
Summary for Reach 2ER: Existing Offisite Drainage North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.670 ac, 22.39% Impervious, Inflow Depth > 1.63" for 2 YR event
Inflow = 1.74 cfs @ 12.16 hrs, Volume= 0.091 af
Outflow = 1.74 cfs @ 12.16 hrs, Volume= 0.091 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2ER: Existing Offisite Drainage North



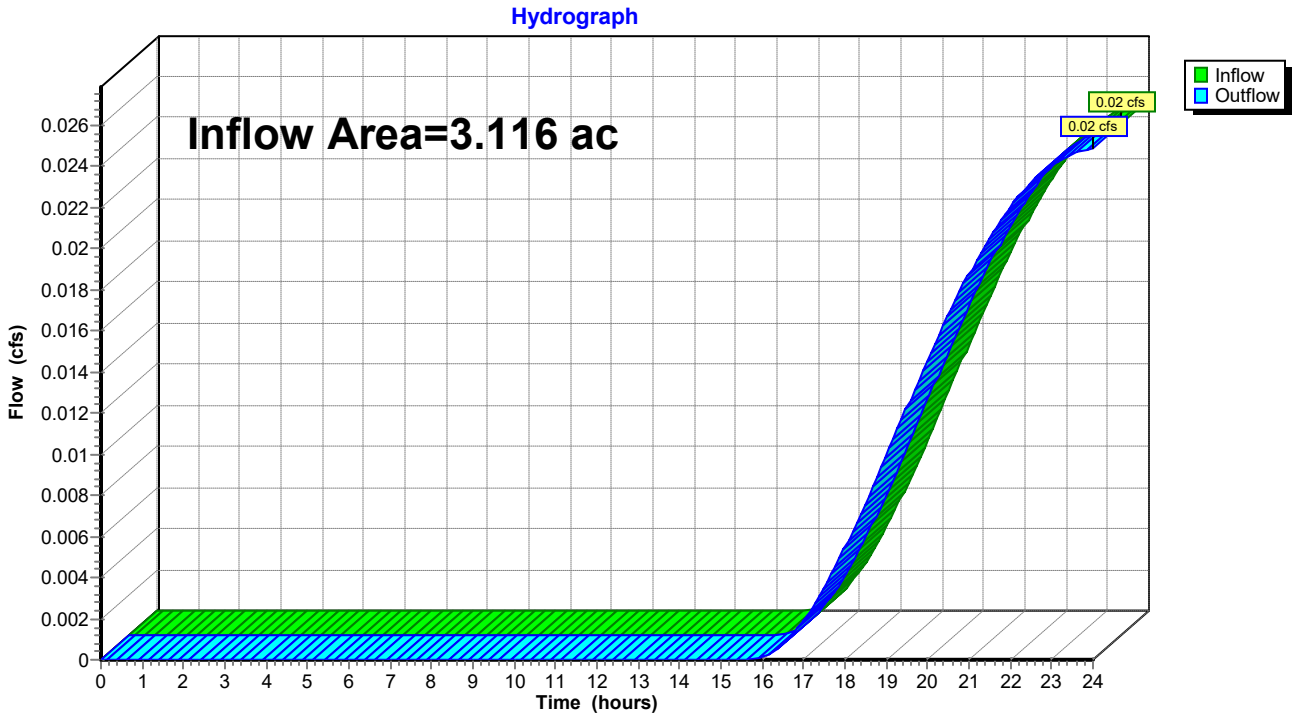
Summary for Reach 2PR: Wetland Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 0.03" for 2 YR event
Inflow = 0.02 cfs @ 24.00 hrs, Volume= 0.009 af
Outflow = 0.02 cfs @ 24.00 hrs, Volume= 0.009 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2PR: Wetland Outlet



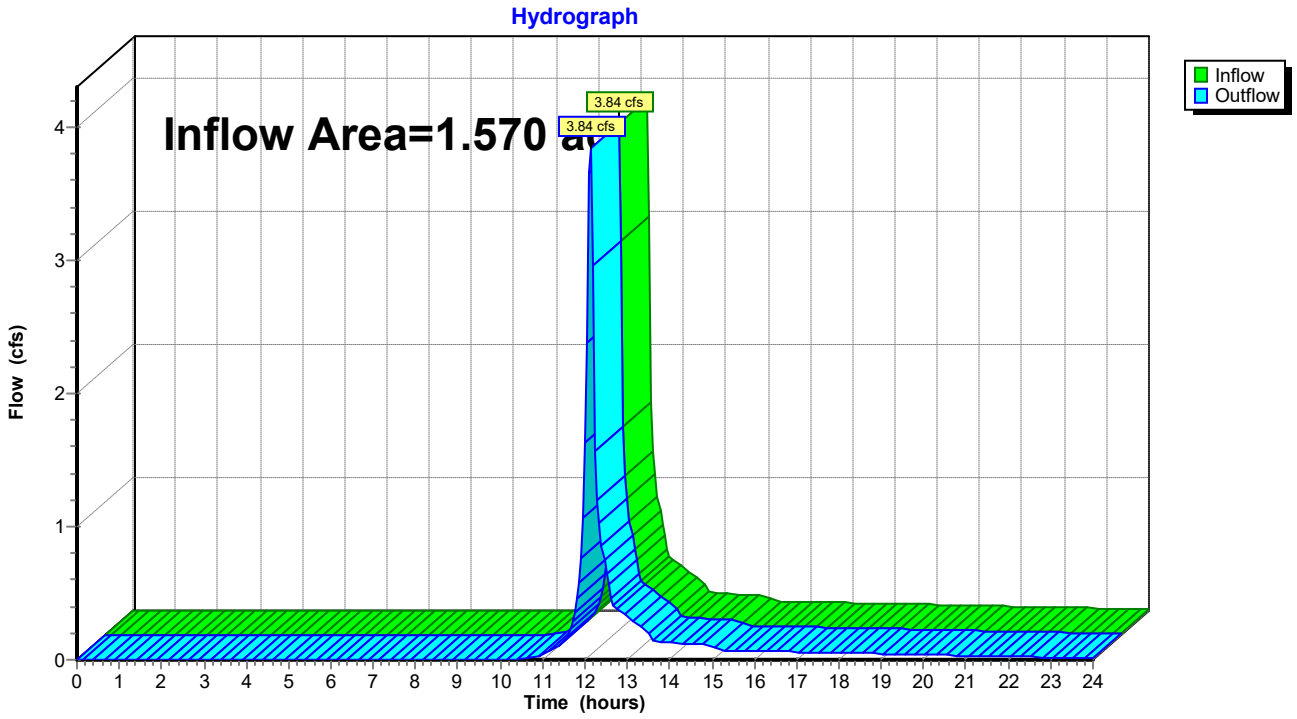
Summary for Reach 3ER: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.570 ac, 8.92% Impervious, Inflow Depth > 1.34" for 2 YR event
Inflow = 3.84 cfs @ 12.13 hrs, Volume= 0.176 af
Outflow = 3.84 cfs @ 12.13 hrs, Volume= 0.176 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3ER: Total Offsite Drainage - South



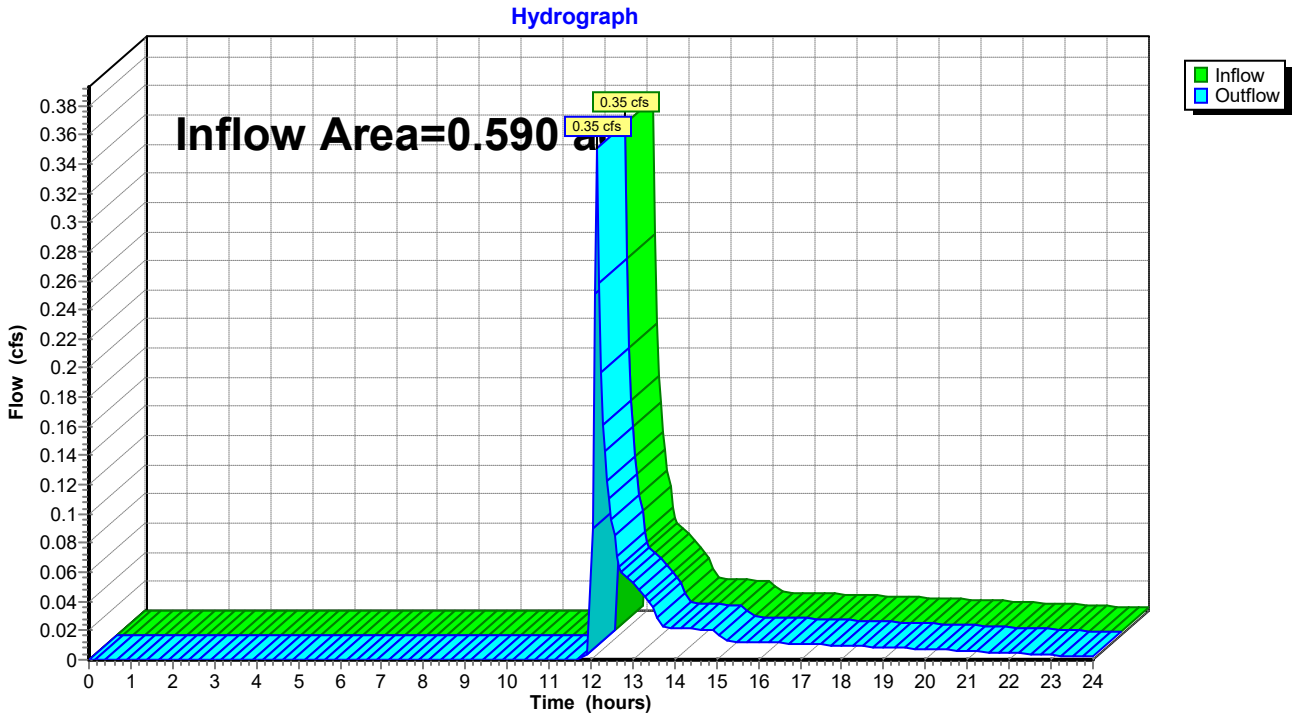
Summary for Reach 3PR: Offsite North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.590 ac, 8.47% Impervious, Inflow Depth > 0.41" for 2 YR event
Inflow = 0.35 cfs @ 12.15 hrs, Volume= 0.020 af
Outflow = 0.35 cfs @ 12.15 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3PR: Offsite North



Summary for Pond 1EP: Wetland

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 1.62" for 2 YR event
Inflow = 7.05 cfs @ 12.25 hrs, Volume= 0.468 af
Outflow = 0.12 cfs @ 18.69 hrs, Volume= 0.088 af, Atten= 98%, Lag= 386.6 min
Primary = 0.12 cfs @ 18.69 hrs, Volume= 0.088 af
Routed to Reach 1ER : Drainage through Wetland Culvert

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 920.96' @ 18.69 hrs Surf.Area= 0.480 ac Storage= 0.396 af

Plug-Flow detention time= 429.8 min calculated for 0.088 af (19% of inflow)
Center-of-Mass det. time= 326.4 min (1,135.6 - 809.2)

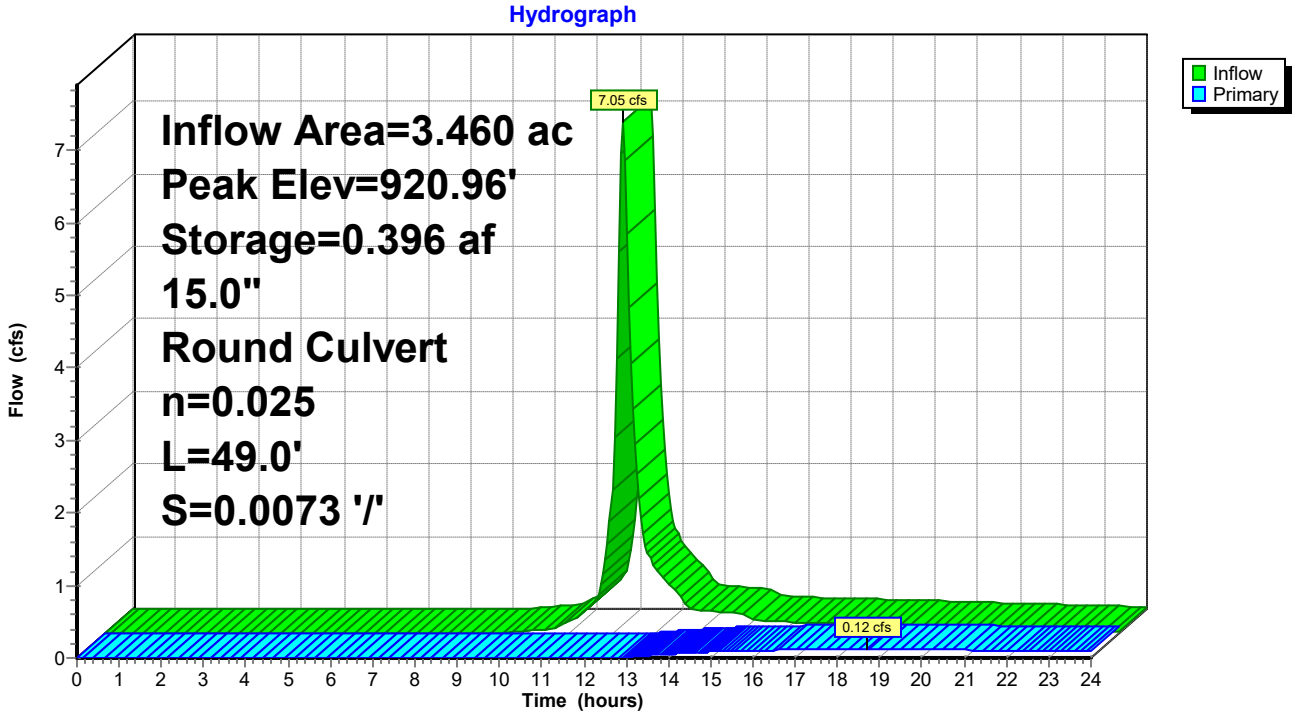
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf

Primary OutFlow Max=0.12 cfs @ 18.69 hrs HW=920.96' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.12 cfs @ 1.17 fps)

Pond 1EP: Wetland



Summary for Pond 1PP: Chambers

Inflow Area = 1.145 ac, 91.27% Impervious, Inflow Depth > 2.33" for 2 YR event
Inflow = 3.70 cfs @ 12.17 hrs, Volume= 0.222 af
Outflow = 2.60 cfs @ 12.27 hrs, Volume= 0.165 af, Atten= 30%, Lag= 5.7 min
Primary = 2.60 cfs @ 12.27 hrs, Volume= 0.165 af
Routed to Pond 2PP : Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 922.92' @ 12.27 hrs Surf.Area= 0.072 ac Storage= 0.093 af

Plug-Flow detention time= 128.8 min calculated for 0.165 af (74% of inflow)
Center-of-Mass det. time= 63.3 min (831.9 - 768.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	920.00'	0.000 af	**30.00'W x 104.00'L x 5.00'H Field A** 0.358 af Overall - 0.147 af Embedded = 0.211 af x 0.0% Voids
#2A	920.50'	0.147 af	**CMP Round 48** x 25 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +2.00' x 12.57 sf x 5 rows
		0.147 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	922.10'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.56 cfs @ 12.27 hrs HW=922.91' TW=920.25' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 2.56 cfs @ 3.06 fps)

Pond 1PP: Chambers - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +2.00' x 12.57 sf x 5 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

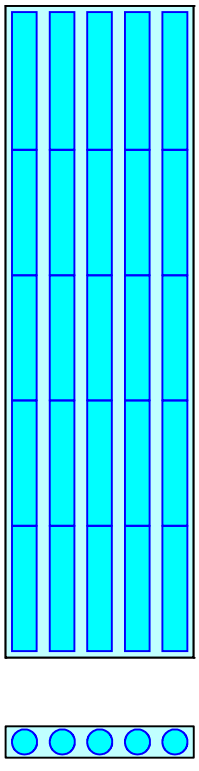
5 Chambers/Row x 20.00' Long +2.00' Row Adjustment = 102.00' Row Length +12.0" End Stone x 2 = 104.00' Base Length
5 Rows x 48.0" Wide + 24.0" Spacing x 4 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

25 Chambers x 251.3 cf +2.00' Row Adjustment x 12.57 sf x 5 Rows = 6,408.8 cf Chamber Storage

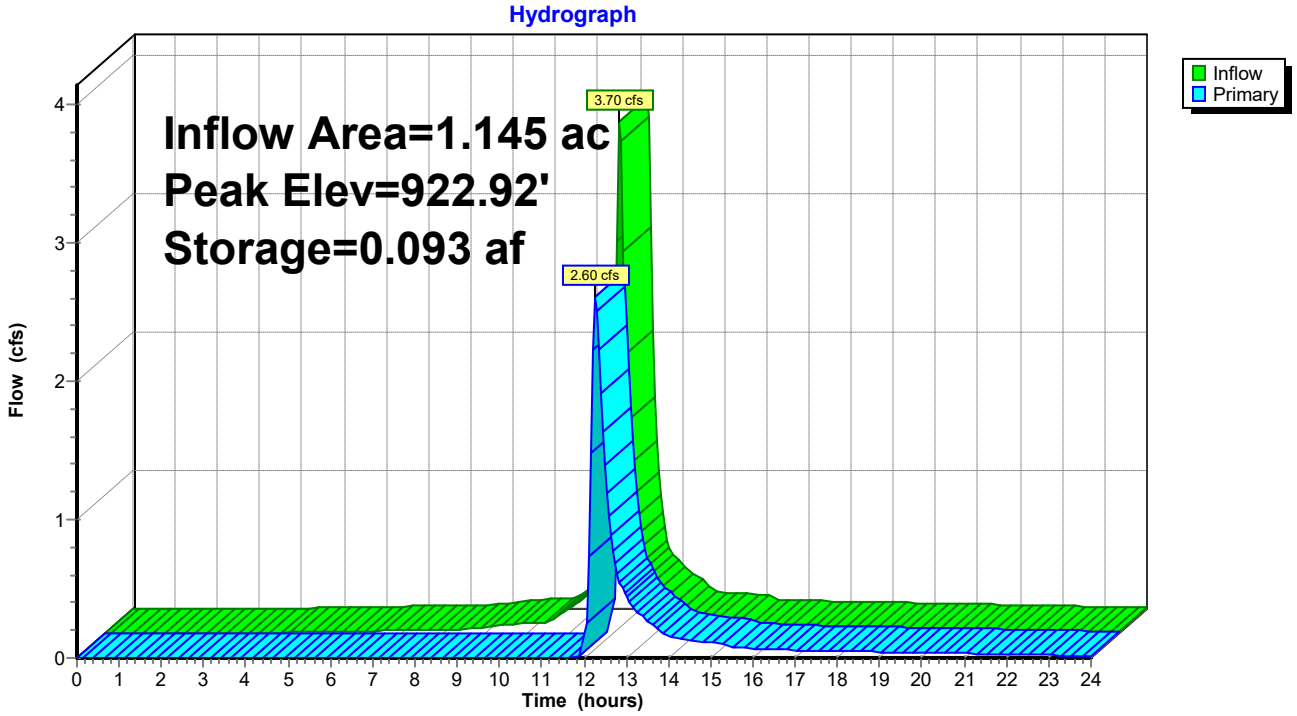
15,600.0 cf Field - 6,408.8 cf Chambers = 9,191.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 6,408.8 cf = 0.147 af
Overall Storage Efficiency = 41.1%
Overall System Size = 104.00' x 30.00' x 5.00'

25 Chambers
577.8 cy Field
340.4 cy Stone



Pond 1PP: Chambers



Summary for Pond 2PP: Wetland

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 1.35" for 2 YR event
Inflow = 5.21 cfs @ 12.23 hrs, Volume= 0.350 af
Outflow = 0.02 cfs @ 24.00 hrs, Volume= 0.009 af, Atten= 100%, Lag= 706.1 min
Primary = 0.02 cfs @ 24.00 hrs, Volume= 0.009 af
Routed to Reach 2PR : Wetland Outlet

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 920.85' @ 24.00 hrs Surf.Area= 0.463 ac Storage= 0.341 af

Plug-Flow detention time= 581.2 min calculated for 0.009 af (3% of inflow)
Center-of-Mass det. time= 458.4 min (1,286.3 - 828.0)

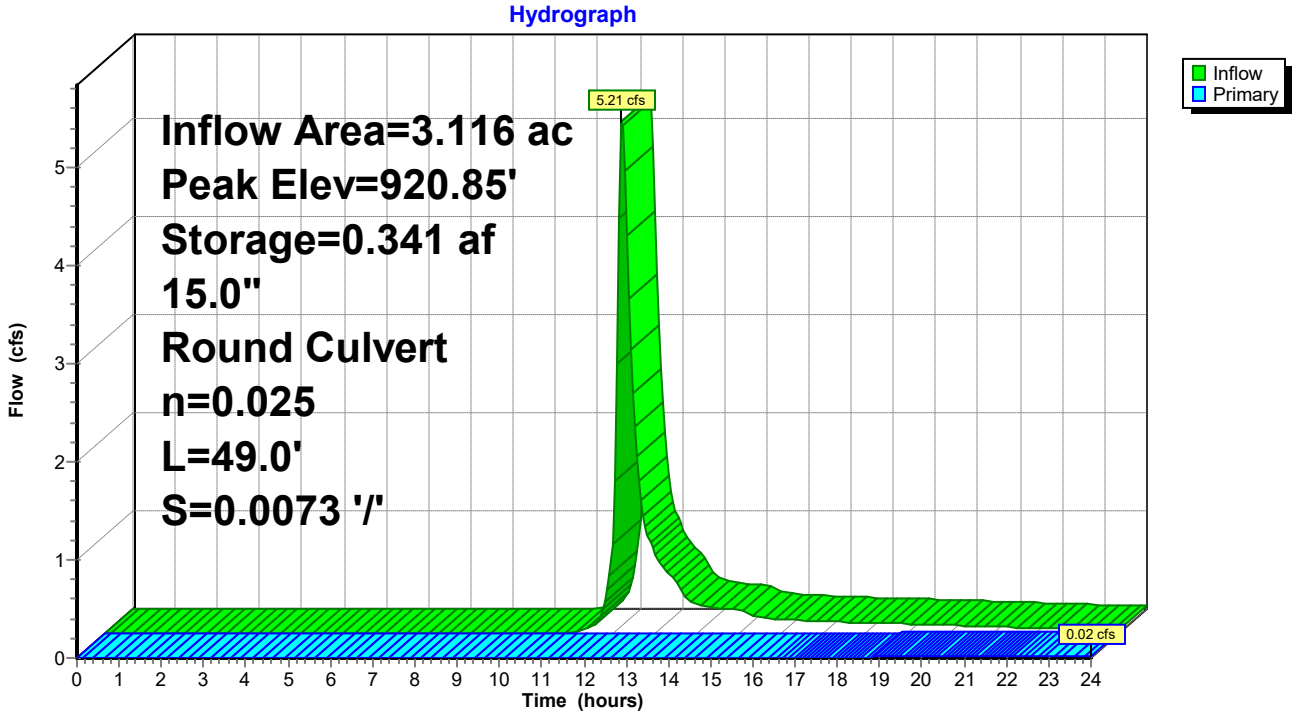
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025, Flow Area= 1.23 sf

Primary OutFlow Max=0.02 cfs @ 24.00 hrs HW=920.85' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.02 cfs @ 0.73 fps)

Pond 2PP: Wetland



Summary for Pond 9PP: Infiltration Basin

Inflow Area = 0.289 ac, 41.52% Impervious, Inflow Depth > 1.63" for 2 YR event
Inflow = 0.71 cfs @ 12.18 hrs, Volume= 0.039 af
Outflow = 0.60 cfs @ 12.24 hrs, Volume= 0.032 af, Atten= 16%, Lag= 3.9 min
Discarded = 0.00 cfs @ 10.70 hrs, Volume= 0.003 af
Primary = 0.60 cfs @ 12.24 hrs, Volume= 0.029 af
Routed to Reach 1PR : Total Offsite Drainage - South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 925.99' @ 12.24 hrs Surf.Area= 1,958 sf Storage= 463 cf

Plug-Flow detention time= 88.1 min calculated for 0.032 af (83% of inflow)
Center-of-Mass det. time= 28.9 min (833.0 - 804.1)

Volume	Invert	Avail.Storage	Storage Description
#1	925.75'	490 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

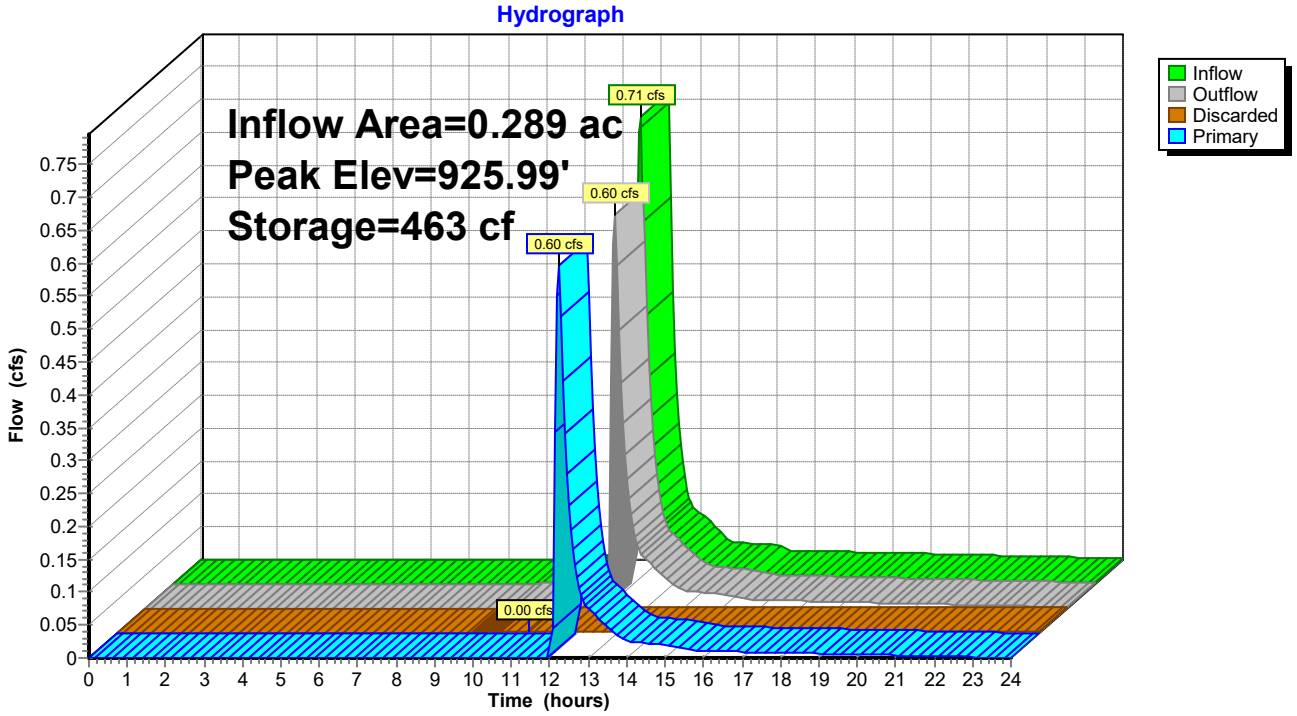
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
925.75	1,958	0	0
926.00	1,958	490	490

Device	Routing	Invert	Outlet Devices
#1	Primary	925.90'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	925.75'	**0.060 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 10.70 hrs HW=925.75' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.59 cfs @ 12.24 hrs HW=925.99' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.59 cfs @ 0.69 fps)

Pond 9PP: Infiltration Basin



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Direct Drainage to 1EP Runoff Area=3.460 ac 4.62% Impervious Runoff Depth>2.89"
Flow Length=268' Slope=0.0500 '/' Tc=15.8 min CN=87 Runoff=12.38 cfs 0.834 af

Subcatchment 1P: Direct Drainage to 1PP Runoff Area=0.415 ac 75.90% Impervious Runoff Depth>3.09"
Tc=10.0 min CN=89 Runoff=1.89 cfs 0.107 af

Subcatchment 2E: Direct Drainage Offsite - Runoff Area=0.670 ac 22.39% Impervious Runoff Depth>2.89"
Flow Length=167' Slope=0.0840 '/' Tc=8.8 min CN=87 Runoff=3.04 cfs 0.162 af

Subcatchment 2P: Direct Drainage to 2PP Runoff Area=1.160 ac 2.59% Impervious Runoff Depth>2.27"
Flow Length=222' Slope=0.0400 '/' Tc=14.8 min CN=80 Runoff=3.42 cfs 0.220 af

Subcatchment 3E: Direct Drainage Offsite - Runoff Area=1.570 ac 8.92% Impervious Runoff Depth>2.53"
Flow Length=340' Slope=0.0530 '/' Tc=5.3 min CN=83 Runoff=7.13 cfs 0.331 af

Subcatchment 3P: Direct Drainage to 3PP Runoff Area=0.730 ac 100.00% Impervious Runoff Depth>4.04"
Tc=10.0 min CN=98 Runoff=3.89 cfs 0.246 af

Subcatchment 4P: Direct Drainage Offsite - Runoff Area=1.230 ac 8.13% Impervious Runoff Depth>2.36"
Flow Length=300' Slope=0.0600 '/' Tc=4.8 min CN=81 Runoff=5.37 cfs 0.242 af

Subcatchment 5P: Direct Drainage Offsite - Runoff Area=0.590 ac 8.47% Impervious Runoff Depth>1.13"
Flow Length=75' Slope=0.0530 '/' Tc=5.6 min CN=64 Runoff=1.17 cfs 0.056 af

Subcatchment 7P: Direct Drainage to Runoff Area=0.811 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=150' Slope=0.0930 '/' Tc=7.7 min CN=79 Runoff=3.01 cfs 0.148 af

Subcatchment 8P: Direct Drainage Off site Runoff Area=0.110 ac 0.00% Impervious Runoff Depth>1.66"
Tc=0.0 min CN=72 Runoff=0.38 cfs 0.015 af

Subcatchment 9P: Runoff Area=0.289 ac 41.52% Impervious Runoff Depth>2.89"
Tc=10.0 min CN=87 Runoff=1.25 cfs 0.070 af

Reach 1ER: Drainage through Wetland Culvert Inflow=0.82 cfs 0.418 af
Outflow=0.82 cfs 0.418 af

Reach 1PR: Total Offsite Drainage - South Inflow=6.56 cfs 0.316 af
Outflow=6.56 cfs 0.316 af

Reach 2ER: Existing Offisite Drainage North Inflow=3.04 cfs 0.162 af
Outflow=3.04 cfs 0.162 af

Reach 2PR: Wetland Outlet Inflow=0.39 cfs 0.256 af
Outflow=0.39 cfs 0.256 af

Reach 3ER: Total Offsite Drainage - South Inflow=7.13 cfs 0.331 af
Outflow=7.13 cfs 0.331 af

Reach 3PR: Offsite North Inflow=1.17 cfs 0.056 af
Outflow=1.17 cfs 0.056 af

Pond 1EP: Wetland Peak Elev=921.33' Storage=0.581 af Inflow=12.38 cfs 0.834 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=0.82 cfs 0.418 af

Pond 1PP: Chambers Peak Elev=923.30' Storage=0.110 af Inflow=5.77 cfs 0.353 af
Outflow=4.52 cfs 0.295 af

Pond 2PP: Wetland Peak Elev=921.15' Storage=0.485 af Inflow=10.12 cfs 0.663 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=0.39 cfs 0.256 af

Pond 9PP: Infiltration Basin Peak Elev=926.05' Storage=490 cf Inflow=1.25 cfs 0.070 af
Discarded=0.00 cfs 0.004 af Primary=1.36 cfs 0.059 af Outflow=1.36 cfs 0.063 af

Total Runoff Area = 11.035 ac Runoff Volume = 2.429 af Average Runoff Depth = 2.64"
83.73% Pervious = 9.240 ac 16.27% Impervious = 1.795 ac

Summary for Subcatchment 1E: Direct Drainage to 1EP

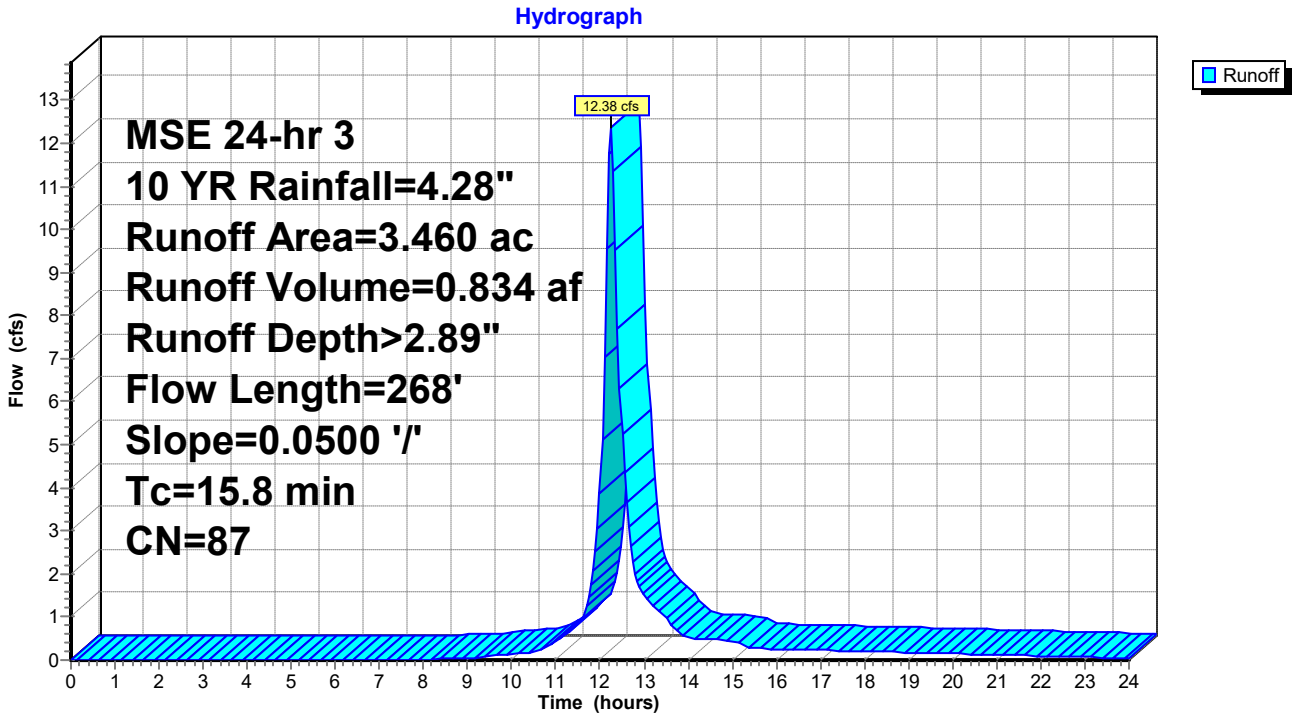
Runoff = 12.38 cfs @ 12.24 hrs, Volume= 0.834 af, Depth> 2.89"
Routed to Pond 1EP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

	Area (ac)	CN	Description
	3.300	86	Woods/grass comb., Poor, HSG D
*	0.160	98	Impervious
	3.460	87	Weighted Average
	3.300		95.38% Pervious Area
	0.160		4.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	268	0.0500	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 1E: Direct Drainage to 1EP



Summary for Subcatchment 1P: Direct Drainage to 1PP

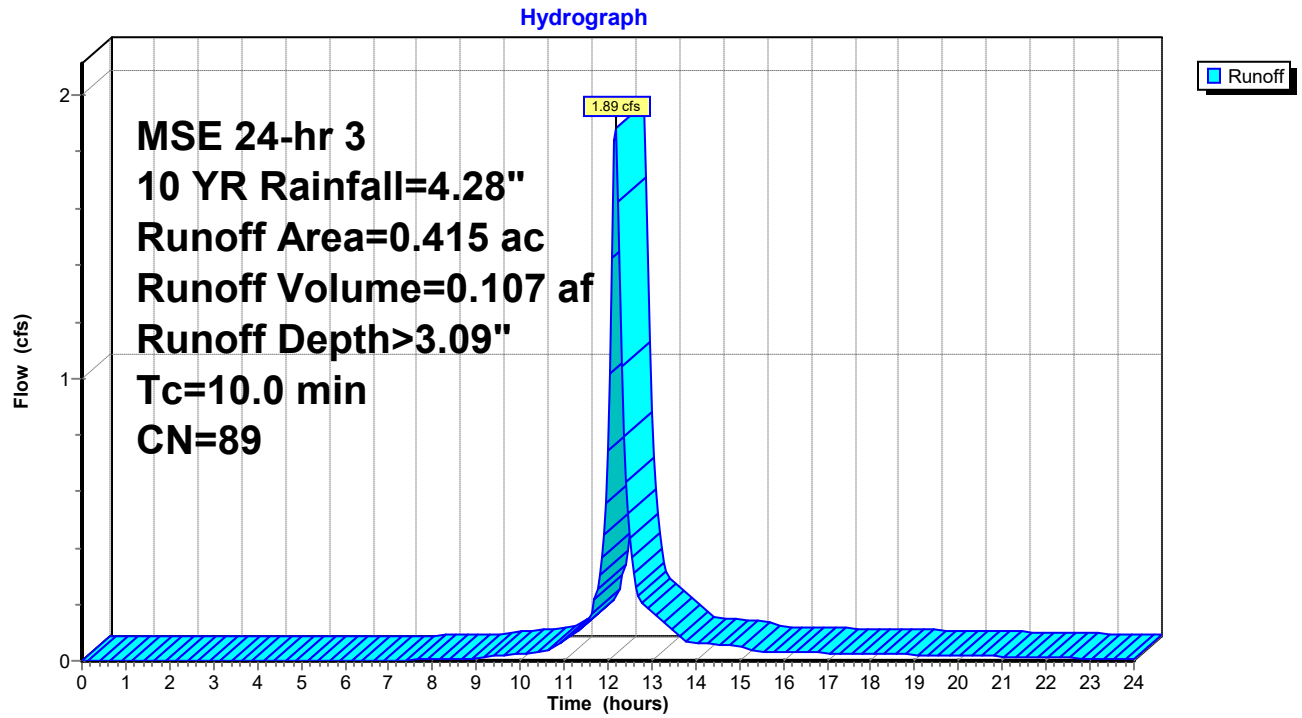
Runoff = 1.89 cfs @ 12.17 hrs, Volume= 0.107 af, Depth> 3.09"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
0.315	98	Paved parking, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.415	89	Weighted Average
0.100		24.10% Pervious Area
0.315		75.90% Impervious Area

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

Subcatchment 1P: Direct Drainage to 1PP



Summary for Subcatchment 2E: Direct Drainage Offsite - North

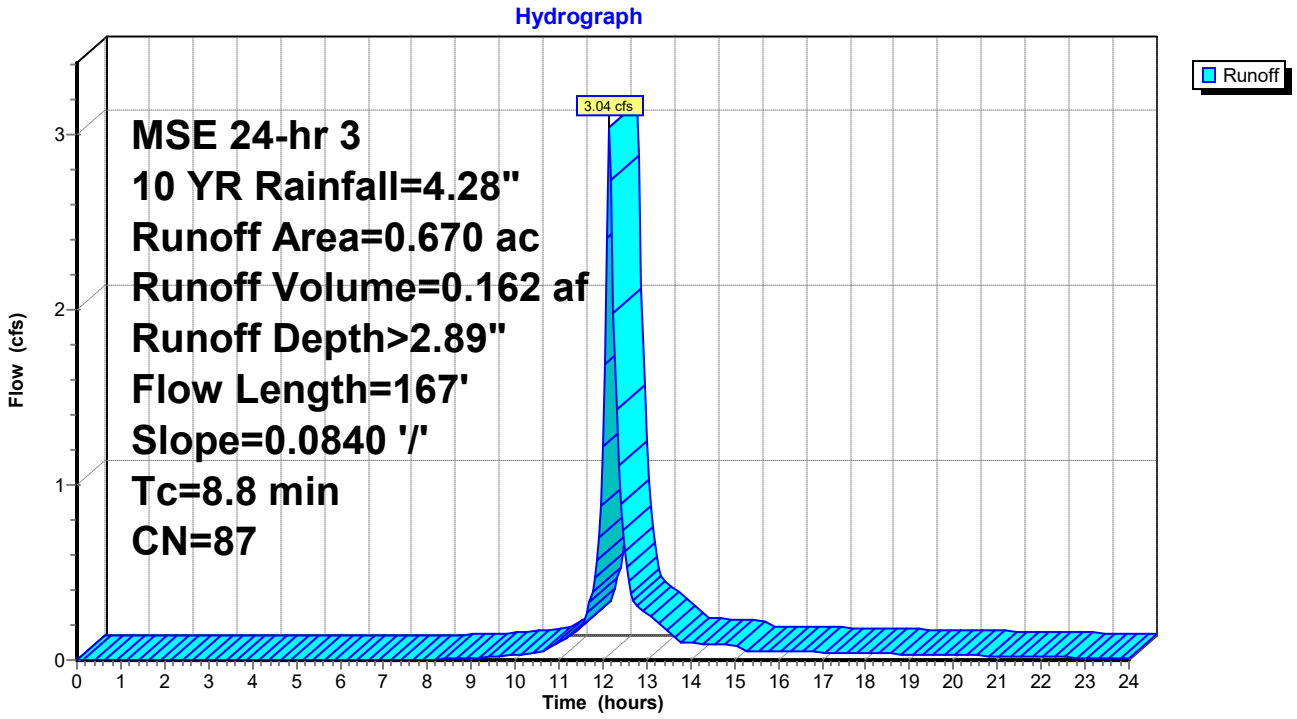
Runoff = 3.04 cfs @ 12.16 hrs, Volume= 0.162 af, Depth> 2.89"
Routed to Reach 2ER : Existing Offisite Drainage North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

	Area (ac)	CN	Description
*	0.150	98	Impervious
	0.520	84	50-75% Grass cover, Fair, HSG D
	0.670	87	Weighted Average
	0.520		77.61% Pervious Area
	0.150		22.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	167	0.0840	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2E: Direct Drainage Offsite - North



Summary for Subcatchment 2P: Direct Drainage to 2PP

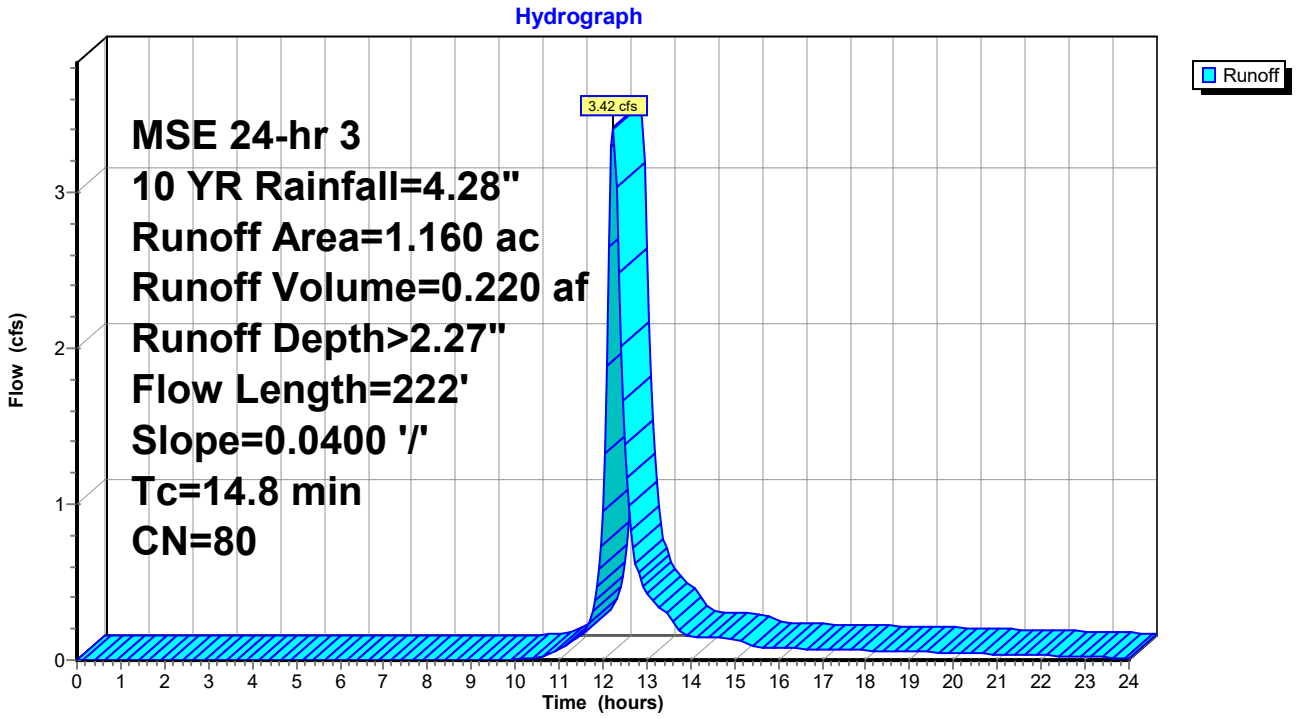
Runoff = 3.42 cfs @ 12.24 hrs, Volume= 0.220 af, Depth> 2.27"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.030	98	Paved parking, HSG A
1.160	80	Weighted Average
1.130		97.41% Pervious Area
0.030		2.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	222	0.0400	0.25		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2P: Direct Drainage to 2PP



Summary for Subcatchment 3E: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

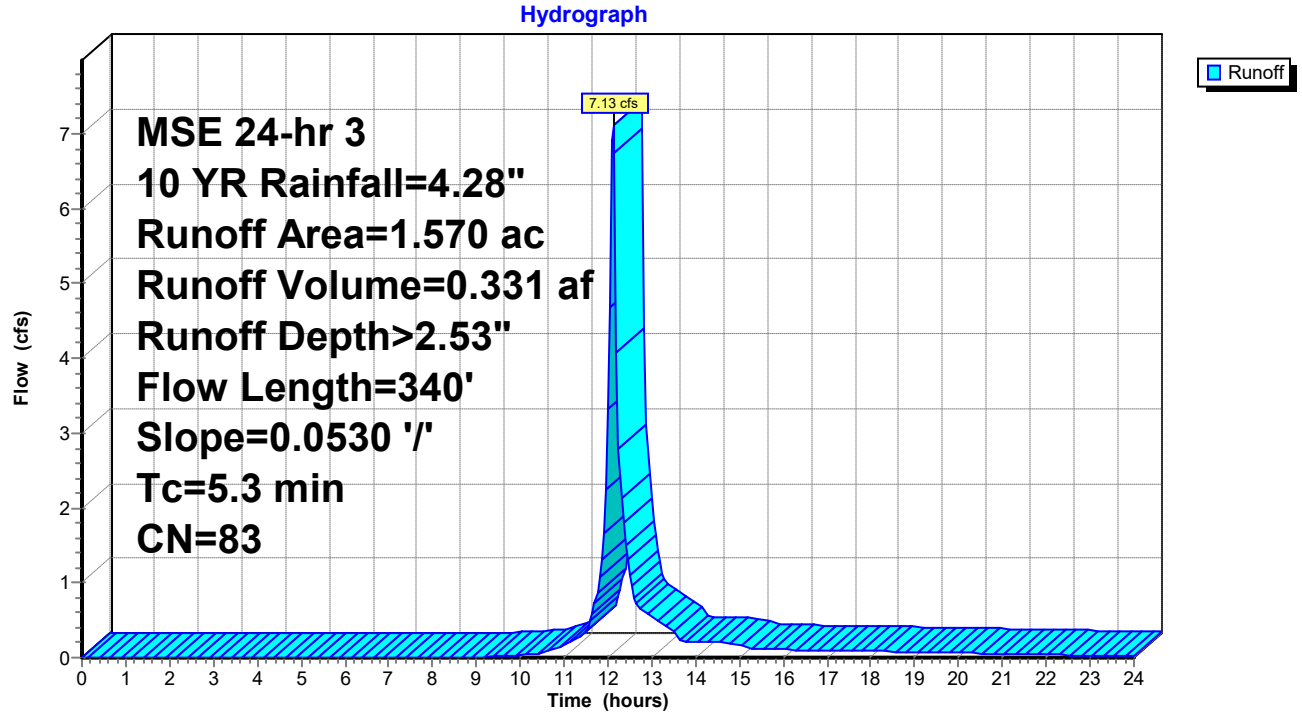
Runoff = 7.13 cfs @ 12.12 hrs, Volume= 0.331 af, Depth> 2.53"
Routed to Reach 3ER : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

	Area (ac)	CN	Description
	1.430	82	Woods/grass comb., Fair, HSG D
*	0.140	98	Impervious
	1.570	83	Weighted Average
	1.430		91.08% Pervious Area
	0.140		8.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	340	0.0530	1.07		**Lag/CN Method,**

Subcatchment 3E: Direct Drainage Offsite - South



Summary for Subcatchment 3P: Direct Drainage to 3PP

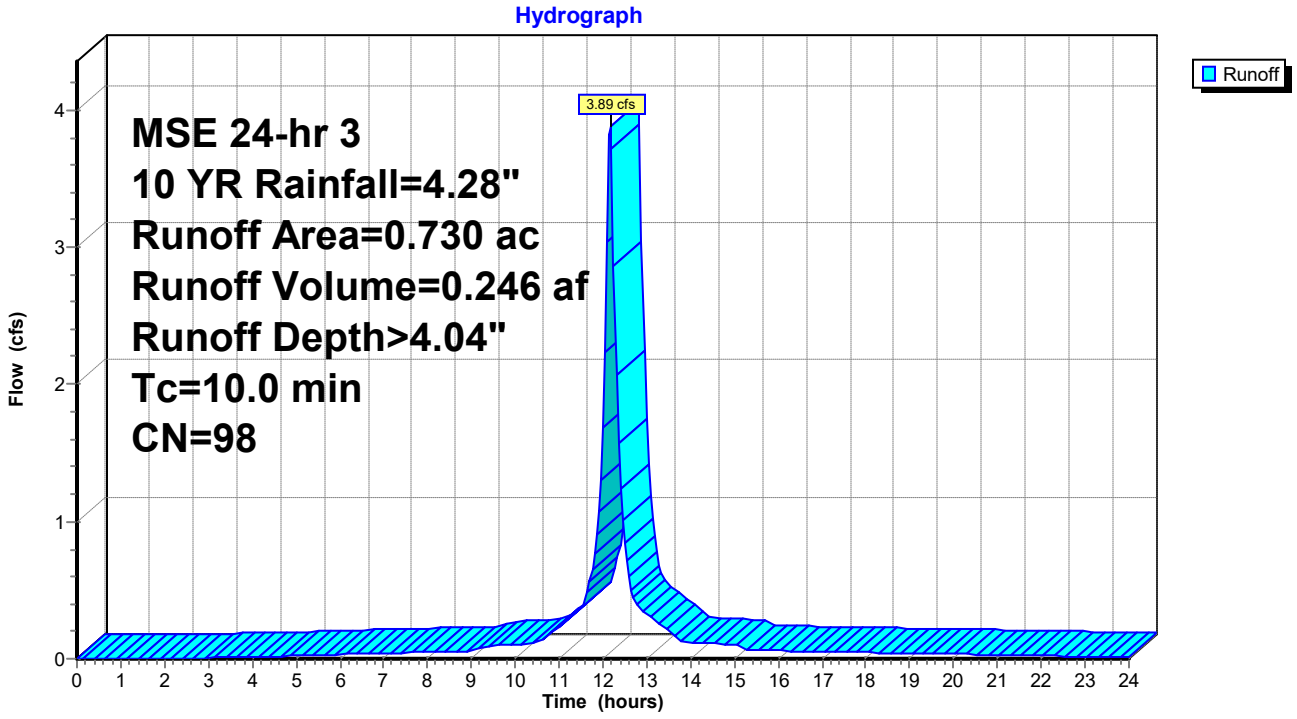
Runoff = 3.89 cfs @ 12.17 hrs, Volume= 0.246 af, Depth> 4.04"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
0.730	98	Unconnected roofs, HSG A
0.730		100.00% Impervious Area
0.730		100.00% Unconnected

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

Subcatchment 3P: Direct Drainage to 3PP



Summary for Subcatchment 4P: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

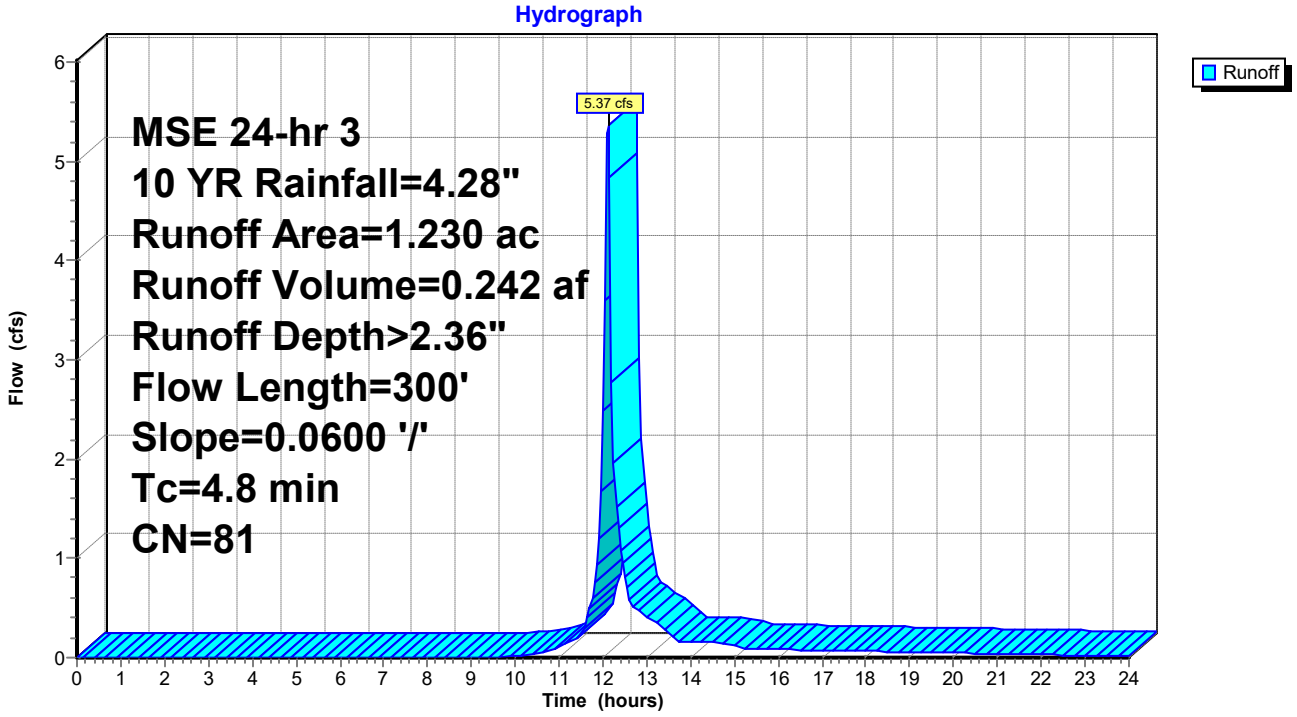
Runoff = 5.37 cfs @ 12.11 hrs, Volume= 0.242 af, Depth> 2.36"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.100	98	Roofs, HSG A
1.230	81	Weighted Average
1.130		91.87% Pervious Area
0.100		8.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0600	1.04		**Lag/CN Method,**

Subcatchment 4P: Direct Drainage Offsite - South



Summary for Subcatchment 5P: Direct Drainage Offsite - North

[49] Hint: Tc<2dt may require smaller dt

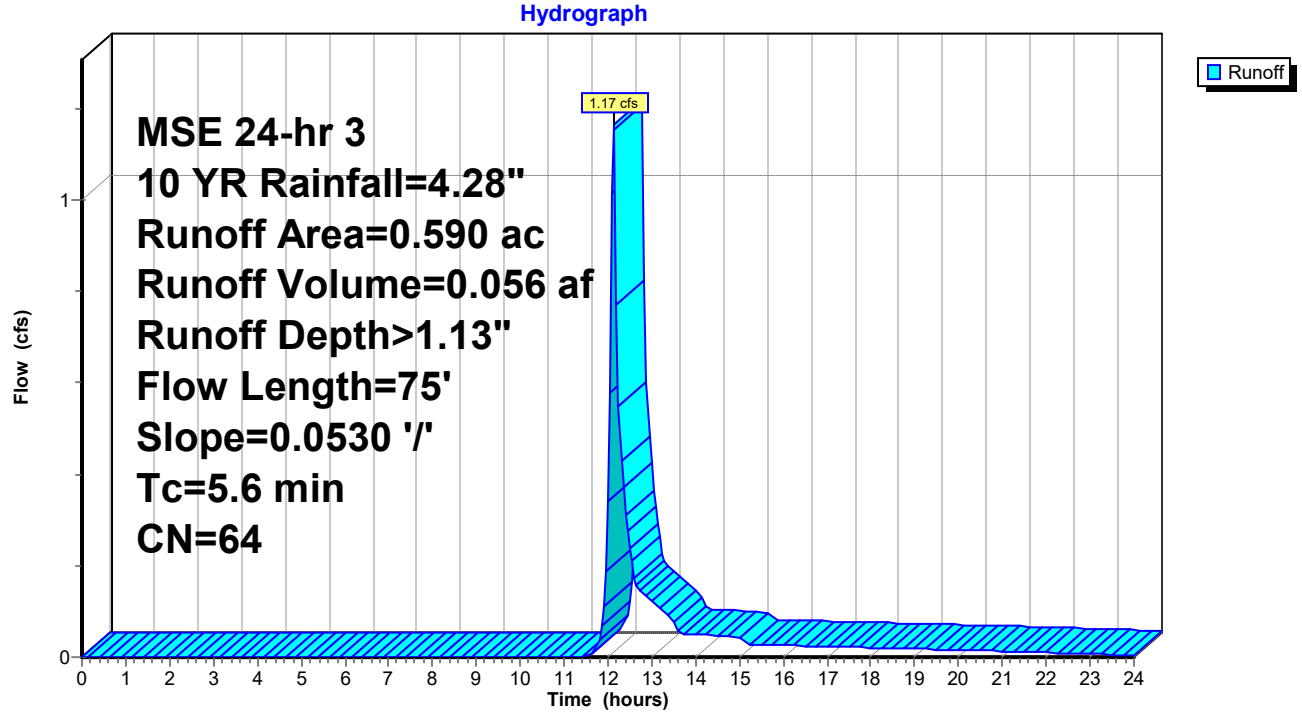
Runoff = 1.17 cfs @ 12.14 hrs, Volume= 0.056 af, Depth> 1.13"
Routed to Reach 3PR : Offsite North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
0.540	61	>75% Grass cover, Good, HSG B
0.050	98	Paved parking, HSG A
0.590	64	Weighted Average
0.540		91.53% Pervious Area
0.050		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	75	0.0530	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 5P: Direct Drainage Offsite - North



Summary for Subcatchment 7P: Direct Drainage to Wetland

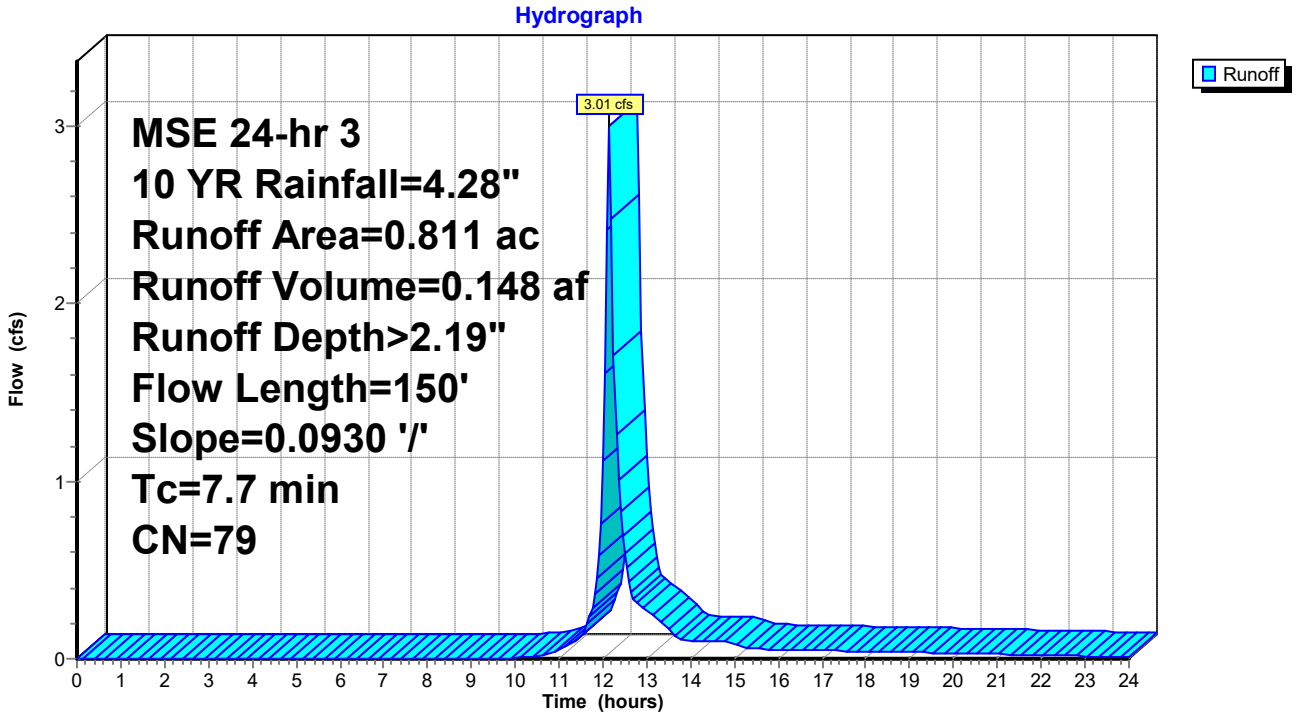
Runoff = 3.01 cfs @ 12.15 hrs, Volume= 0.148 af, Depth> 2.19"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
0.811	79	Woods/grass comb., Good, HSG D
0.811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	150	0.0930	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 7P: Direct Drainage to Wetland



Summary for Subcatchment 8P: Direct Drainage Off site south

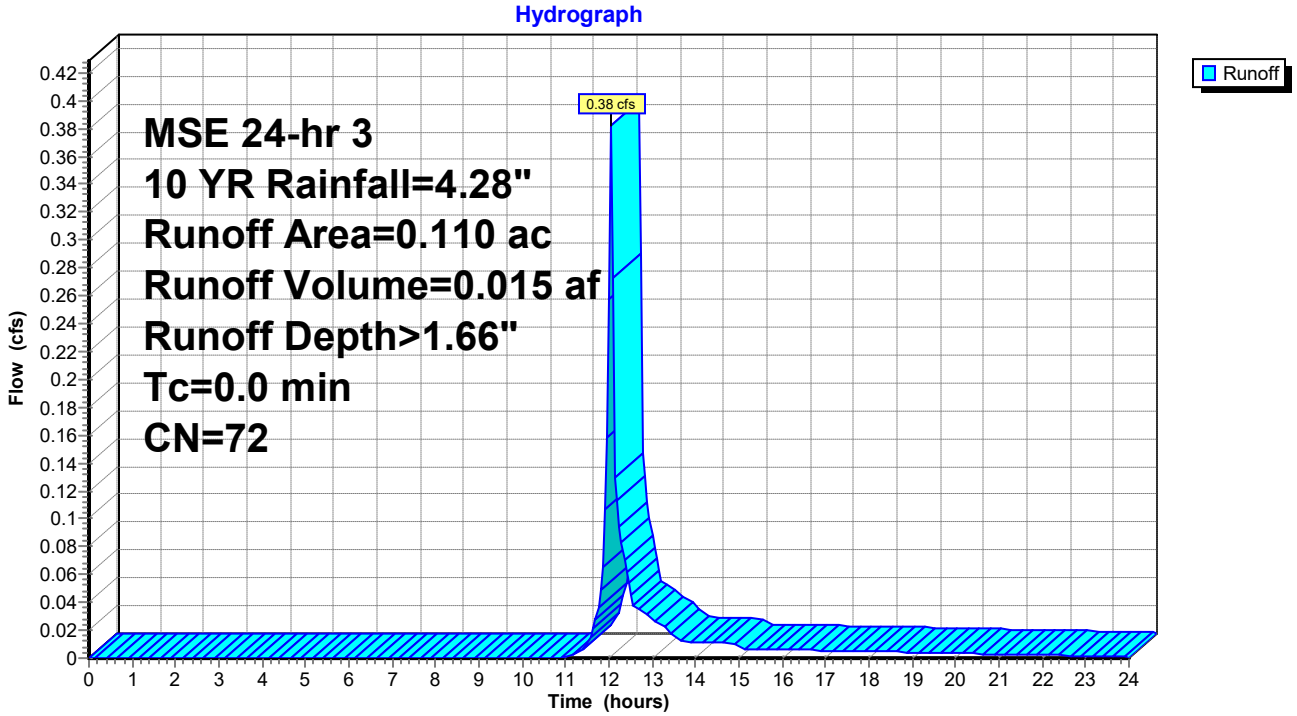
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.38 cfs @ 12.05 hrs, Volume= 0.015 af, Depth> 1.66"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

Area (ac)	CN	Description
0.110	72	Woods/grass comb., Good, HSG C
0.110		100.00% Pervious Area

Subcatchment 8P: Direct Drainage Off site south



Summary for Subcatchment 9P:

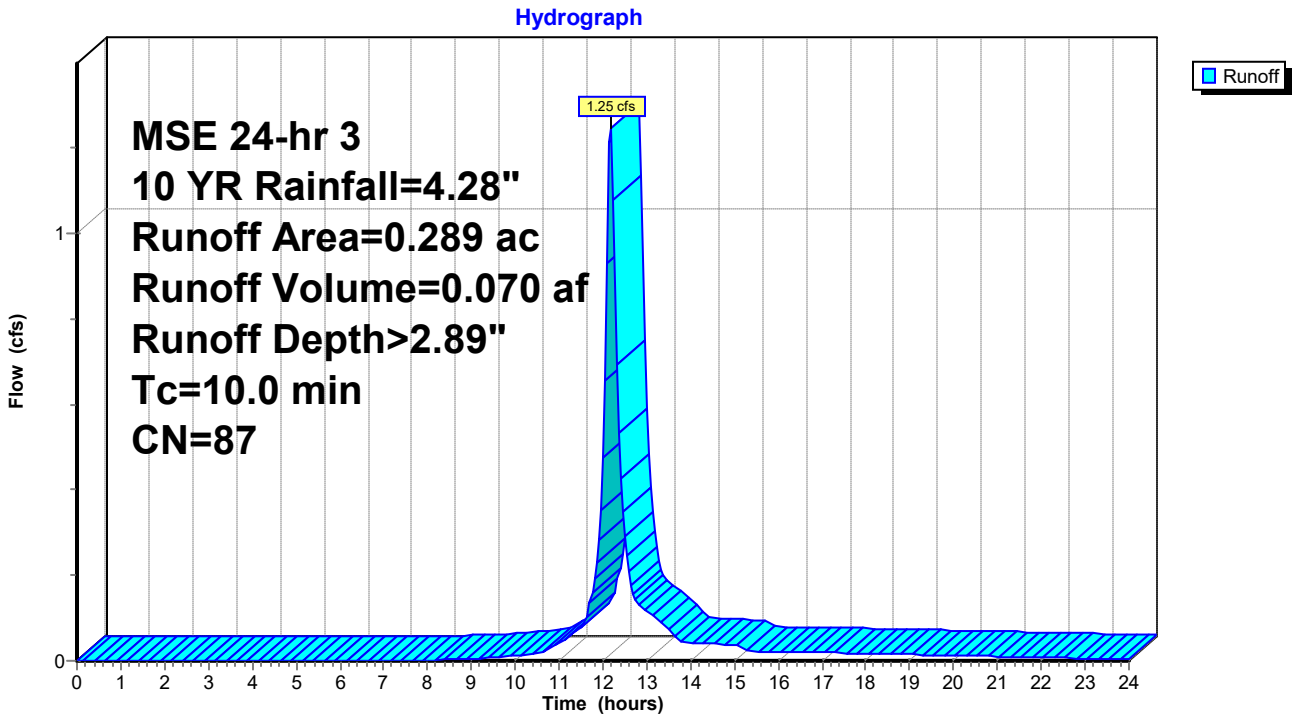
Runoff = 1.25 cfs @ 12.17 hrs, Volume= 0.070 af, Depth> 2.89"
Routed to Pond 9PP : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 10 YR Rainfall=4.28"

	Area (ac)	CN	Description
*	0.120	98	
	0.169	79	<50% Grass cover, Poor, HSG B
	0.289	87	Weighted Average
	0.169		58.48% Pervious Area
	0.120		41.52% Impervious Area

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

Subcatchment 9P:



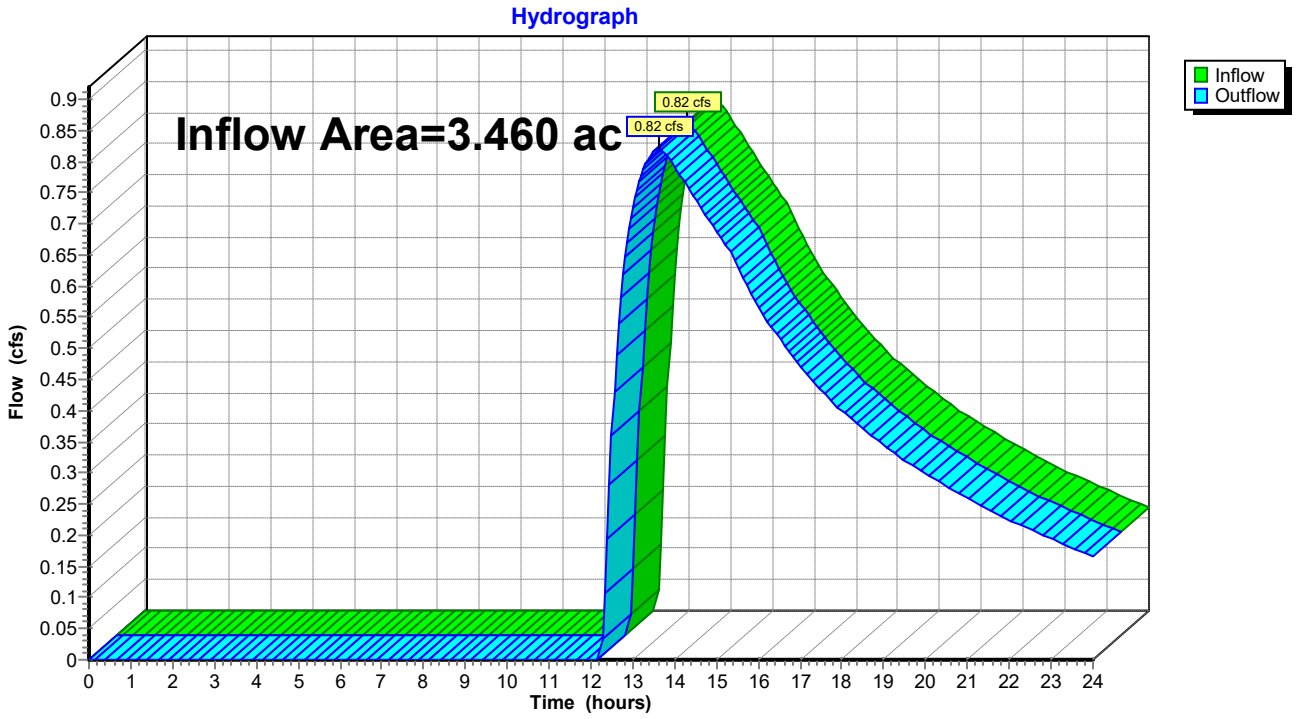
Summary for Reach 1ER: Drainage through Wetland Culvert

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 1.45" for 10 YR event
Inflow = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af
Outflow = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1ER: Drainage through Wetland Culvert



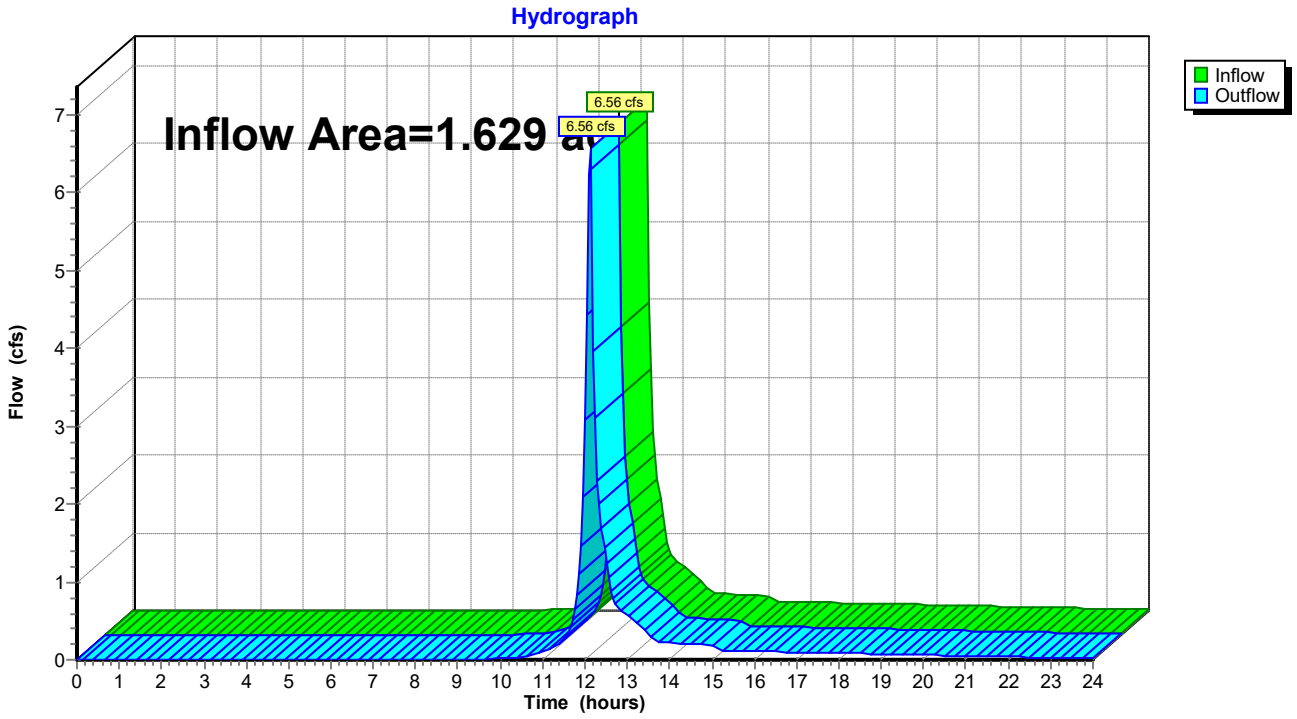
Summary for Reach 1PR: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.629 ac, 13.51% Impervious, Inflow Depth > 2.33" for 10 YR event
Inflow = 6.56 cfs @ 12.13 hrs, Volume= 0.316 af
Outflow = 6.56 cfs @ 12.13 hrs, Volume= 0.316 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1PR: Total Offsite Drainage - South



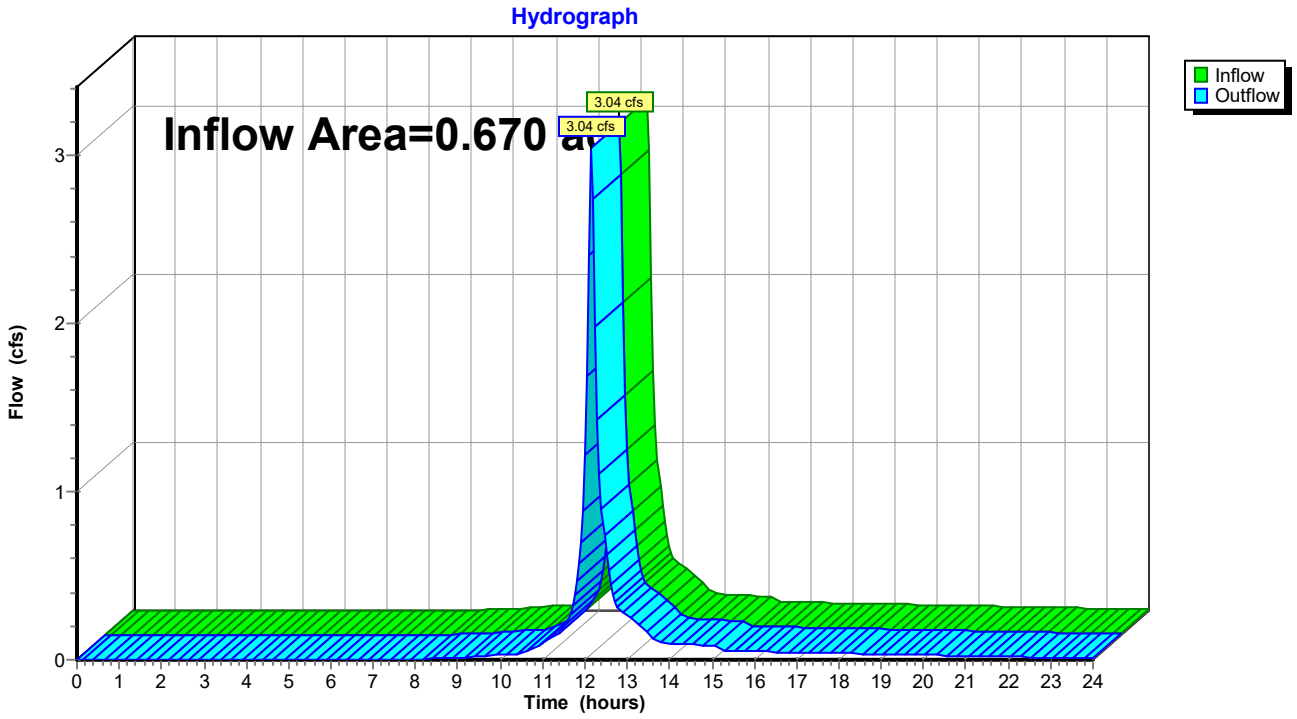
Summary for Reach 2ER: Existing Offisite Drainage North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.670 ac, 22.39% Impervious, Inflow Depth > 2.89" for 10 YR event
Inflow = 3.04 cfs @ 12.16 hrs, Volume= 0.162 af
Outflow = 3.04 cfs @ 12.16 hrs, Volume= 0.162 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2ER: Existing Offisite Drainage North



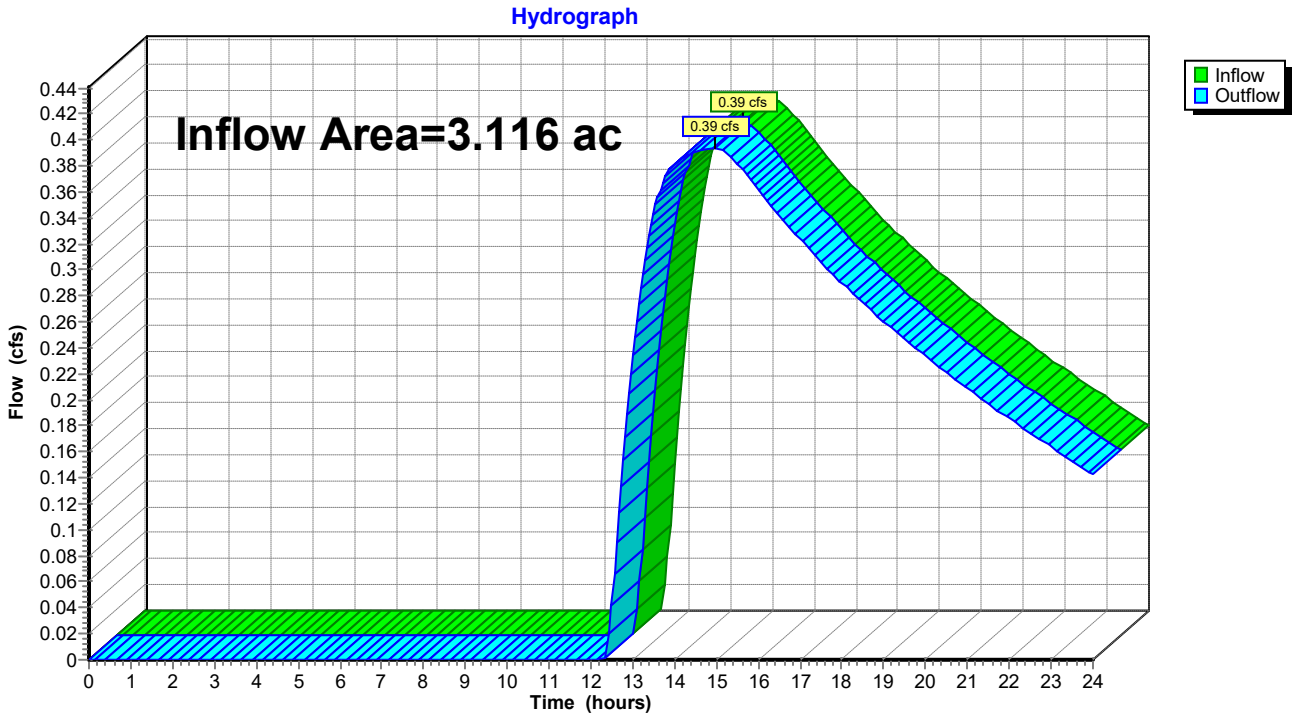
Summary for Reach 2PR: Wetland Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 0.99" for 10 YR event
Inflow = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af
Outflow = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2PR: Wetland Outlet



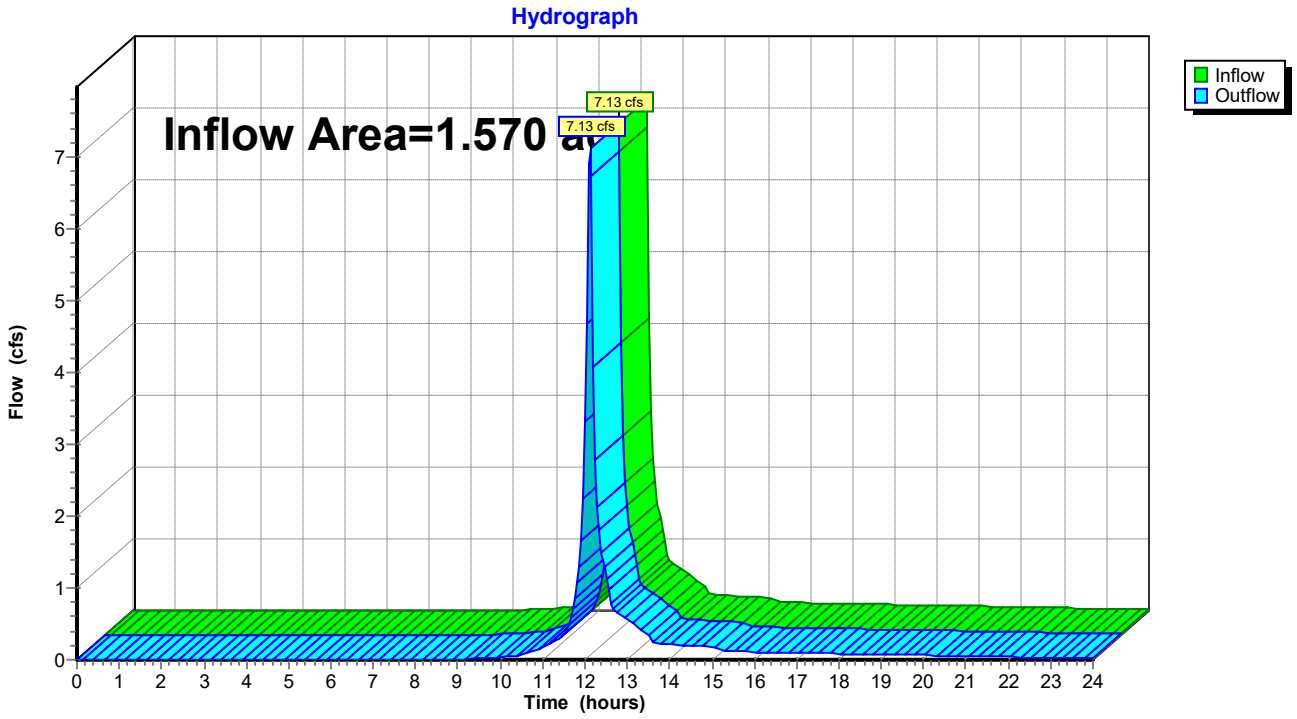
Summary for Reach 3ER: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.570 ac, 8.92% Impervious, Inflow Depth > 2.53" for 10 YR event
Inflow = 7.13 cfs @ 12.12 hrs, Volume= 0.331 af
Outflow = 7.13 cfs @ 12.12 hrs, Volume= 0.331 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3ER: Total Offsite Drainage - South



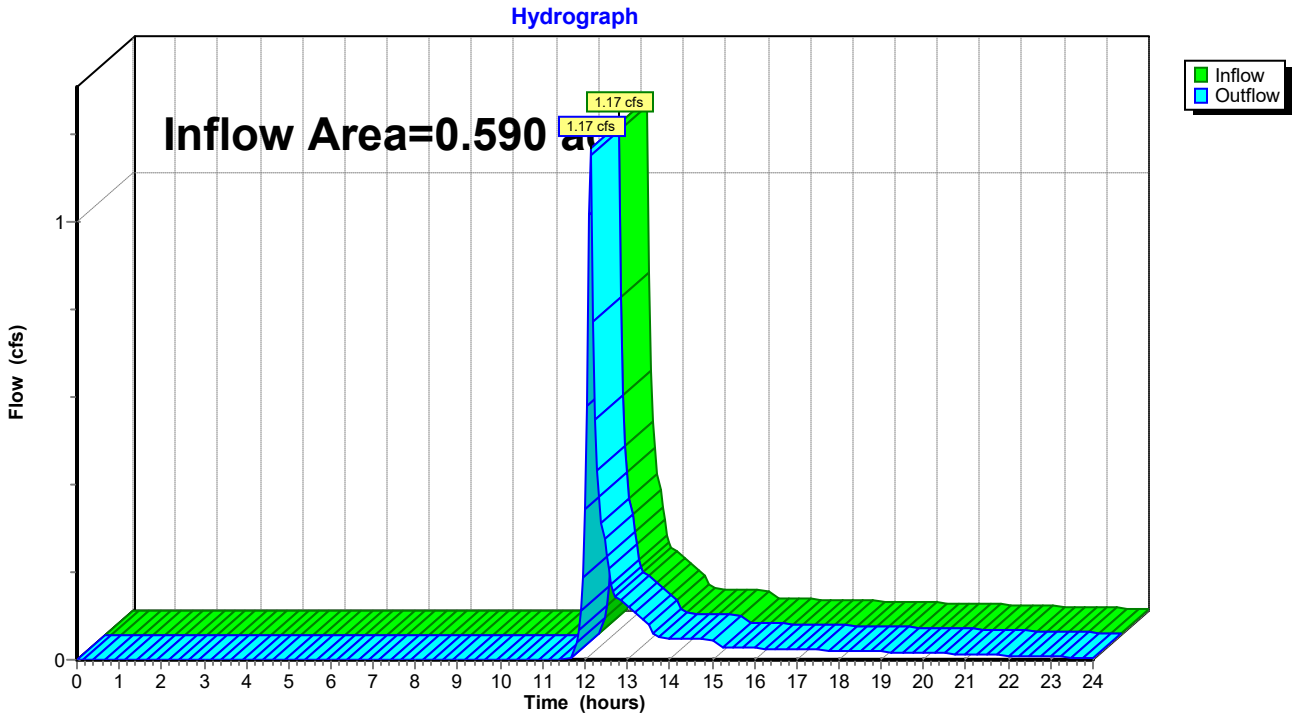
Summary for Reach 3PR: Offsite North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.590 ac, 8.47% Impervious, Inflow Depth > 1.13" for 10 YR event
Inflow = 1.17 cfs @ 12.14 hrs, Volume= 0.056 af
Outflow = 1.17 cfs @ 12.14 hrs, Volume= 0.056 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3PR: Offsite North



Summary for Pond 1EP: Wetland

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 2.89" for 10 YR event
Inflow = 12.38 cfs @ 12.24 hrs, Volume= 0.834 af
Outflow = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af, Atten= 93%, Lag= 83.1 min
Primary = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af
Routed to Reach 1ER : Drainage through Wetland Culvert

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 921.33' @ 13.63 hrs Surf.Area= 0.533 ac Storage= 0.581 af

Plug-Flow detention time= 286.5 min calculated for 0.417 af (50% of inflow)
Center-of-Mass det. time= 206.4 min (1,004.2 - 797.7)

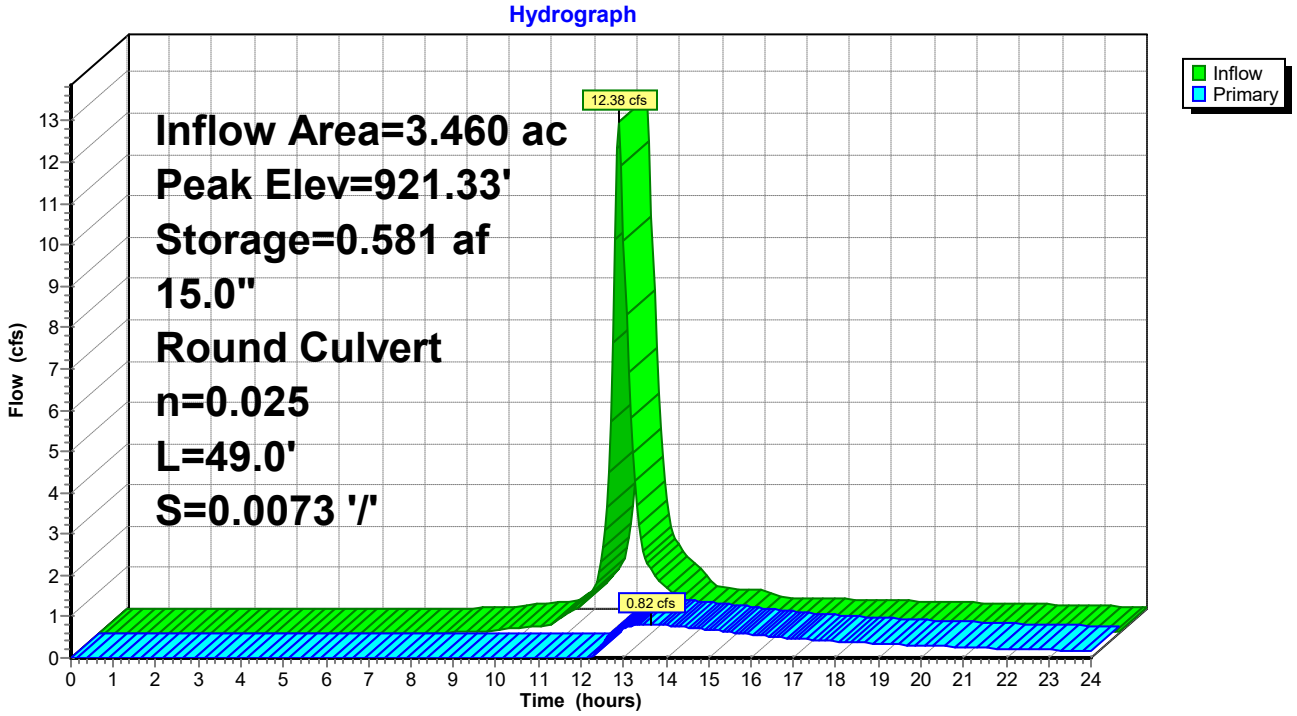
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf

Primary OutFlow Max=0.82 cfs @ 13.63 hrs HW=921.33' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.82 cfs @ 2.11 fps)

Pond 1EP: Wetland



Summary for Pond 1PP: Chambers

Inflow Area = 1.145 ac, 91.27% Impervious, Inflow Depth > 3.70" for 10 YR event
Inflow = 5.77 cfs @ 12.17 hrs, Volume= 0.353 af
Outflow = 4.52 cfs @ 12.25 hrs, Volume= 0.295 af, Atten= 22%, Lag= 4.5 min
Primary = 4.52 cfs @ 12.25 hrs, Volume= 0.295 af
Routed to Pond 2PP : Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 923.30' @ 12.25 hrs Surf.Area= 0.072 ac Storage= 0.110 af

Plug-Flow detention time= 104.0 min calculated for 0.294 af (83% of inflow)
Center-of-Mass det. time= 51.0 min (813.0 - 761.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	920.00'	0.000 af	**30.00'W x 104.00'L x 5.00'H Field A** 0.358 af Overall - 0.147 af Embedded = 0.211 af x 0.0% Voids
#2A	920.50'	0.147 af	**CMP Round 48** x 25 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +2.00' x 12.57 sf x 5 rows
		0.147 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	922.10'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.50 cfs @ 12.25 hrs HW=923.30' TW=920.56' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 4.50 cfs @ 3.72 fps)

Pond 1PP: Chambers - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +2.00' x 12.57 sf x 5 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

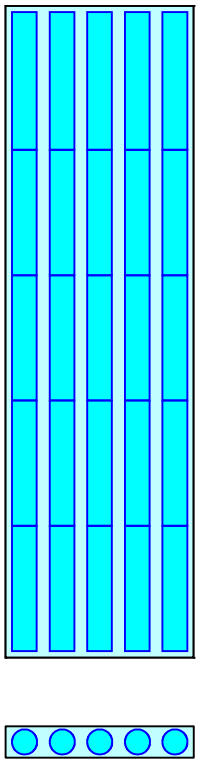
5 Chambers/Row x 20.00' Long +2.00' Row Adjustment = 102.00' Row Length +12.0" End Stone x 2 = 104.00' Base Length
5 Rows x 48.0" Wide + 24.0" Spacing x 4 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

25 Chambers x 251.3 cf +2.00' Row Adjustment x 12.57 sf x 5 Rows = 6,408.8 cf Chamber Storage

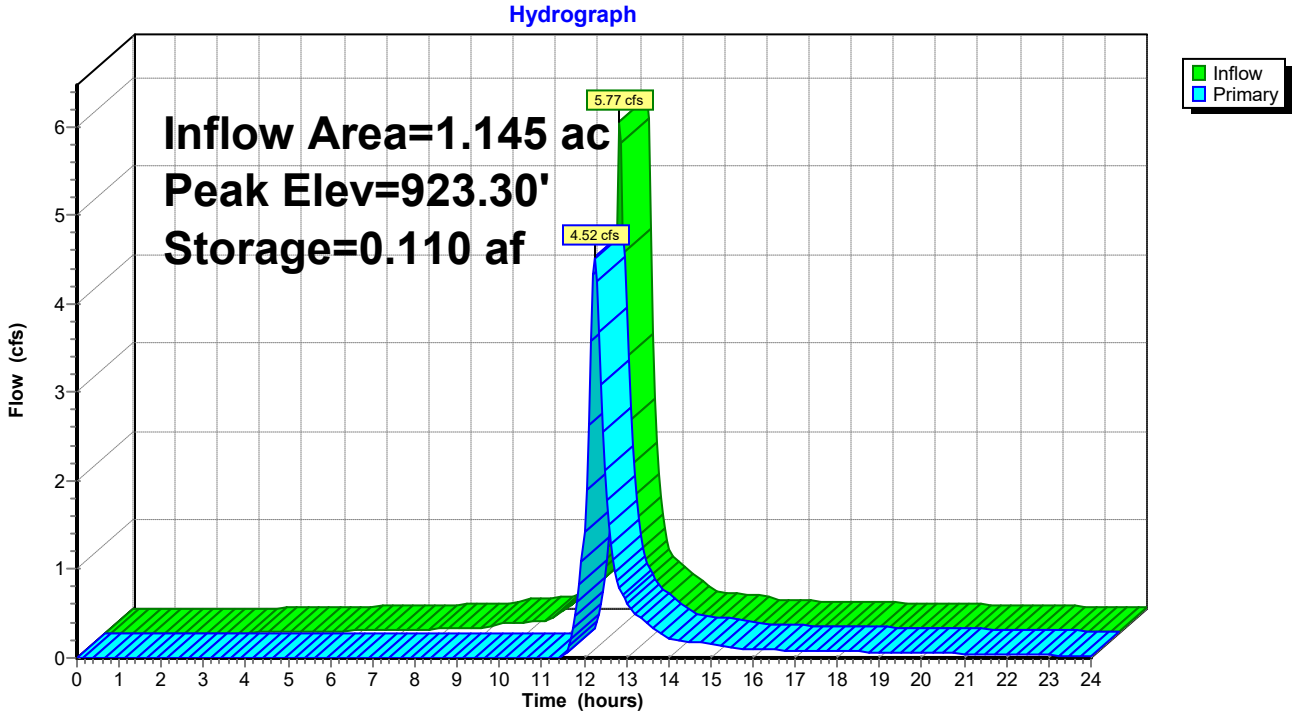
15,600.0 cf Field - 6,408.8 cf Chambers = 9,191.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 6,408.8 cf = 0.147 af
Overall Storage Efficiency = 41.1%
Overall System Size = 104.00' x 30.00' x 5.00'

25 Chambers
577.8 cy Field
340.4 cy Stone



Pond 1PP: Chambers



Summary for Pond 2PP: Wetland

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 2.55" for 10 YR event
Inflow = 10.12 cfs @ 12.21 hrs, Volume= 0.663 af
Outflow = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af, Atten= 96%, Lag= 166.6 min
Primary = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af
Routed to Reach 2PR : Wetland Outlet

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 921.15' @ 14.98 hrs Surf.Area= 0.506 ac Storage= 0.485 af

Plug-Flow detention time= 326.9 min calculated for 0.255 af (39% of inflow)
Center-of-Mass det. time= 240.0 min (1,051.4 - 811.4)

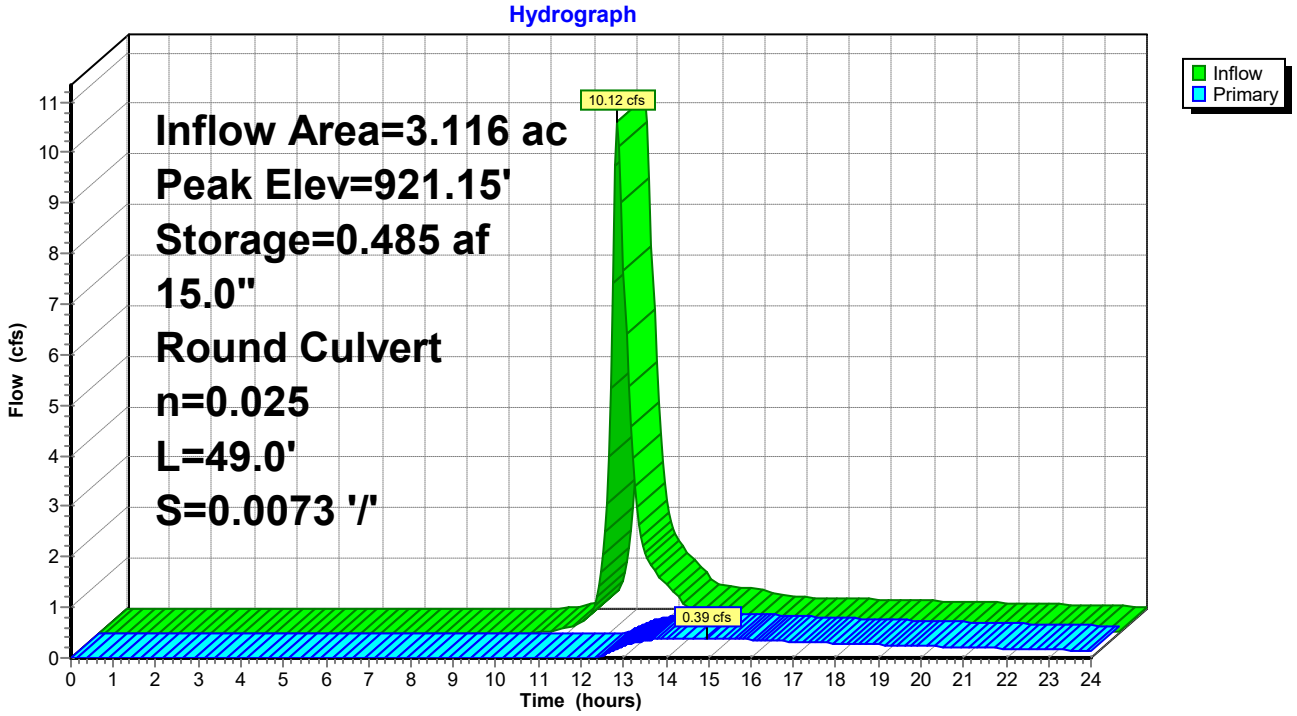
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025, Flow Area= 1.23 sf

Primary OutFlow Max=0.39 cfs @ 14.98 hrs HW=921.15' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.39 cfs @ 1.70 fps)

Pond 2PP: Wetland



Summary for Pond 9PP: Infiltration Basin

[93] Warning: Storage range exceeded by 0.05'
[90] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.289 ac, 41.52% Impervious, Inflow Depth > 2.89" for 10 YR event
Inflow = 1.25 cfs @ 12.17 hrs, Volume= 0.070 af
Outflow = 1.36 cfs @ 12.16 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 9.40 hrs, Volume= 0.004 af
Primary = 1.36 cfs @ 12.16 hrs, Volume= 0.059 af
Routed to Reach 1PR : Total Offsite Drainage - South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 926.05' @ 12.16 hrs Surf.Area= 1,958 sf Storage= 490 cf

Plug-Flow detention time= 60.1 min calculated for 0.063 af (90% of inflow)
Center-of-Mass det. time= 19.6 min (812.2 - 792.6)

Volume	Invert	Avail.Storage	Storage Description
#1	925.75'	490 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

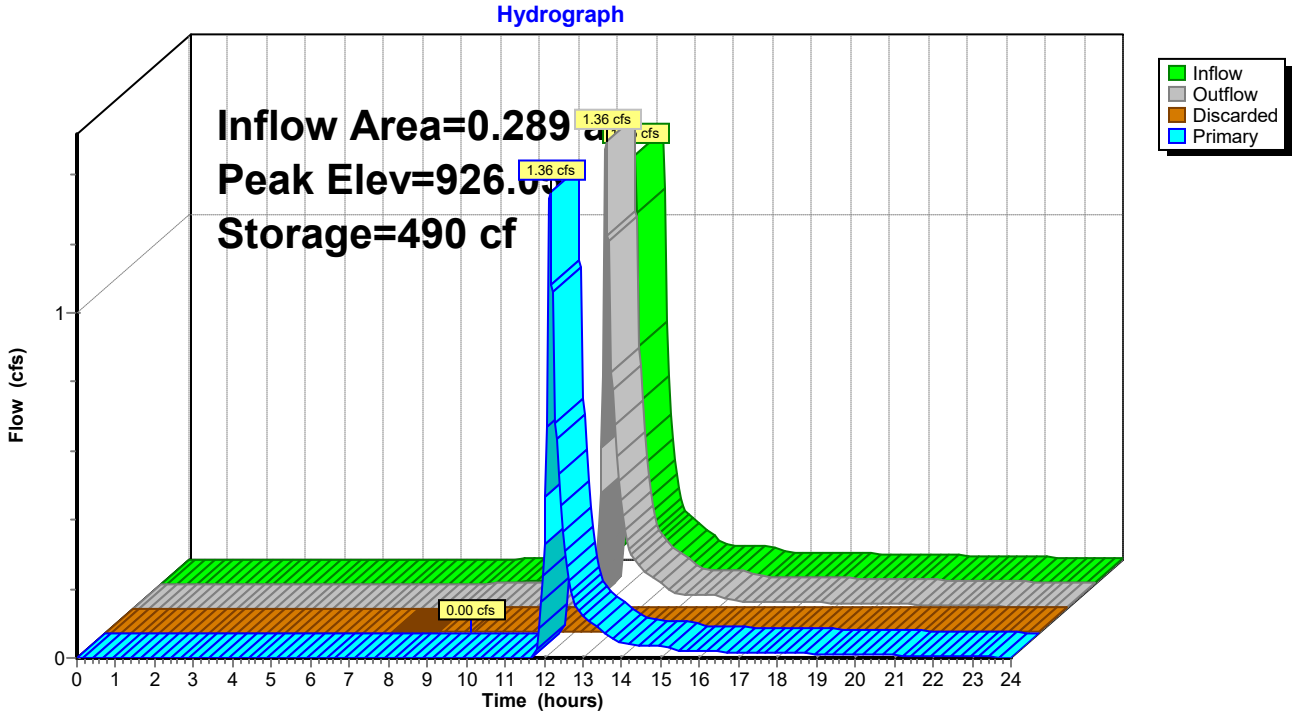
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
925.75	1,958	0	0
926.00	1,958	490	490

Device	Routing	Invert	Outlet Devices
#1	Primary	925.90'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	925.75'	**0.060 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 9.40 hrs HW=925.75' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.27 cfs @ 12.16 hrs HW=926.04' TW=0.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Weir Controls 1.27 cfs @ 0.89 fps)

Pond 9PP: Infiltration Basin



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Direct Drainage to 1EP Runoff Area=3.460 ac 4.62% Impervious Runoff Depth>5.86"
Flow Length=268' Slope=0.0500 '/' Tc=15.8 min CN=87 Runoff=24.30 cfs 1.690 af

Subcatchment 1P: Direct Drainage to 1PP Runoff Area=0.415 ac 75.90% Impervious Runoff Depth>6.10"
Tc=10.0 min CN=89 Runoff=3.59 cfs 0.211 af

Subcatchment 2E: Direct Drainage Offsite - Runoff Area=0.670 ac 22.39% Impervious Runoff Depth>5.86"
Flow Length=167' Slope=0.0840 '/' Tc=8.8 min CN=87 Runoff=5.94 cfs 0.327 af

Subcatchment 2P: Direct Drainage to 2PP Runoff Area=1.160 ac 2.59% Impervious Runoff Depth>5.06"
Flow Length=222' Slope=0.0400 '/' Tc=14.8 min CN=80 Runoff=7.48 cfs 0.489 af

Subcatchment 3E: Direct Drainage Offsite - Runoff Area=1.570 ac 8.92% Impervious Runoff Depth>5.41"
Flow Length=340' Slope=0.0530 '/' Tc=5.3 min CN=83 Runoff=14.71 cfs 0.707 af

Subcatchment 3P: Direct Drainage to 3PP Runoff Area=0.730 ac 100.00% Impervious Runoff Depth>7.16"
Tc=10.0 min CN=98 Runoff=6.76 cfs 0.435 af

Subcatchment 4P: Direct Drainage Offsite - Runoff Area=1.230 ac 8.13% Impervious Runoff Depth>5.18"
Flow Length=300' Slope=0.0600 '/' Tc=4.8 min CN=81 Runoff=11.43 cfs 0.531 af

Subcatchment 5P: Direct Drainage Offsite - Runoff Area=0.590 ac 8.47% Impervious Runoff Depth>3.31"
Flow Length=75' Slope=0.0530 '/' Tc=5.6 min CN=64 Runoff=3.54 cfs 0.163 af

Subcatchment 7P: Direct Drainage to Runoff Area=0.811 ac 0.00% Impervious Runoff Depth>4.95"
Flow Length=150' Slope=0.0930 '/' Tc=7.7 min CN=79 Runoff=6.63 cfs 0.335 af

Subcatchment 8P: Direct Drainage Off site Runoff Area=0.110 ac 0.00% Impervious Runoff Depth>4.17"
Tc=0.0 min CN=72 Runoff=0.95 cfs 0.038 af

Subcatchment 9P: Runoff Area=0.289 ac 41.52% Impervious Runoff Depth>5.86"
Tc=10.0 min CN=87 Runoff=2.44 cfs 0.141 af

Reach 1ER: Drainage through Wetland Culvert Inflow=3.38 cfs 1.239 af
Outflow=3.38 cfs 1.239 af

Reach 1PR: Total Offsite Drainage - South Inflow=13.90 cfs 0.699 af
Outflow=13.90 cfs 0.699 af

Reach 2ER: Existing Offisite Drainage North Inflow=5.94 cfs 0.327 af
Outflow=5.94 cfs 0.327 af

Reach 2PR: Wetland Outlet Inflow=2.51 cfs 0.967 af
Outflow=2.51 cfs 0.967 af

Reach 3ER: Total Offsite Drainage - South Inflow=14.71 cfs 0.707 af
Outflow=14.71 cfs 0.707 af

Reach 3PR: Offsite North Inflow=3.54 cfs 0.163 af
Outflow=3.54 cfs 0.163 af

Pond 1EP: Wetland Peak Elev=922.13' Storage=1.052 af Inflow=24.30 cfs 1.690 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=3.38 cfs 1.239 af

Pond 1PP: Chambers Peak Elev=924.73' Storage=0.147 af Inflow=10.34 cfs 0.646 af
Outflow=8.36 cfs 0.587 af

Pond 2PP: Wetland Peak Elev=921.85' Storage=0.879 af Inflow=19.98 cfs 1.411 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=2.51 cfs 0.967 af

Pond 9PP: Infiltration Basin Peak Elev=926.13' Storage=490 cf Inflow=2.44 cfs 0.141 af
Discarded=0.00 cfs 0.004 af Primary=2.53 cfs 0.130 af Outflow=2.53 cfs 0.134 af

Total Runoff Area = 11.035 ac Runoff Volume = 5.068 af Average Runoff Depth = 5.51"
83.73% Pervious = 9.240 ac 16.27% Impervious = 1.795 ac

Summary for Subcatchment 1E: Direct Drainage to 1EP

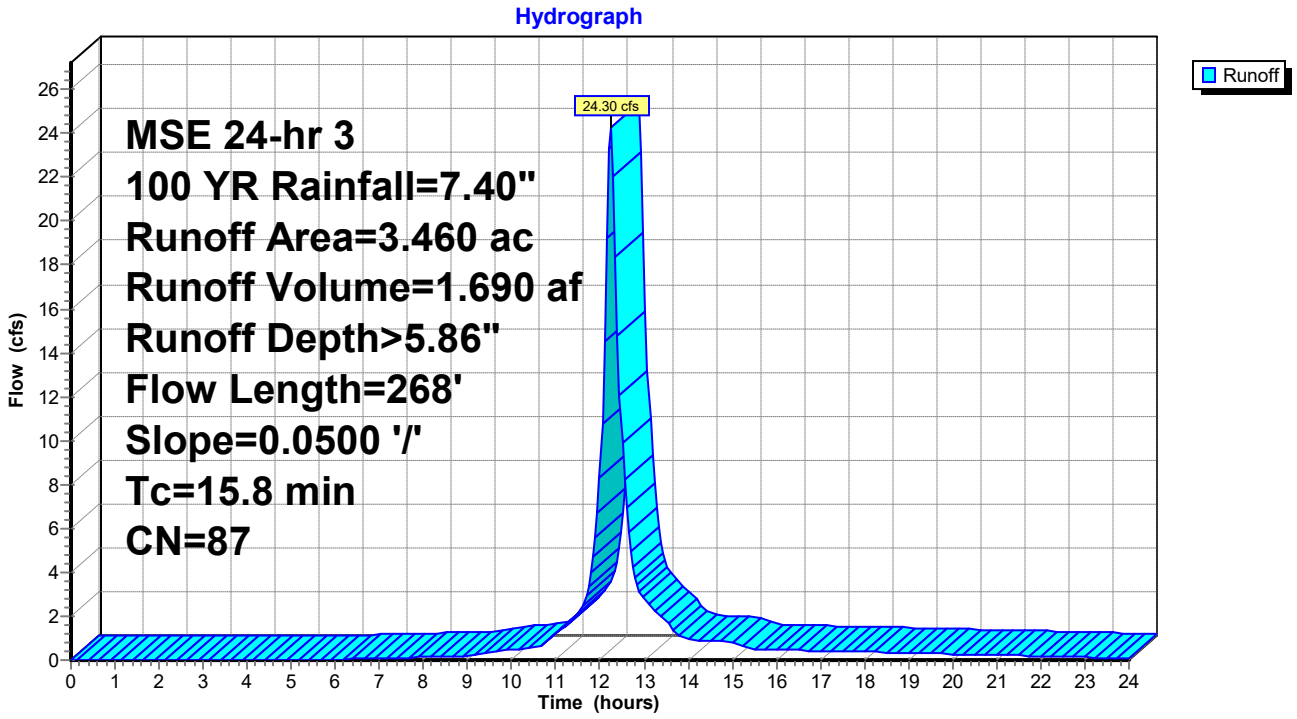
Runoff = 24.30 cfs @ 12.24 hrs, Volume= 1.690 af, Depth> 5.86"
Routed to Pond 1EP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

	Area (ac)	CN	Description
	3.300	86	Woods/grass comb., Poor, HSG D
*	0.160	98	Impervious
	3.460	87	Weighted Average
	3.300		95.38% Pervious Area
	0.160		4.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	268	0.0500	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 1E: Direct Drainage to 1EP



Summary for Subcatchment 1P: Direct Drainage to 1PP

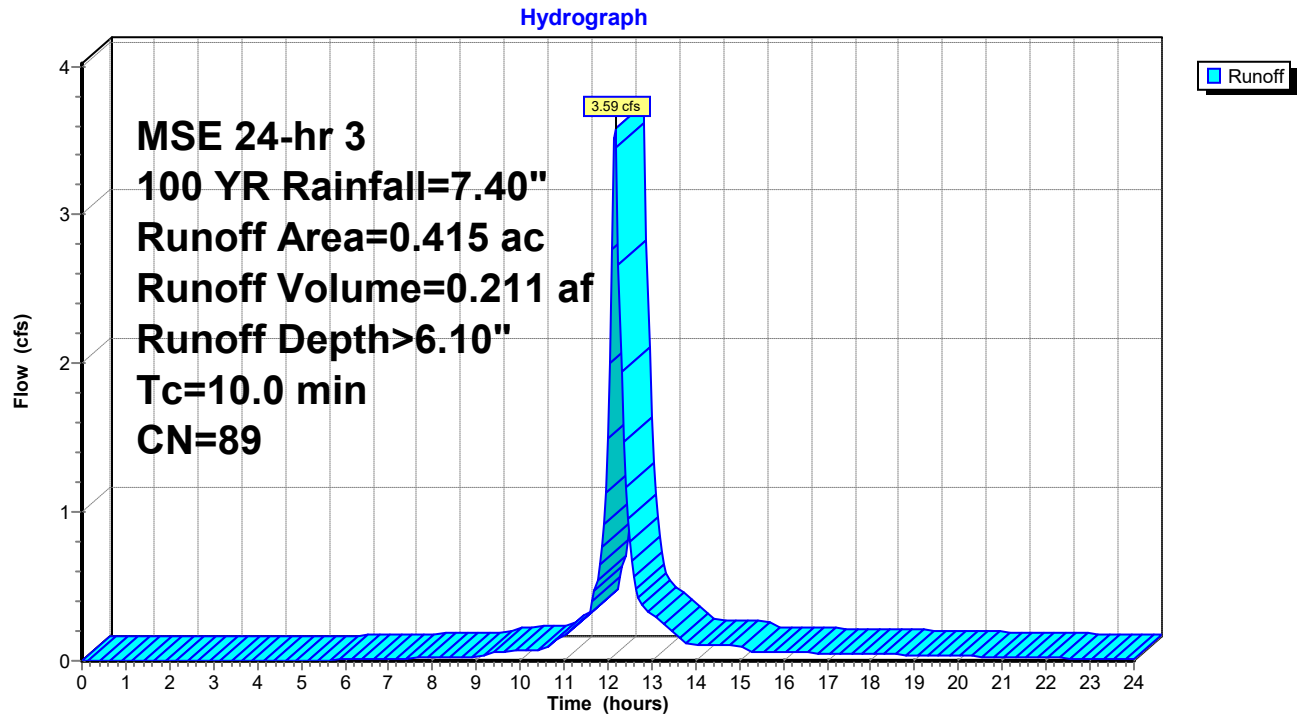
Runoff = 3.59 cfs @ 12.17 hrs, Volume= 0.211 af, Depth> 6.10"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
0.315	98	Paved parking, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.415	89	Weighted Average
0.100		24.10% Pervious Area
0.315		75.90% Impervious Area

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

Subcatchment 1P: Direct Drainage to 1PP



Summary for Subcatchment 2E: Direct Drainage Offsite - North

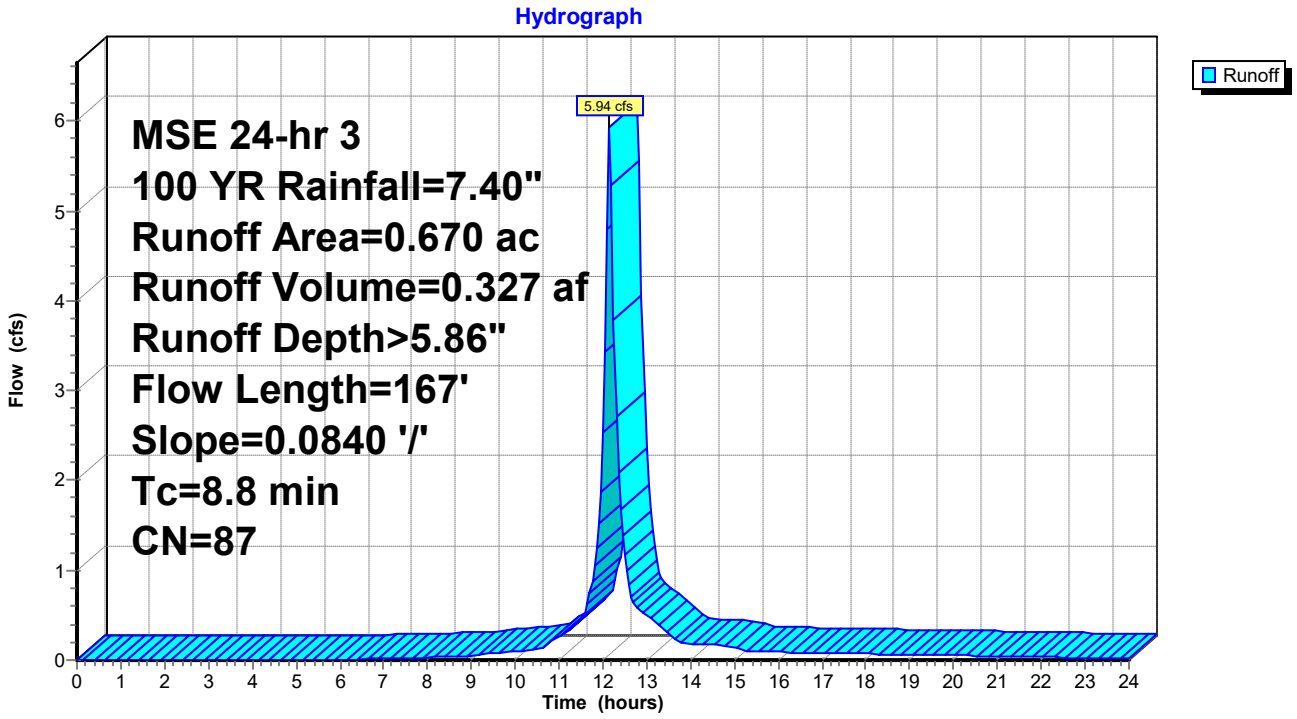
Runoff = 5.94 cfs @ 12.16 hrs, Volume= 0.327 af, Depth> 5.86"
Routed to Reach 2ER : Existing Offisite Drainage North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

	Area (ac)	CN	Description
*	0.150	98	Impervious
	0.520	84	50-75% Grass cover, Fair, HSG D
	0.670	87	Weighted Average
	0.520		77.61% Pervious Area
	0.150		22.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	167	0.0840	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2E: Direct Drainage Offsite - North



Summary for Subcatchment 2P: Direct Drainage to 2PP

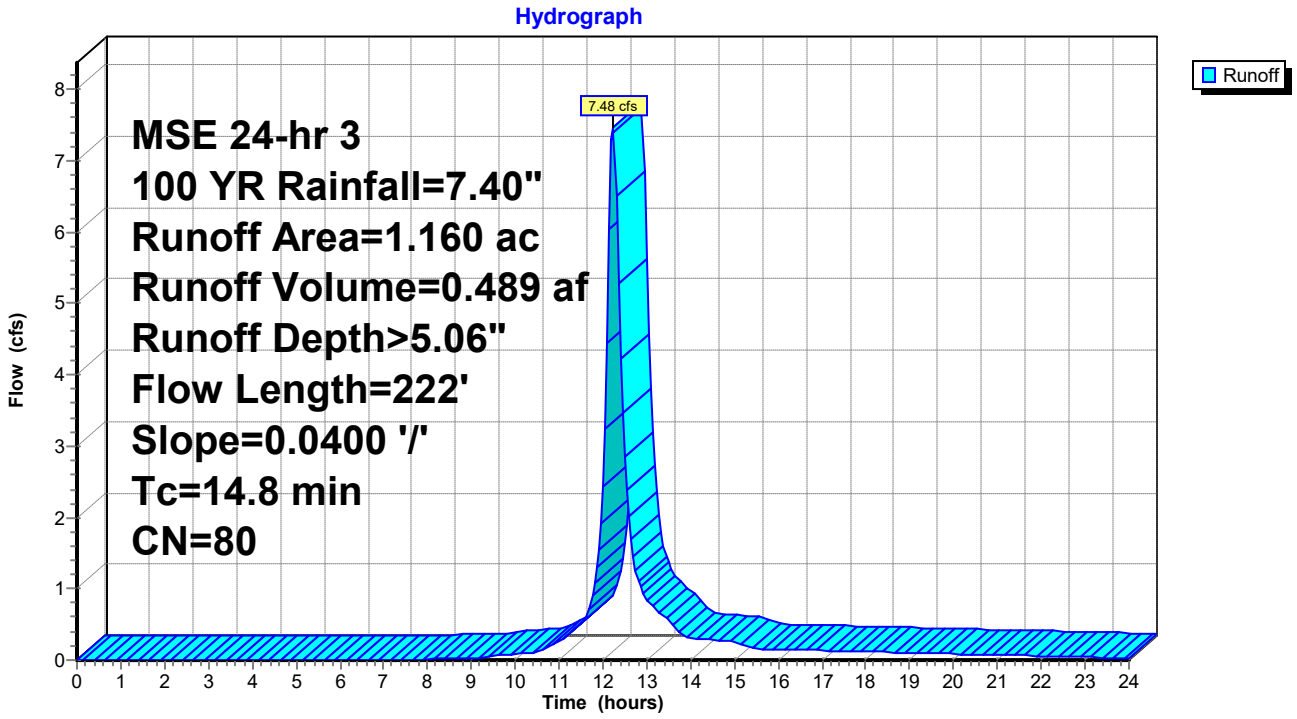
Runoff = 7.48 cfs @ 12.23 hrs, Volume= 0.489 af, Depth> 5.06"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.030	98	Paved parking, HSG A
1.160	80	Weighted Average
1.130		97.41% Pervious Area
0.030		2.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	222	0.0400	0.25		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2P: Direct Drainage to 2PP



Summary for Subcatchment 3E: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

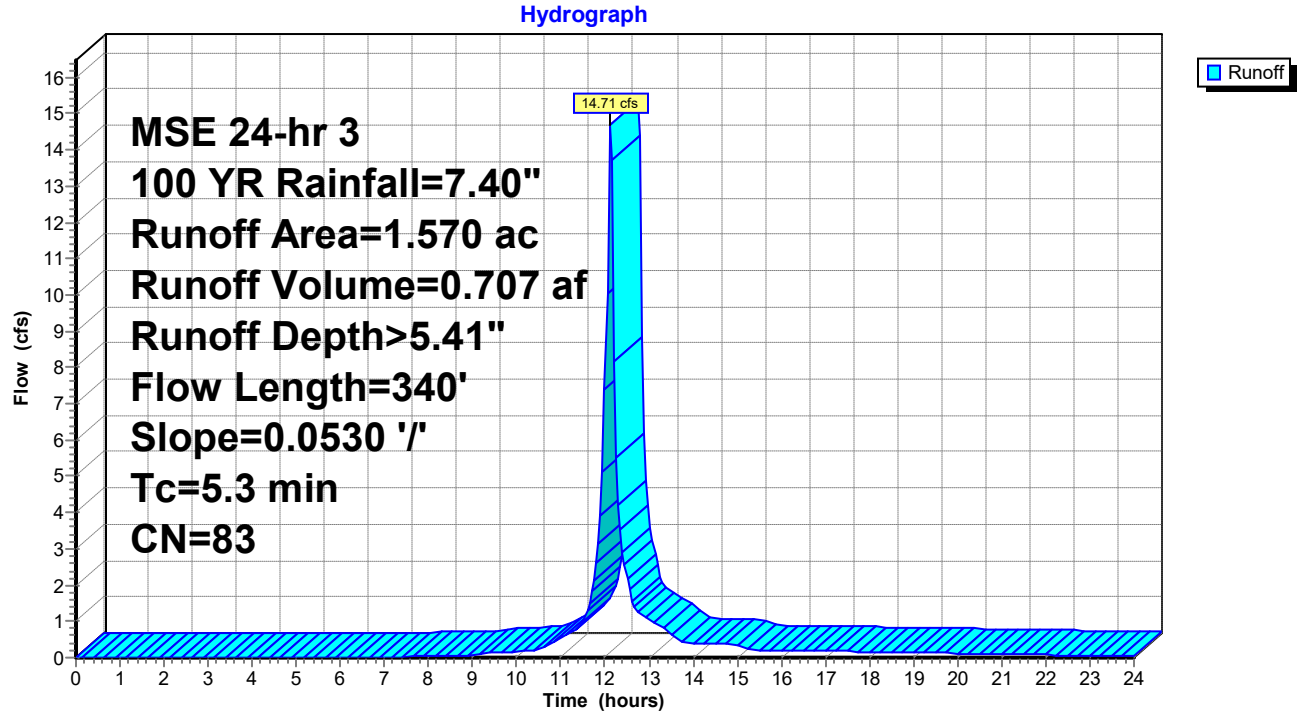
Runoff = 14.71 cfs @ 12.12 hrs, Volume= 0.707 af, Depth> 5.41"
Routed to Reach 3ER : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

	Area (ac)	CN	Description
	1.430	82	Woods/grass comb., Fair, HSG D
*	0.140	98	Impervious
	1.570	83	Weighted Average
	1.430		91.08% Pervious Area
	0.140		8.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	340	0.0530	1.07		**Lag/CN Method,**

Subcatchment 3E: Direct Drainage Offsite - South



Summary for Subcatchment 3P: Direct Drainage to 3PP

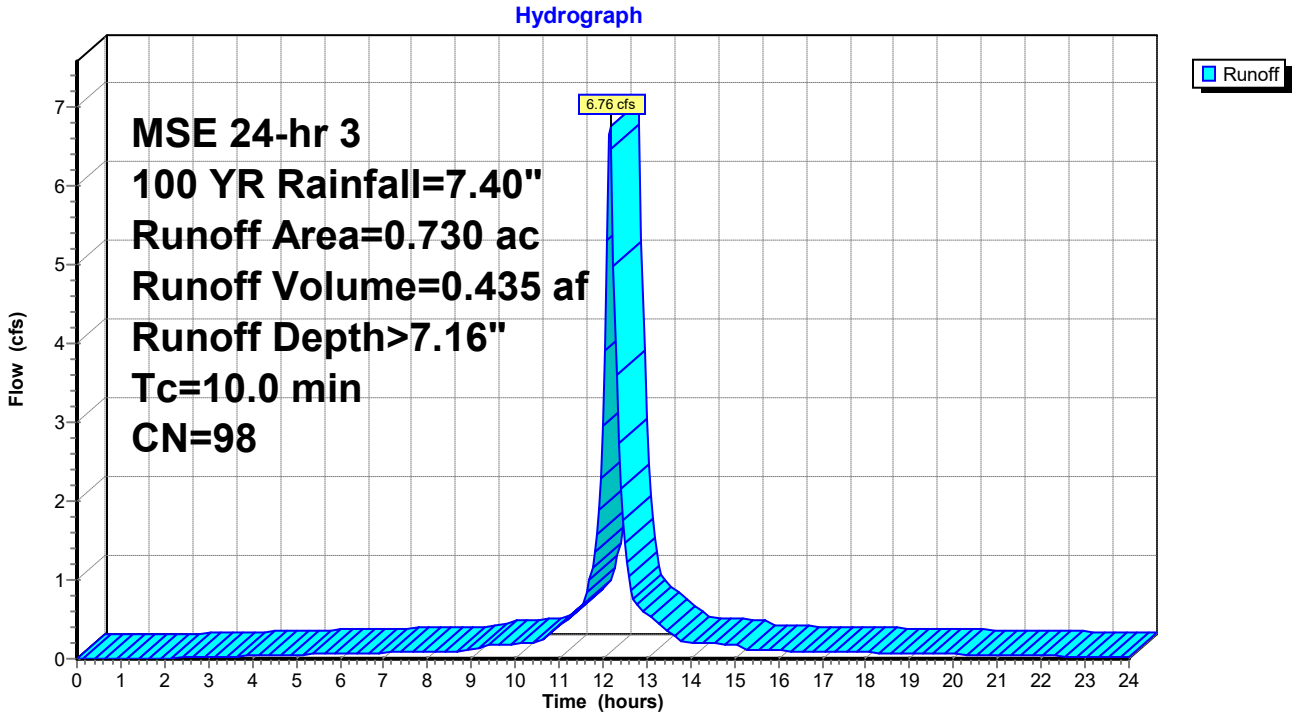
Runoff = 6.76 cfs @ 12.17 hrs, Volume= 0.435 af, Depth> 7.16"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
0.730	98	Unconnected roofs, HSG A
0.730		100.00% Impervious Area
0.730		100.00% Unconnected

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

Subcatchment 3P: Direct Drainage to 3PP



Summary for Subcatchment 4P: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

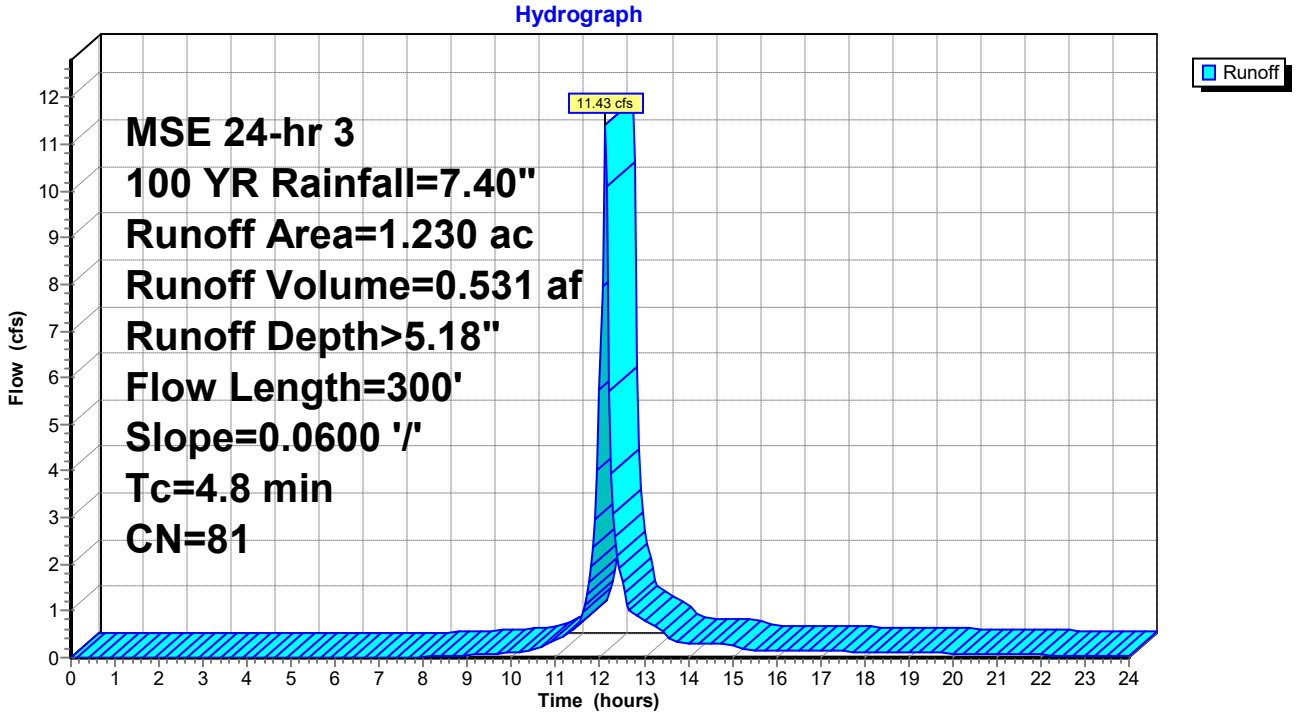
Runoff = 11.43 cfs @ 12.11 hrs, Volume= 0.531 af, Depth> 5.18"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.100	98	Roofs, HSG A
1.230	81	Weighted Average
1.130		91.87% Pervious Area
0.100		8.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0600	1.04		**Lag/CN Method,**

Subcatchment 4P: Direct Drainage Offsite - South



Summary for Subcatchment 5P: Direct Drainage Offsite - North

[49] Hint: Tc<2dt may require smaller dt

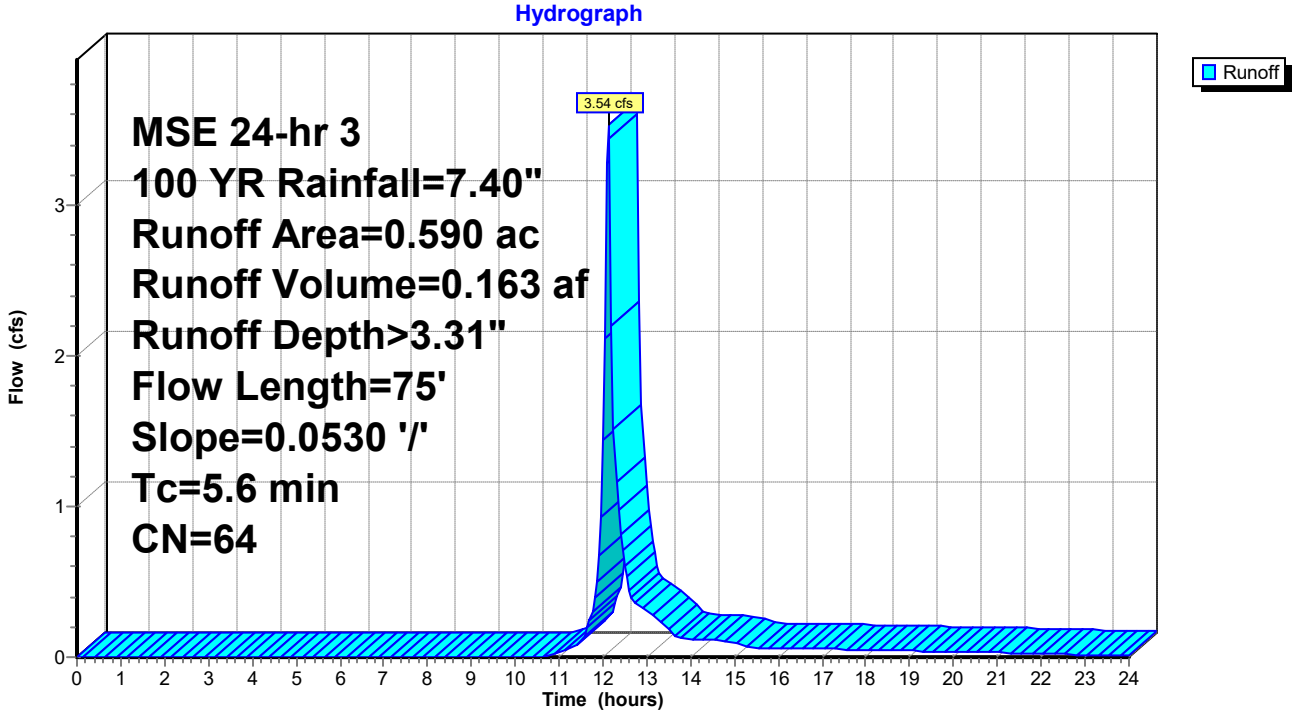
Runoff = 3.54 cfs @ 12.13 hrs, Volume= 0.163 af, Depth> 3.31"
Routed to Reach 3PR : Offsite North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
0.540	61	>75% Grass cover, Good, HSG B
0.050	98	Paved parking, HSG A
0.590	64	Weighted Average
0.540		91.53% Pervious Area
0.050		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	75	0.0530	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 5P: Direct Drainage Offsite - North



Summary for Subcatchment 7P: Direct Drainage to Wetland

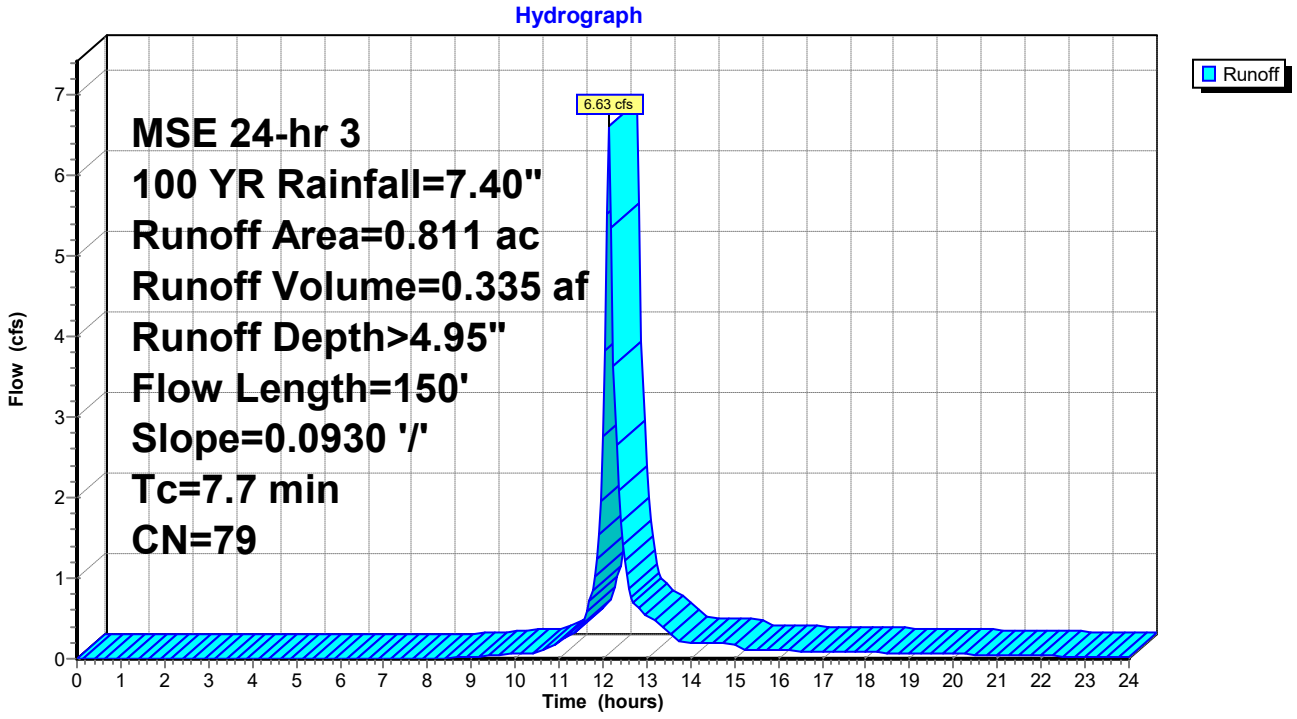
Runoff = 6.63 cfs @ 12.15 hrs, Volume= 0.335 af, Depth> 4.95"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
0.811	79	Woods/grass comb., Good, HSG D
0.811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	150	0.0930	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 7P: Direct Drainage to Wetland



Summary for Subcatchment 8P: Direct Drainage Off site south

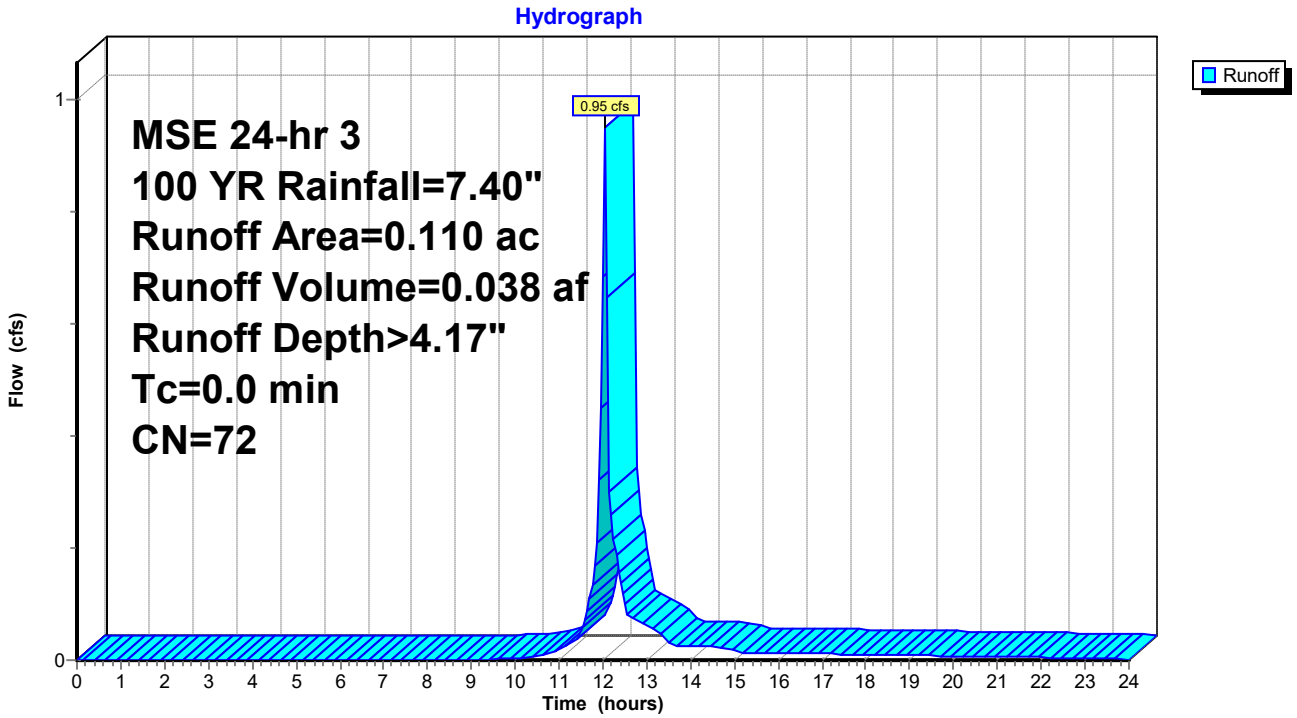
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.95 cfs @ 12.05 hrs, Volume= 0.038 af, Depth> 4.17"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

Area (ac)	CN	Description
0.110	72	Woods/grass comb., Good, HSG C
0.110		100.00% Pervious Area

Subcatchment 8P: Direct Drainage Off site south



Summary for Subcatchment 9P:

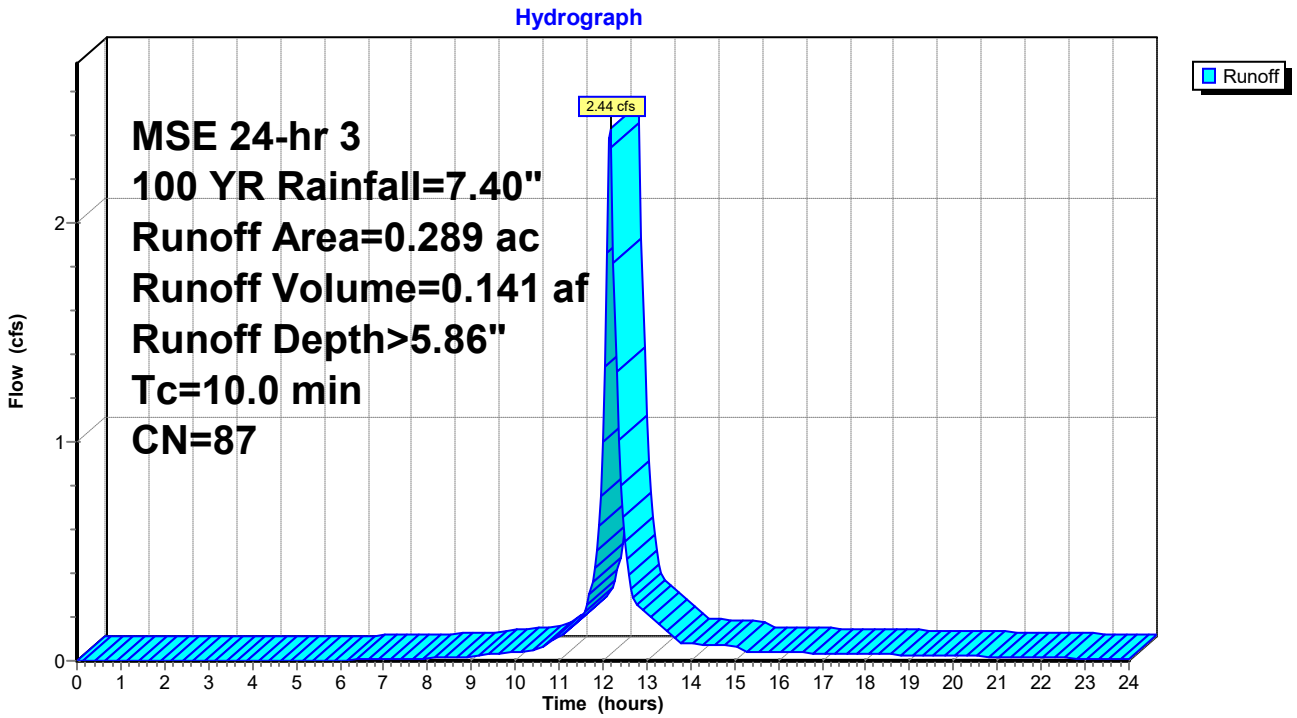
Runoff = 2.44 cfs @ 12.17 hrs, Volume= 0.141 af, Depth> 5.86"
Routed to Pond 9PP : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 100 YR Rainfall=7.40"

	Area (ac)	CN	Description
*	0.120	98	
	0.169	79	<50% Grass cover, Poor, HSG B
	0.289	87	Weighted Average
	0.169		58.48% Pervious Area
	0.120		41.52% Impervious Area

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

Subcatchment 9P:



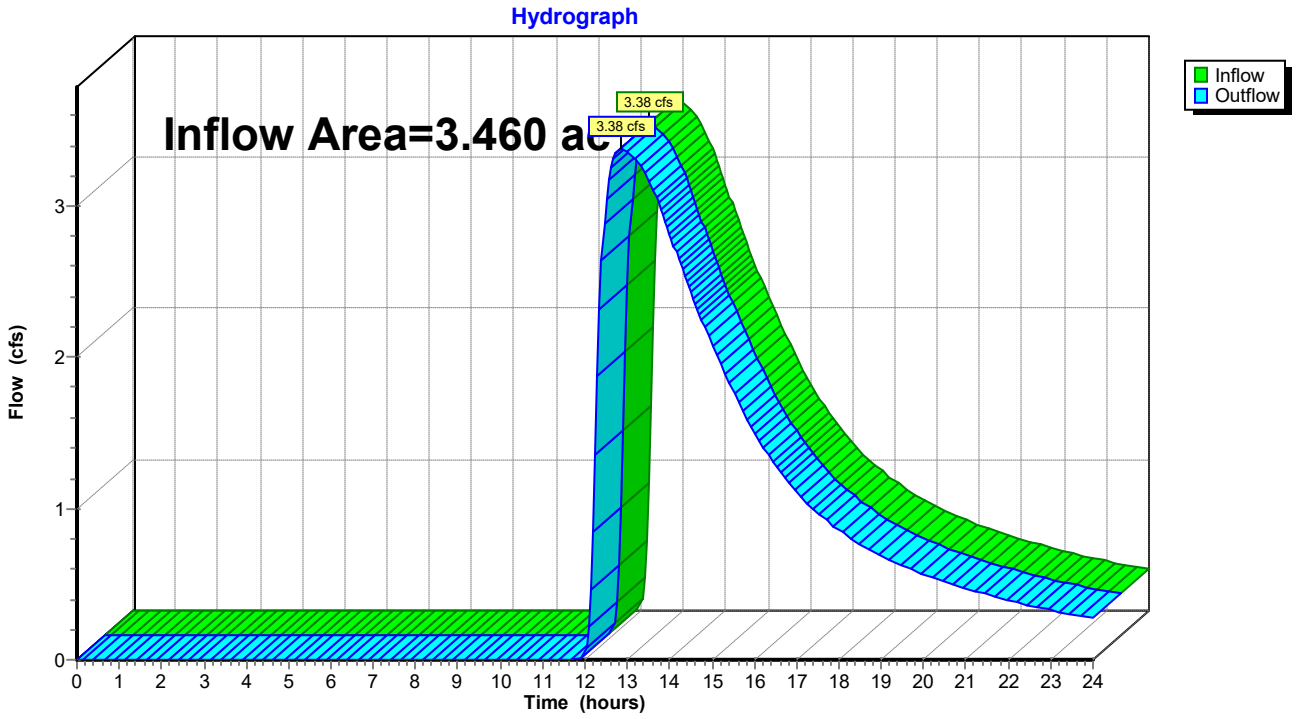
Summary for Reach 1ER: Drainage through Wetland Culvert

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 4.30" for 100 YR event
Inflow = 3.38 cfs @ 12.86 hrs, Volume= 1.239 af
Outflow = 3.38 cfs @ 12.86 hrs, Volume= 1.239 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1ER: Drainage through Wetland Culvert



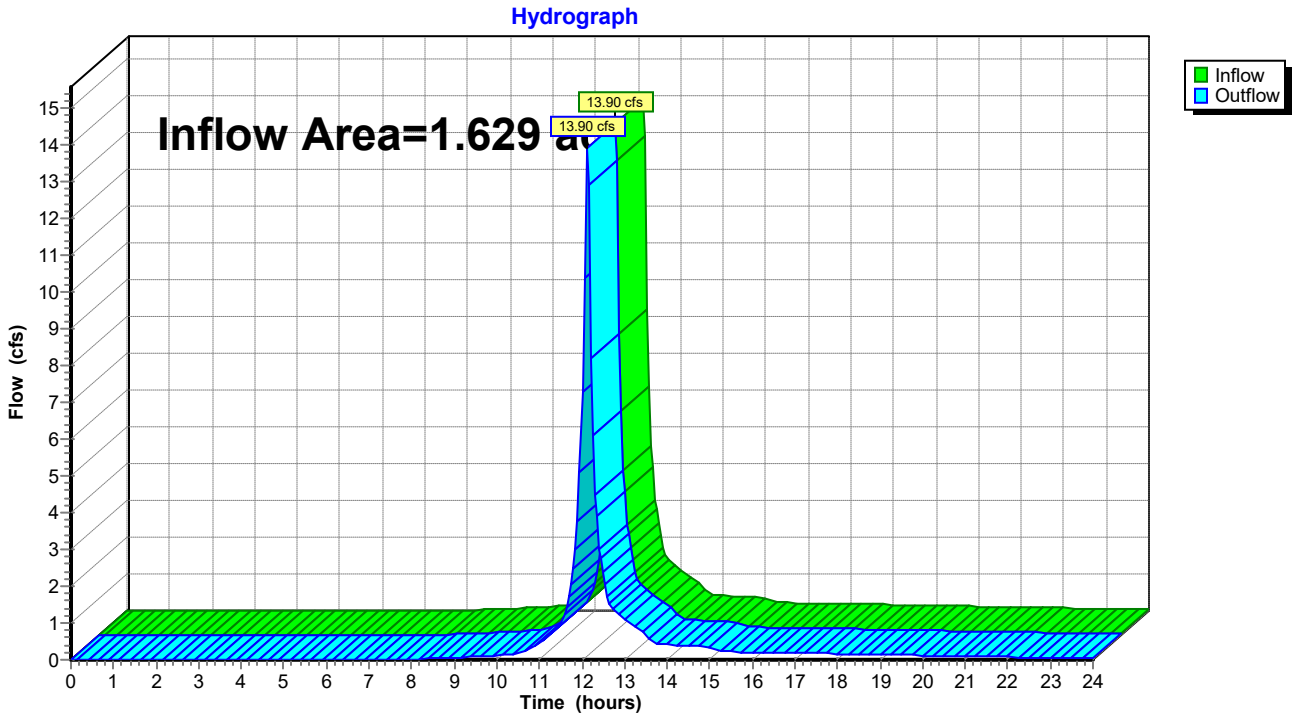
Summary for Reach 1PR: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.629 ac, 13.51% Impervious, Inflow Depth > 5.15" for 100 YR event
Inflow = 13.90 cfs @ 12.12 hrs, Volume= 0.699 af
Outflow = 13.90 cfs @ 12.12 hrs, Volume= 0.699 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1PR: Total Offsite Drainage - South



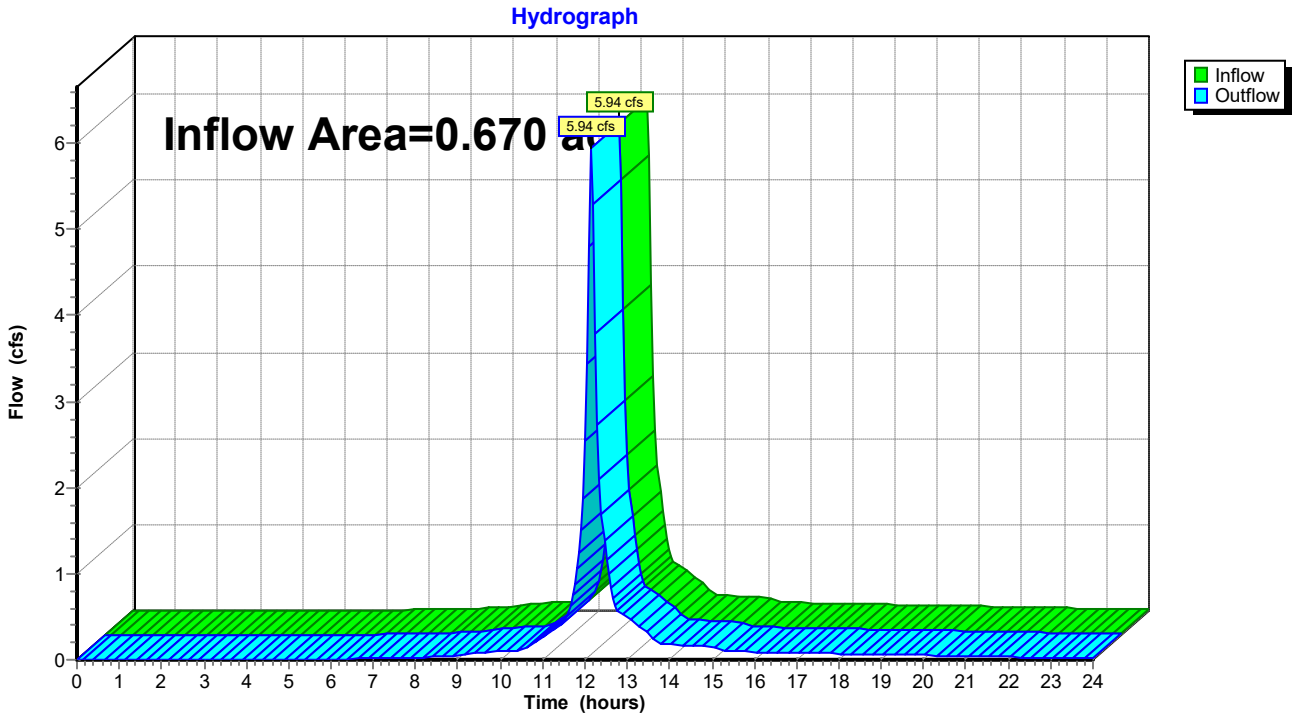
Summary for Reach 2ER: Existing Offisite Drainage North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.670 ac, 22.39% Impervious, Inflow Depth > 5.86" for 100 YR event
Inflow = 5.94 cfs @ 12.16 hrs, Volume= 0.327 af
Outflow = 5.94 cfs @ 12.16 hrs, Volume= 0.327 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2ER: Existing Offisite Drainage North



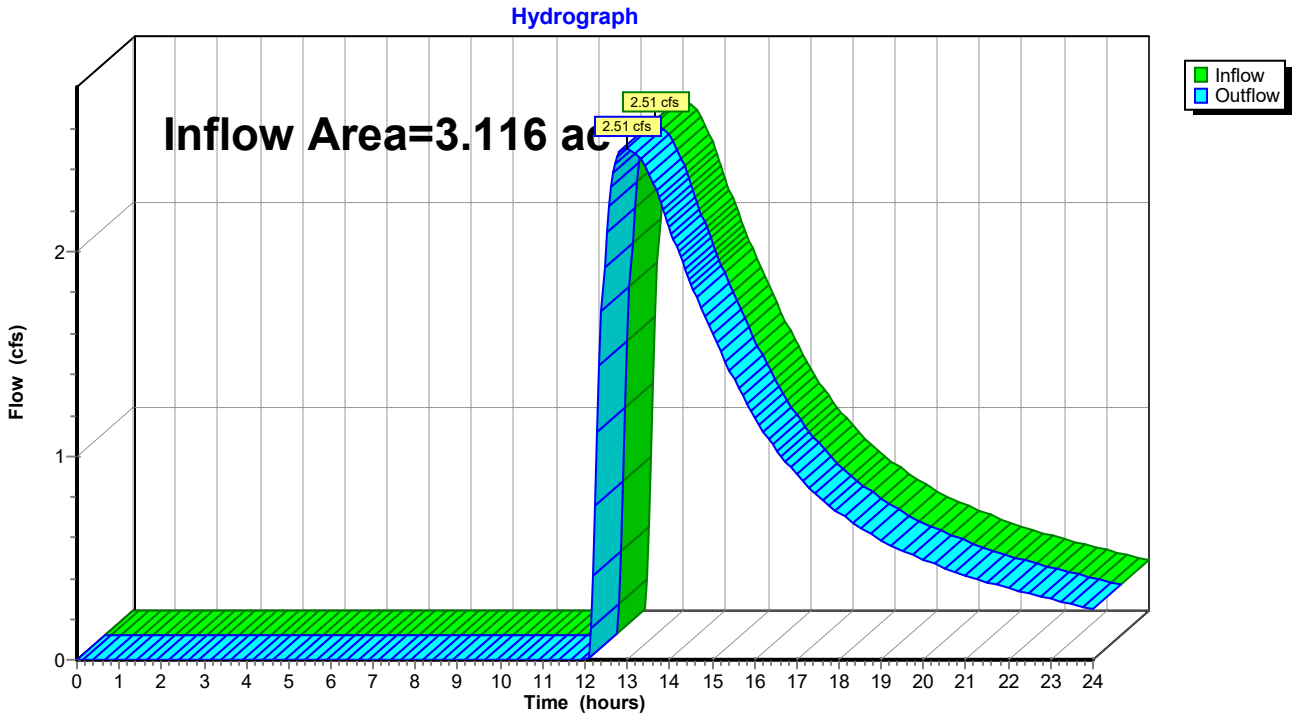
Summary for Reach 2PR: Wetland Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 3.73" for 100 YR event
Inflow = 2.51 cfs @ 12.98 hrs, Volume= 0.967 af
Outflow = 2.51 cfs @ 12.98 hrs, Volume= 0.967 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2PR: Wetland Outlet



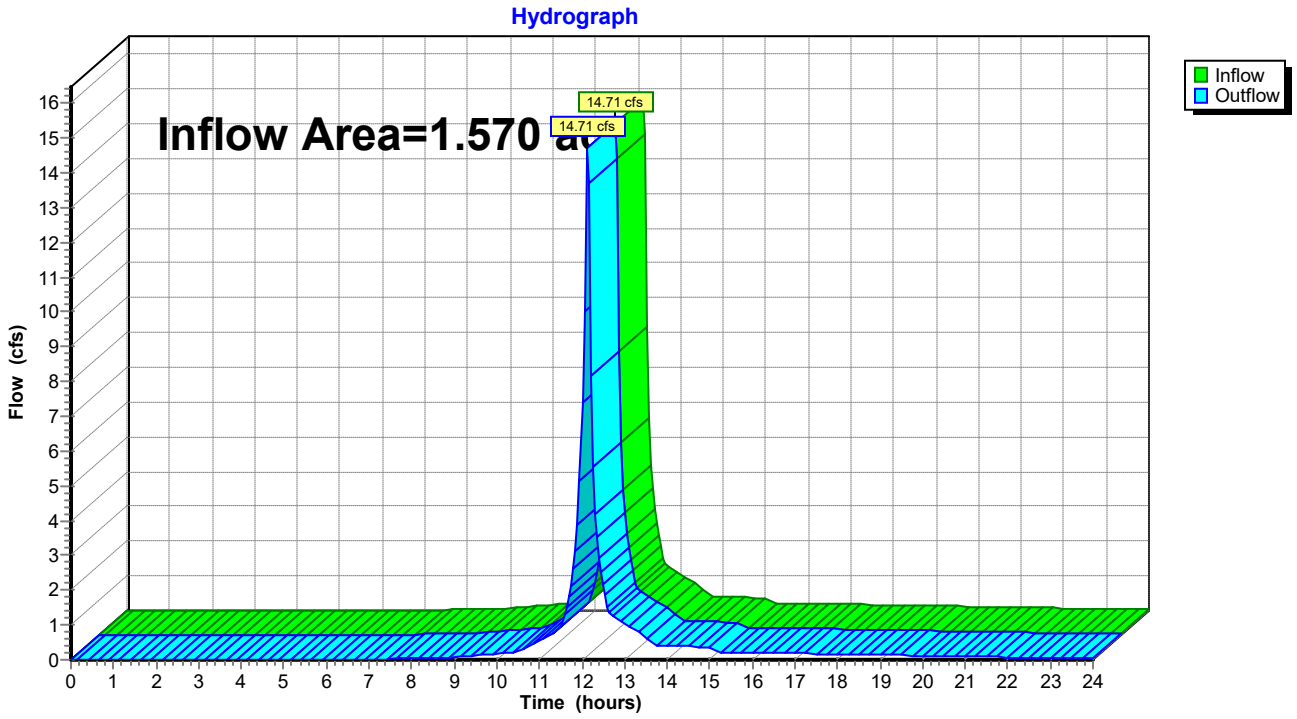
Summary for Reach 3ER: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.570 ac, 8.92% Impervious, Inflow Depth > 5.41" for 100 YR event
Inflow = 14.71 cfs @ 12.12 hrs, Volume= 0.707 af
Outflow = 14.71 cfs @ 12.12 hrs, Volume= 0.707 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3ER: Total Offsite Drainage - South



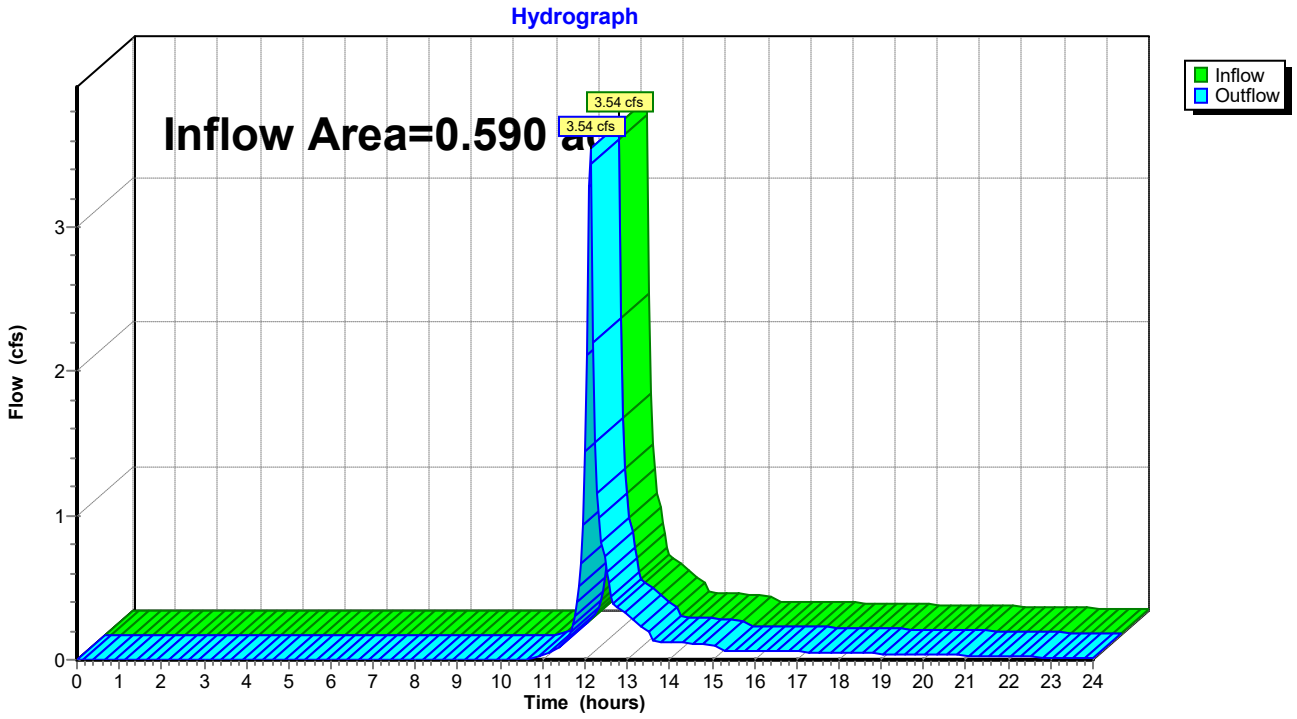
Summary for Reach 3PR: Offsite North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.590 ac, 8.47% Impervious, Inflow Depth > 3.31" for 100 YR event
Inflow = 3.54 cfs @ 12.13 hrs, Volume= 0.163 af
Outflow = 3.54 cfs @ 12.13 hrs, Volume= 0.163 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3PR: Offsite North



Summary for Pond 1EP: Wetland

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 5.86" for 100 YR event
Inflow = 24.30 cfs @ 12.24 hrs, Volume= 1.690 af
Outflow = 3.38 cfs @ 12.86 hrs, Volume= 1.239 af, Atten= 86%, Lag= 37.0 min
Primary = 3.38 cfs @ 12.86 hrs, Volume= 1.239 af
Routed to Reach 1ER : Drainage through Wetland Culvert

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 922.13' @ 12.86 hrs Surf.Area= 0.654 ac Storage= 1.052 af

Plug-Flow detention time= 220.7 min calculated for 1.239 af (73% of inflow)
Center-of-Mass det. time= 155.8 min (939.7 - 783.8)

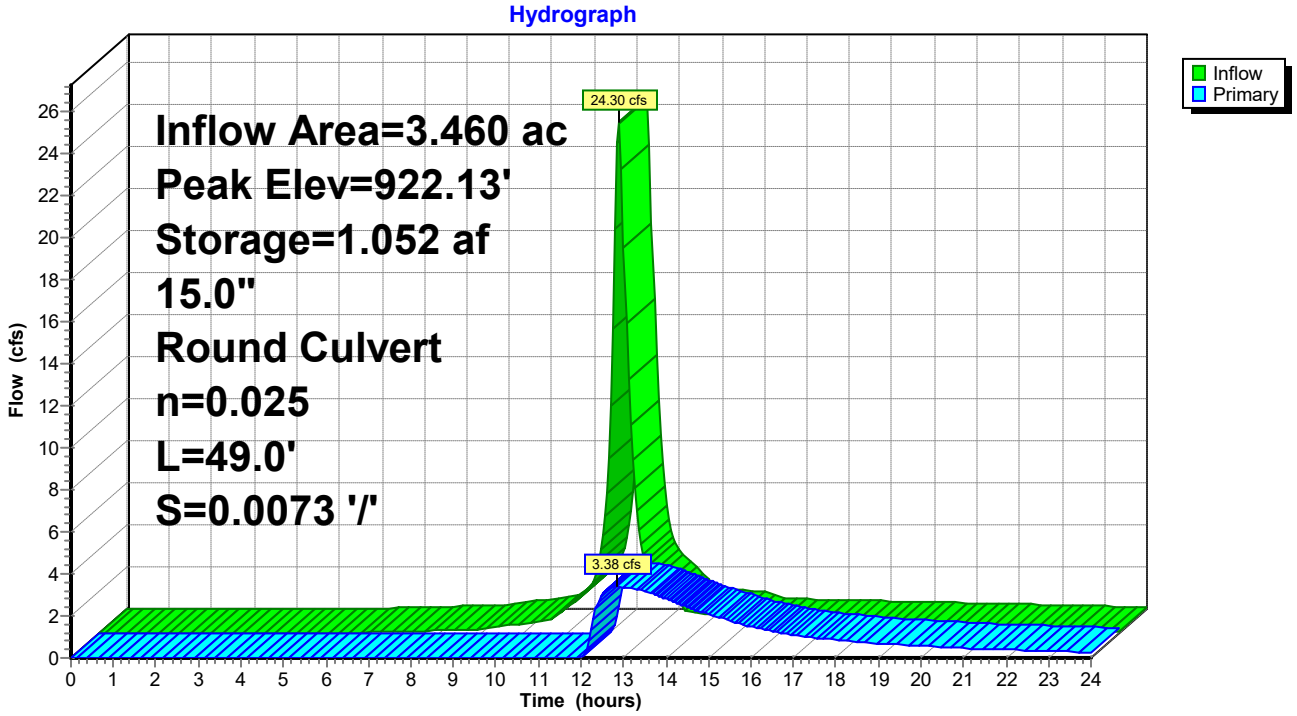
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf

Primary OutFlow Max=3.38 cfs @ 12.86 hrs HW=922.13' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 3.38 cfs @ 3.09 fps)

Pond 1EP: Wetland



Summary for Pond 1PP: Chambers

Inflow Area = 1.145 ac, 91.27% Impervious, Inflow Depth > 6.77" for 100 YR event
Inflow = 10.34 cfs @ 12.17 hrs, Volume= 0.646 af
Outflow = 8.36 cfs @ 12.25 hrs, Volume= 0.587 af, Atten= 19%, Lag= 4.8 min
Primary = 8.36 cfs @ 12.25 hrs, Volume= 0.587 af
Routed to Pond 2PP : Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 924.73' @ 12.25 hrs Surf.Area= 0.072 ac Storage= 0.147 af

Plug-Flow detention time= 79.2 min calculated for 0.586 af (91% of inflow)
Center-of-Mass det. time= 41.3 min (795.0 - 753.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	920.00'	0.000 af	**30.00'W x 104.00'L x 5.00'H Field A** 0.358 af Overall - 0.147 af Embedded = 0.211 af x 0.0% Voids
#2A	920.50'	0.147 af	**CMP Round 48** x 25 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +2.00' x 12.57 sf x 5 rows
		0.147 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	922.10'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=8.34 cfs @ 12.25 hrs HW=924.71' TW=921.30' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 8.34 cfs @ 6.79 fps)

Pond 1PP: Chambers - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +2.00' x 12.57 sf x 5 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

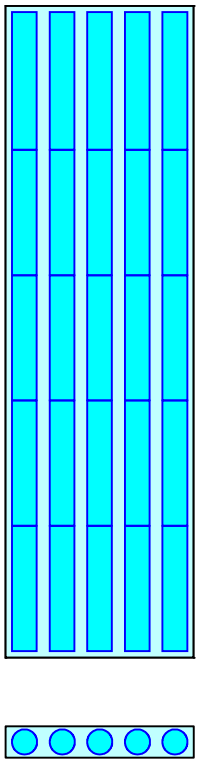
5 Chambers/Row x 20.00' Long +2.00' Row Adjustment = 102.00' Row Length +12.0" End Stone x 2 = 104.00' Base Length
5 Rows x 48.0" Wide + 24.0" Spacing x 4 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

25 Chambers x 251.3 cf +2.00' Row Adjustment x 12.57 sf x 5 Rows = 6,408.8 cf Chamber Storage

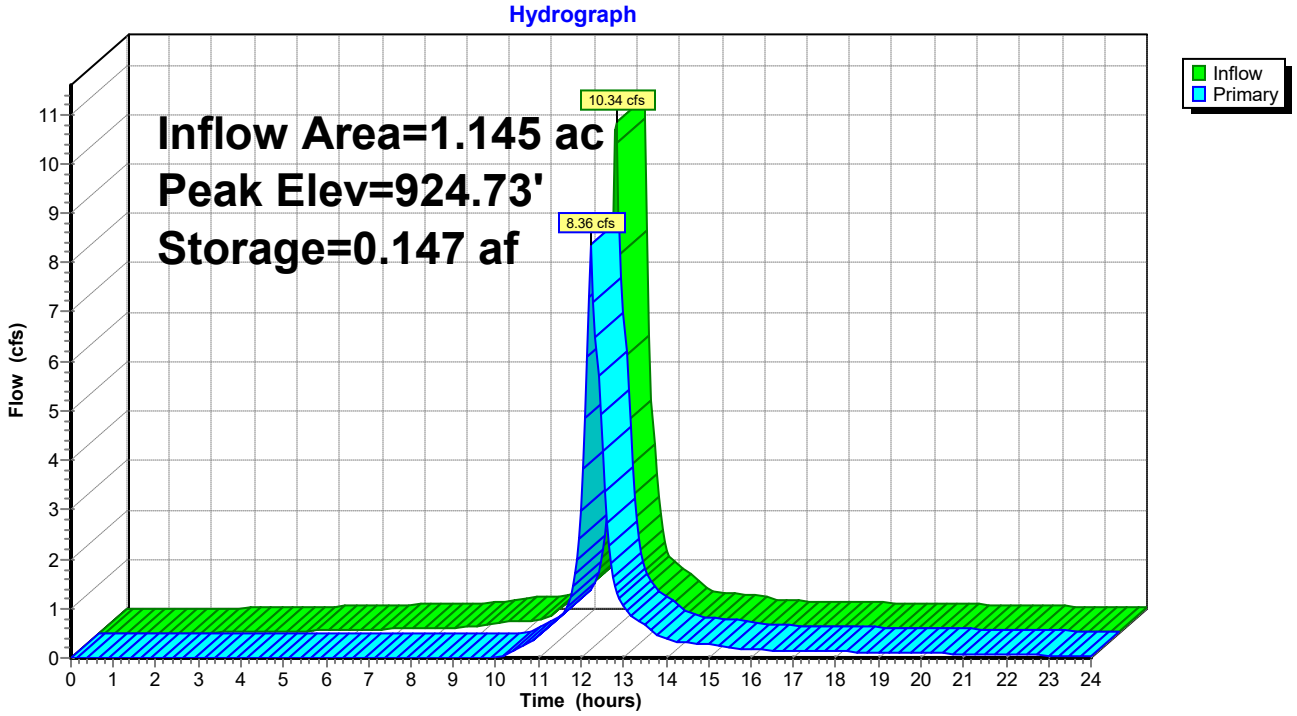
15,600.0 cf Field - 6,408.8 cf Chambers = 9,191.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 6,408.8 cf = 0.147 af
Overall Storage Efficiency = 41.1%
Overall System Size = 104.00' x 30.00' x 5.00'

25 Chambers
577.8 cy Field
340.4 cy Stone



Pond 1PP: Chambers



Summary for Pond 2PP: Wetland

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 5.43" for 100 YR event
Inflow = 19.98 cfs @ 12.21 hrs, Volume= 1.411 af
Outflow = 2.51 cfs @ 12.98 hrs, Volume= 0.967 af, Atten= 87%, Lag= 46.0 min
Primary = 2.51 cfs @ 12.98 hrs, Volume= 0.967 af
Routed to Reach 2PR : Wetland Outlet

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 921.85' @ 12.98 hrs Surf.Area= 0.609 ac Storage= 0.879 af

Plug-Flow detention time= 226.6 min calculated for 0.965 af (68% of inflow)
Center-of-Mass det. time= 158.0 min (952.5 - 794.5)

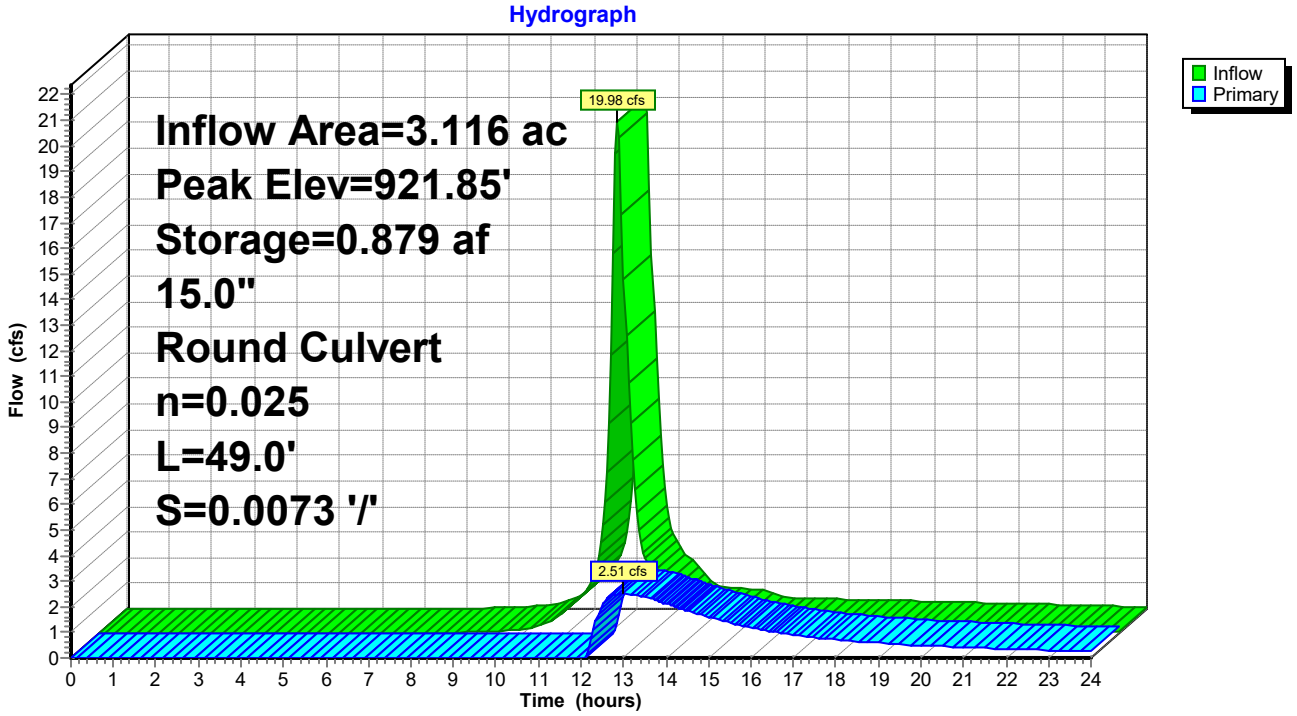
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025, Flow Area= 1.23 sf

Primary OutFlow Max=2.51 cfs @ 12.98 hrs HW=921.85' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 2.51 cfs @ 2.88 fps)

Pond 2PP: Wetland



Summary for Pond 9PP: Infiltration Basin

[93] Warning: Storage range exceeded by 0.13'
[90] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.289 ac, 41.52% Impervious, Inflow Depth > 5.86" for 100 YR event
Inflow = 2.44 cfs @ 12.17 hrs, Volume= 0.141 af
Outflow = 2.53 cfs @ 12.16 hrs, Volume= 0.134 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 6.90 hrs, Volume= 0.004 af
Primary = 2.53 cfs @ 12.16 hrs, Volume= 0.130 af
Routed to Reach 1PR : Total Offsite Drainage - South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 926.13' @ 12.16 hrs Surf.Area= 1,958 sf Storage= 490 cf

Plug-Flow detention time= 39.2 min calculated for 0.134 af (95% of inflow)
Center-of-Mass det. time= 15.2 min (793.8 - 778.6)

Volume	Invert	Avail.Storage	Storage Description
#1	925.75'	490 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

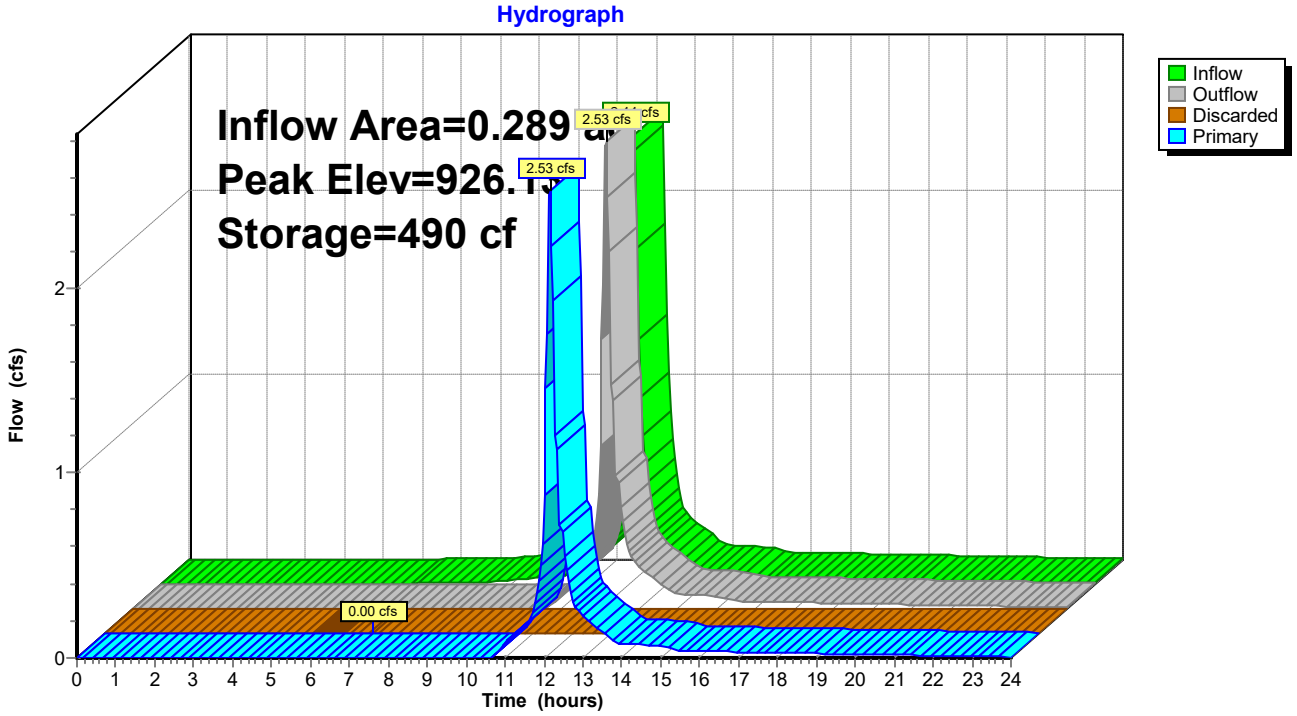
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
925.75	1,958	0	0
926.00	1,958	490	490

Device	Routing	Invert	Outlet Devices
#1	Primary	925.90'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	925.75'	**0.060 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 6.90 hrs HW=925.75' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=2.43 cfs @ 12.16 hrs HW=926.12' TW=0.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Weir Controls 2.43 cfs @ 1.11 fps)

Pond 9PP: Infiltration Basin



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1E: Direct Drainage to 1EP Runoff Area=3.460 ac 4.62% Impervious Runoff Depth>2.89"
Flow Length=268' Slope=0.0500 '/' Tc=15.8 min CN=87 Runoff=12.38 cfs 0.834 af

Subcatchment 1P: Direct Drainage to 1PP Runoff Area=0.415 ac 75.90% Impervious Runoff Depth>3.09"
Tc=10.0 min CN=89 Runoff=1.89 cfs 0.107 af

Subcatchment 2E: Direct Drainage Offsite - Runoff Area=0.670 ac 22.39% Impervious Runoff Depth>2.89"
Flow Length=167' Slope=0.0840 '/' Tc=8.8 min CN=87 Runoff=3.04 cfs 0.162 af

Subcatchment 2P: Direct Drainage to 2PP Runoff Area=1.160 ac 2.59% Impervious Runoff Depth>2.27"
Flow Length=222' Slope=0.0400 '/' Tc=14.8 min CN=80 Runoff=3.42 cfs 0.220 af

Subcatchment 3E: Direct Drainage Offsite - Runoff Area=1.570 ac 8.92% Impervious Runoff Depth>2.53"
Flow Length=340' Slope=0.0530 '/' Tc=5.3 min CN=83 Runoff=7.13 cfs 0.331 af

Subcatchment 3P: Direct Drainage to 3PP Runoff Area=0.730 ac 100.00% Impervious Runoff Depth>4.04"
Tc=10.0 min CN=98 Runoff=3.89 cfs 0.246 af

Subcatchment 4P: Direct Drainage Offsite - Runoff Area=1.230 ac 8.13% Impervious Runoff Depth>2.36"
Flow Length=300' Slope=0.0600 '/' Tc=4.8 min CN=81 Runoff=5.37 cfs 0.242 af

Subcatchment 5P: Direct Drainage Offsite - Runoff Area=0.590 ac 8.47% Impervious Runoff Depth>1.13"
Flow Length=75' Slope=0.0530 '/' Tc=5.6 min CN=64 Runoff=1.17 cfs 0.056 af

Subcatchment 7P: Direct Drainage to Runoff Area=0.811 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=150' Slope=0.0930 '/' Tc=7.7 min CN=79 Runoff=3.01 cfs 0.148 af

Subcatchment 8P: Direct Drainage Off site Runoff Area=0.110 ac 0.00% Impervious Runoff Depth>1.66"
Tc=0.0 min CN=72 Runoff=0.38 cfs 0.015 af

Subcatchment 9P: Runoff Area=0.289 ac 41.52% Impervious Runoff Depth>2.89"
Tc=10.0 min CN=87 Runoff=1.25 cfs 0.070 af

Reach 1ER: Drainage through Wetland Culvert Inflow=0.82 cfs 0.418 af
Outflow=0.82 cfs 0.418 af

Reach 1PR: Total Offsite Drainage - South Inflow=6.56 cfs 0.316 af
Outflow=6.56 cfs 0.316 af

Reach 2ER: Existing Offisite Drainage North Inflow=3.04 cfs 0.162 af
Outflow=3.04 cfs 0.162 af

Reach 2PR: Wetland Outlet Inflow=0.39 cfs 0.256 af
Outflow=0.39 cfs 0.256 af

Reach 3ER: Total Offsite Drainage - South Inflow=7.13 cfs 0.331 af
Outflow=7.13 cfs 0.331 af

Reach 3PR: Offsite North Inflow=1.17 cfs 0.056 af
Outflow=1.17 cfs 0.056 af

Pond 1EP: Wetland Peak Elev=921.33' Storage=0.581 af Inflow=12.38 cfs 0.834 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=0.82 cfs 0.418 af

Pond 1PP: Chambers Peak Elev=923.30' Storage=0.110 af Inflow=5.77 cfs 0.353 af
Outflow=4.52 cfs 0.295 af

Pond 2PP: Wetland Peak Elev=921.15' Storage=0.485 af Inflow=10.12 cfs 0.663 af
15.0" Round Culvert n=0.025 L=49.0' S=0.0073 '/' Outflow=0.39 cfs 0.256 af

Pond 9PP: Infiltration Basin Peak Elev=926.05' Storage=490 cf Inflow=1.25 cfs 0.070 af
Discarded=0.00 cfs 0.004 af Primary=1.36 cfs 0.059 af Outflow=1.36 cfs 0.063 af

Total Runoff Area = 11.035 ac Runoff Volume = 2.429 af Average Runoff Depth = 2.64"
83.73% Pervious = 9.240 ac 16.27% Impervious = 1.795 ac

Summary for Subcatchment 1E: Direct Drainage to 1EP

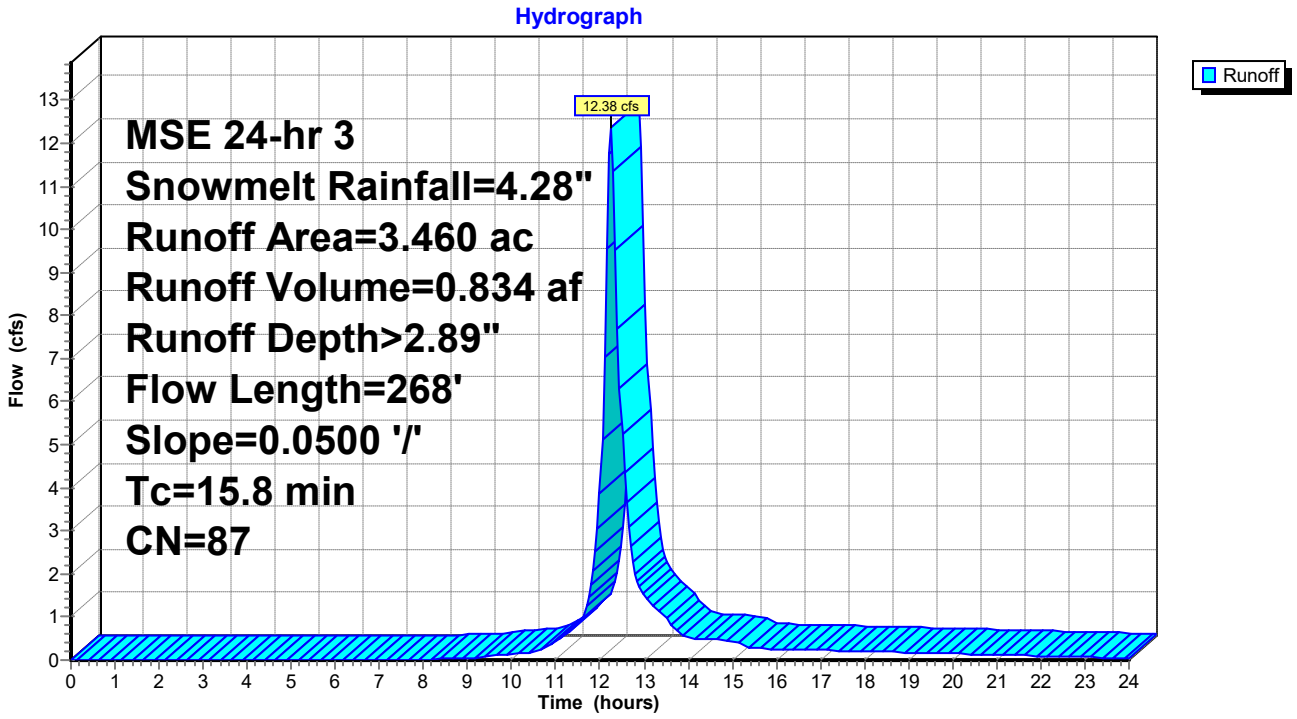
Runoff = 12.38 cfs @ 12.24 hrs, Volume= 0.834 af, Depth> 2.89"
Routed to Pond 1EP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

	Area (ac)	CN	Description
	3.300	86	Woods/grass comb., Poor, HSG D
*	0.160	98	Impervious
	3.460	87	Weighted Average
	3.300		95.38% Pervious Area
	0.160		4.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	268	0.0500	0.28		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 1E: Direct Drainage to 1EP



Summary for Subcatchment 1P: Direct Drainage to 1PP

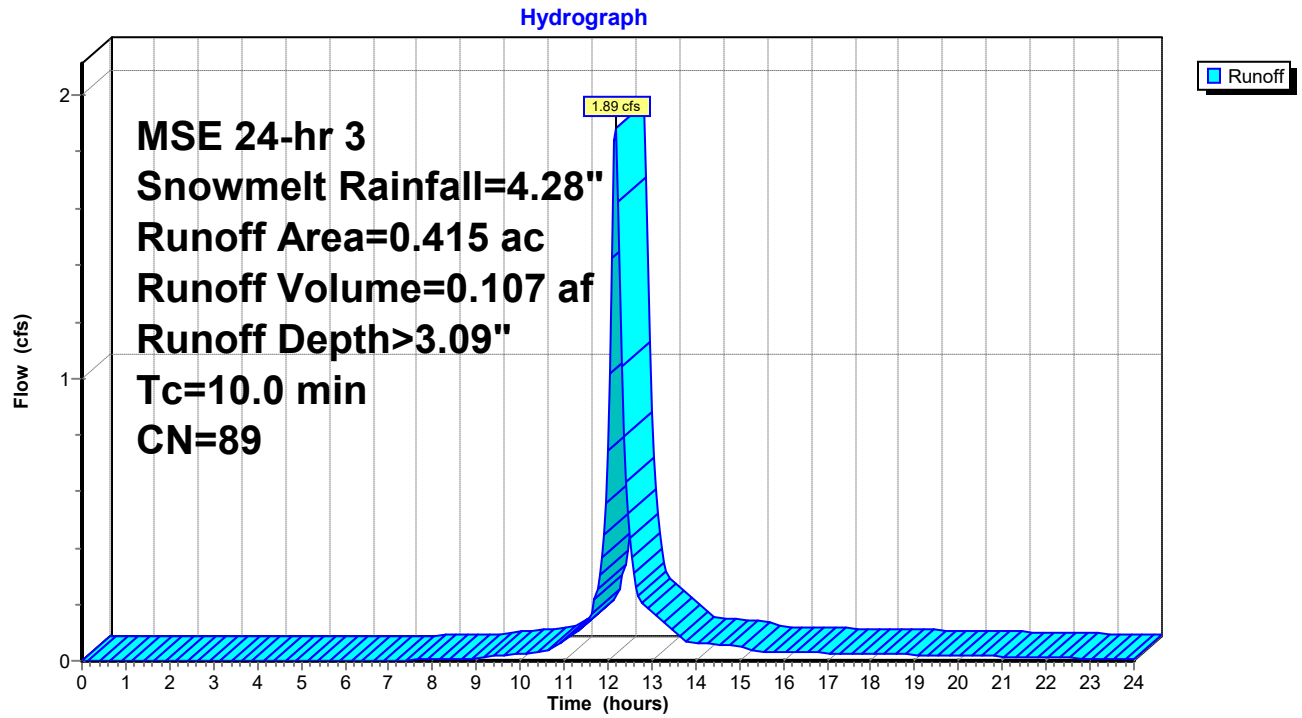
Runoff = 1.89 cfs @ 12.17 hrs, Volume= 0.107 af, Depth> 3.09"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
0.315	98	Paved parking, HSG A
0.100	61	>75% Grass cover, Good, HSG B
0.415	89	Weighted Average
0.100		24.10% Pervious Area
0.315		75.90% Impervious Area

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

Subcatchment 1P: Direct Drainage to 1PP



Summary for Subcatchment 2E: Direct Drainage Offsite - North

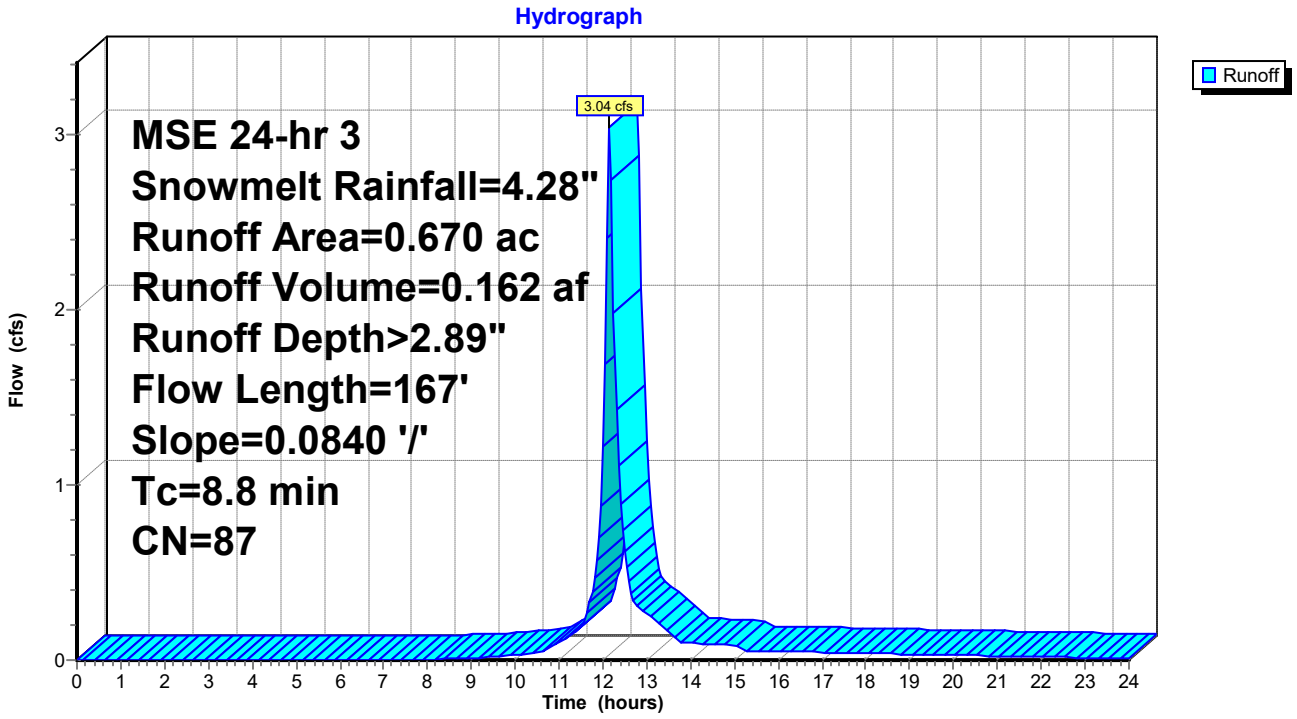
Runoff = 3.04 cfs @ 12.16 hrs, Volume= 0.162 af, Depth> 2.89"
Routed to Reach 2ER : Existing Offisite Drainage North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

	Area (ac)	CN	Description
*	0.150	98	Impervious
	0.520	84	50-75% Grass cover, Fair, HSG D
	0.670	87	Weighted Average
	0.520		77.61% Pervious Area
	0.150		22.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	167	0.0840	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2E: Direct Drainage Offsite - North



Summary for Subcatchment 2P: Direct Drainage to 2PP

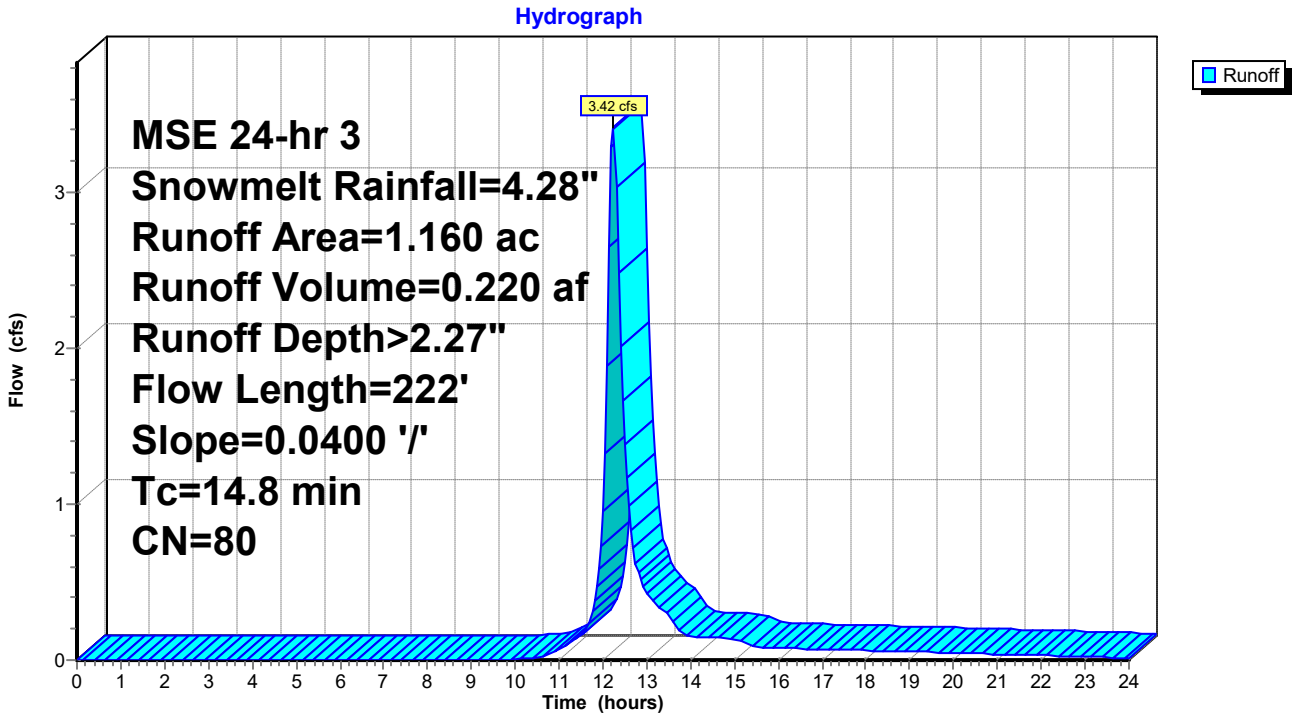
Runoff = 3.42 cfs @ 12.24 hrs, Volume= 0.220 af, Depth> 2.27"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.030	98	Paved parking, HSG A
1.160	80	Weighted Average
1.130		97.41% Pervious Area
0.030		2.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	222	0.0400	0.25		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 2P: Direct Drainage to 2PP



Summary for Subcatchment 3E: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

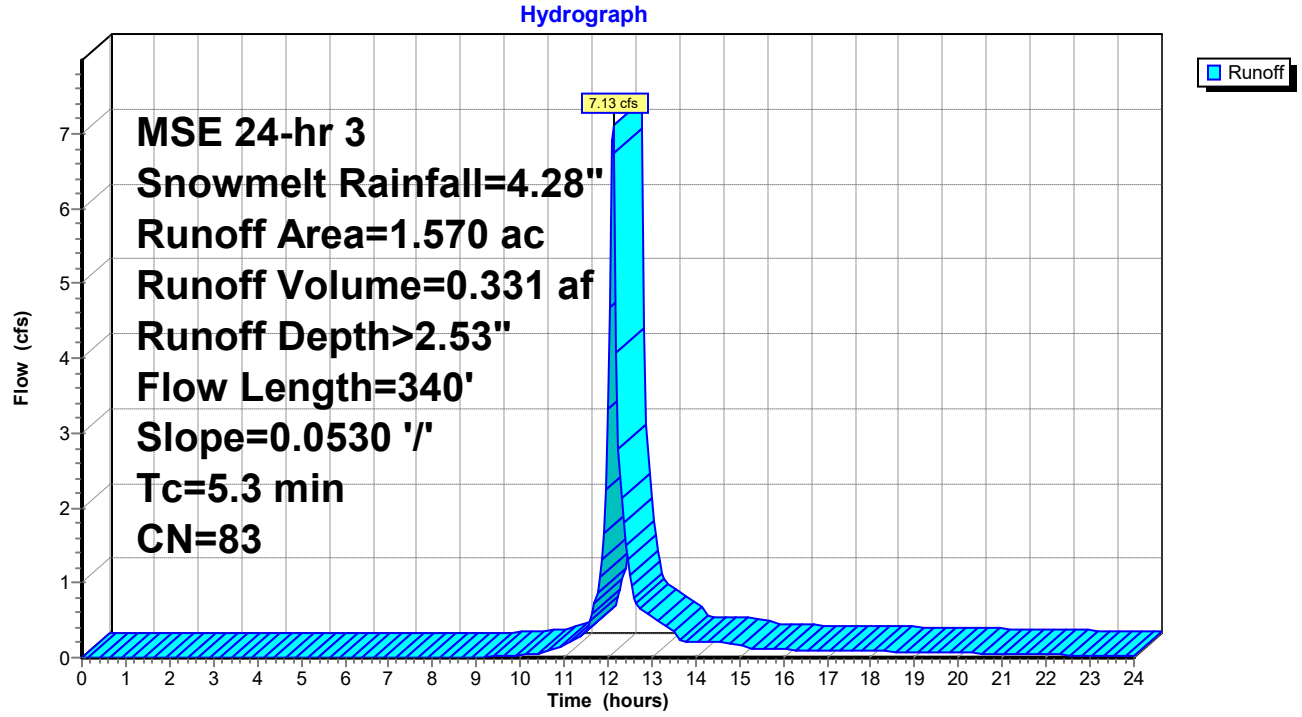
Runoff = 7.13 cfs @ 12.12 hrs, Volume= 0.331 af, Depth> 2.53"
Routed to Reach 3ER : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

	Area (ac)	CN	Description
	1.430	82	Woods/grass comb., Fair, HSG D
*	0.140	98	Impervious
	1.570	83	Weighted Average
	1.430		91.08% Pervious Area
	0.140		8.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.3	340	0.0530	1.07		**Lag/CN Method,**

Subcatchment 3E: Direct Drainage Offsite - South



Summary for Subcatchment 3P: Direct Drainage to 3PP

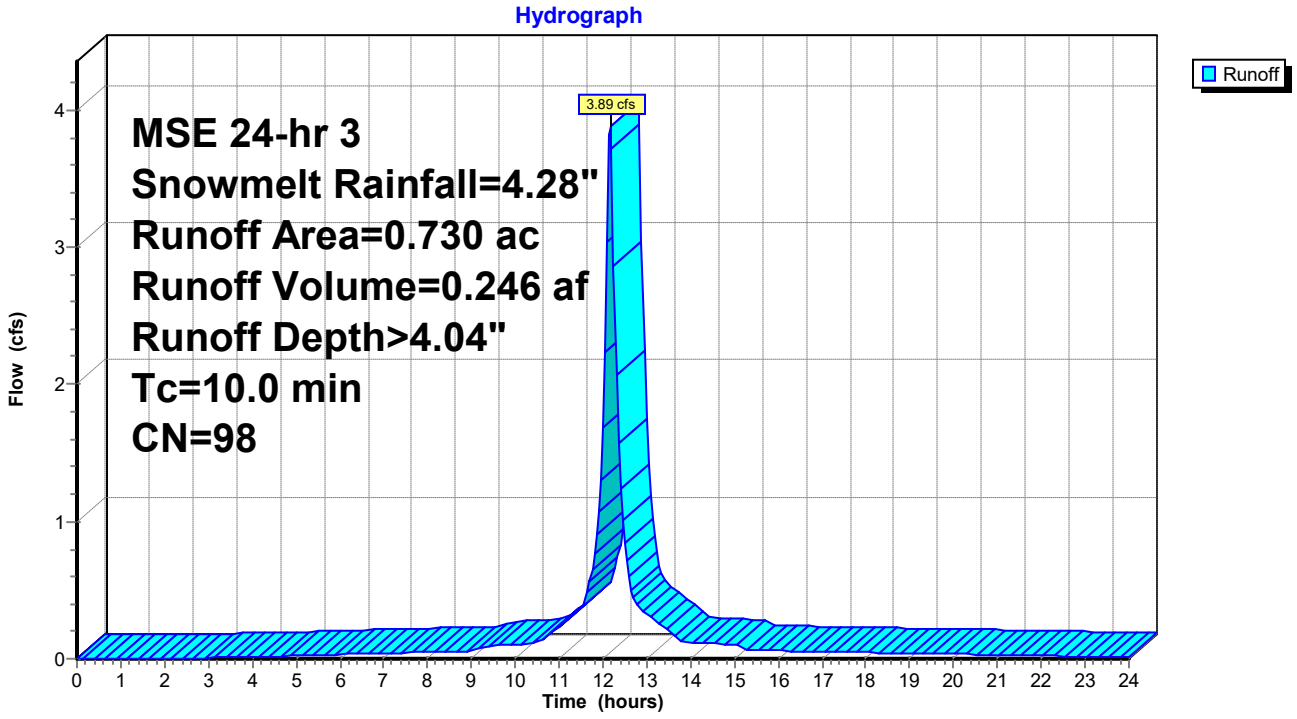
Runoff = 3.89 cfs @ 12.17 hrs, Volume= 0.246 af, Depth> 4.04"
Routed to Pond 1PP : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
0.730	98	Unconnected roofs, HSG A
0.730		100.00% Impervious Area
0.730		100.00% Unconnected

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

Subcatchment 3P: Direct Drainage to 3PP



Summary for Subcatchment 4P: Direct Drainage Offsite - South

[49] Hint: Tc<2dt may require smaller dt

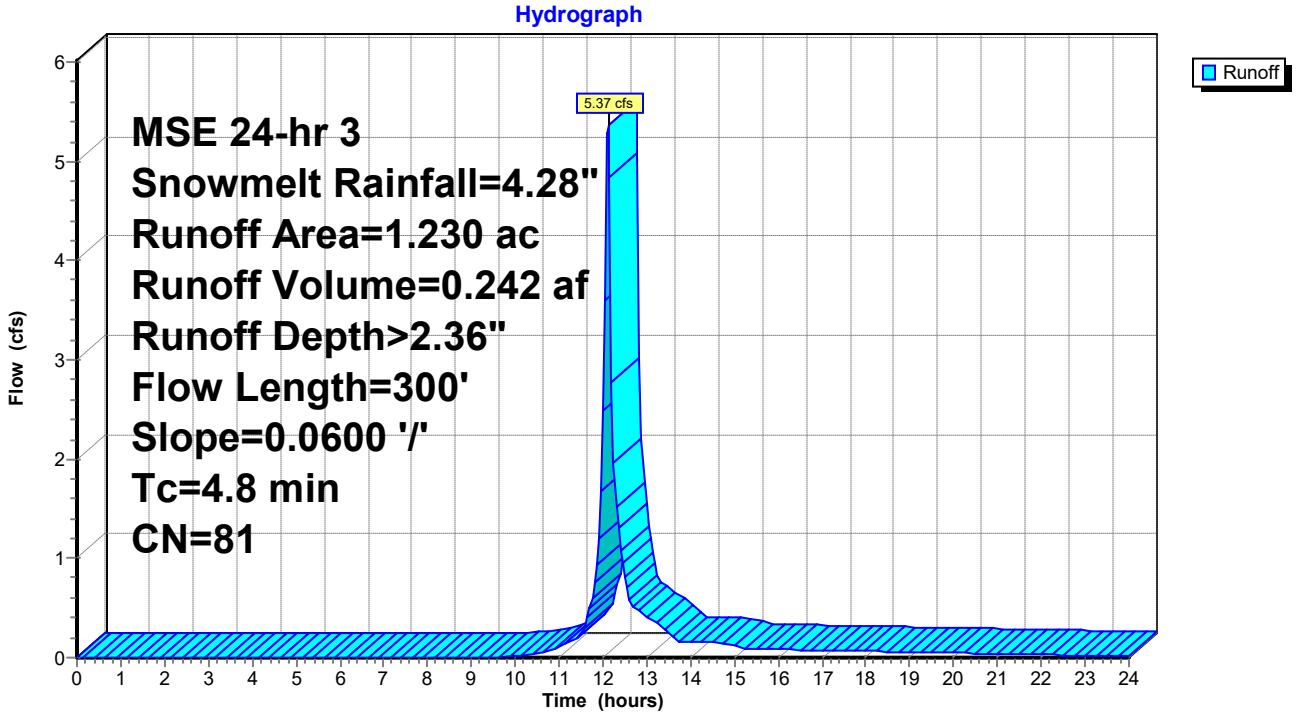
Runoff = 5.37 cfs @ 12.11 hrs, Volume= 0.242 af, Depth> 2.36"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
1.130	80	>75% Grass cover, Good, HSG D
0.100	98	Roofs, HSG A
1.230	81	Weighted Average
1.130		91.87% Pervious Area
0.100		8.13% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	300	0.0600	1.04		**Lag/CN Method,**

Subcatchment 4P: Direct Drainage Offsite - South



Summary for Subcatchment 5P: Direct Drainage Offsite - North

[49] Hint: Tc<2dt may require smaller dt

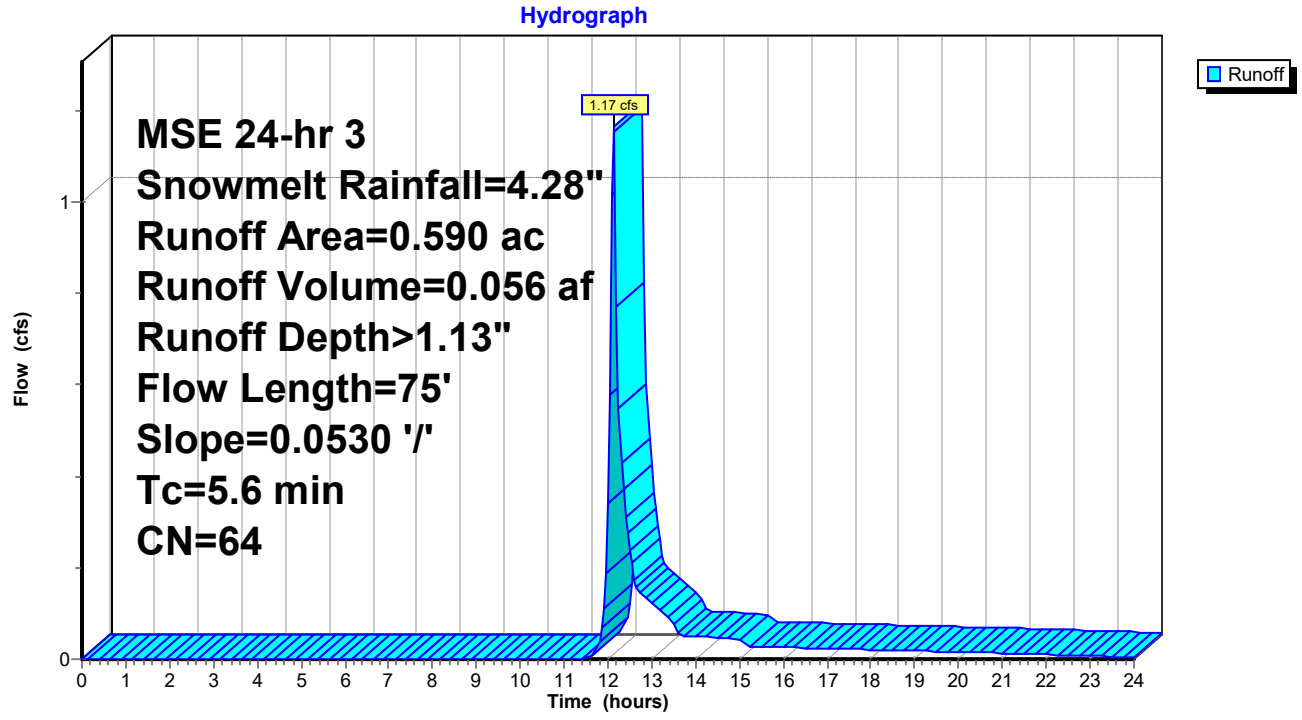
Runoff = 1.17 cfs @ 12.14 hrs, Volume= 0.056 af, Depth> 1.13"
Routed to Reach 3PR : Offsite North

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
0.540	61	>75% Grass cover, Good, HSG B
0.050	98	Paved parking, HSG A
0.590	64	Weighted Average
0.540		91.53% Pervious Area
0.050		8.47% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	75	0.0530	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 5P: Direct Drainage Offsite - North



Summary for Subcatchment 7P: Direct Drainage to Wetland

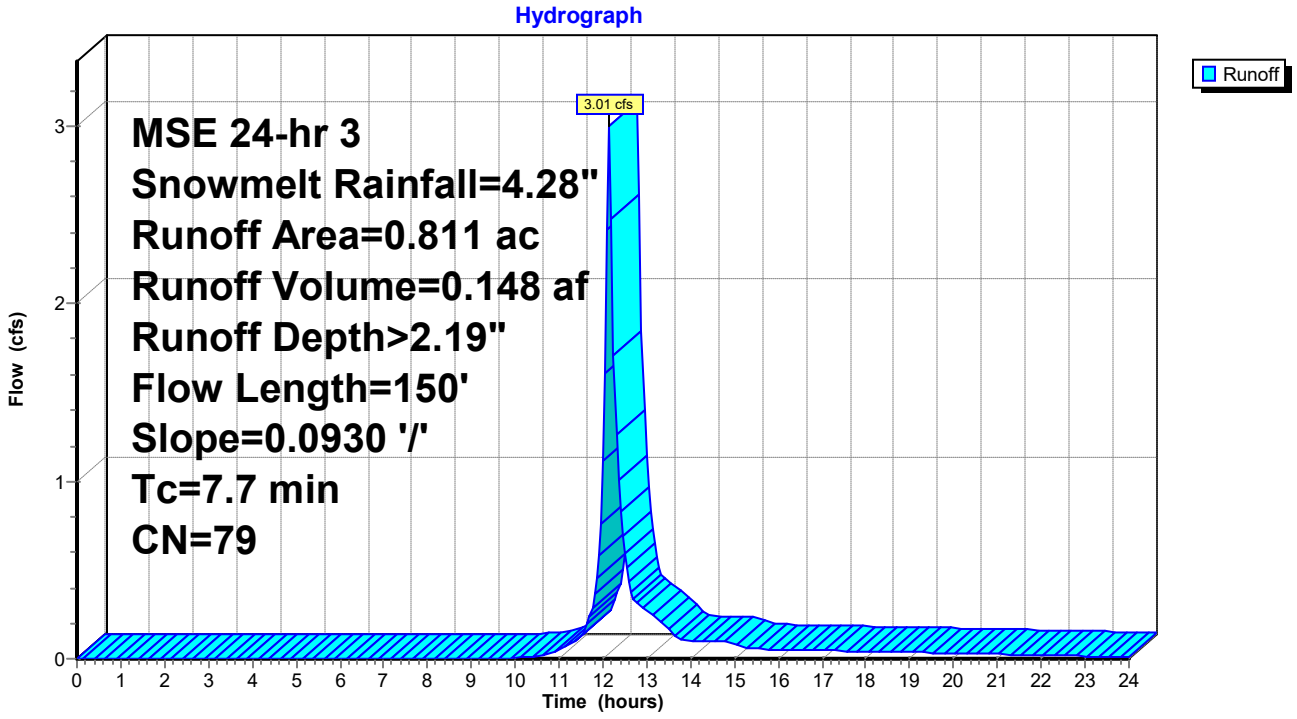
Runoff = 3.01 cfs @ 12.15 hrs, Volume= 0.148 af, Depth> 2.19"
Routed to Pond 2PP : Wetland

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
0.811	79	Woods/grass comb., Good, HSG D
0.811		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	150	0.0930	0.32		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.87"

Subcatchment 7P: Direct Drainage to Wetland



Summary for Subcatchment 8P: Direct Drainage Off site south

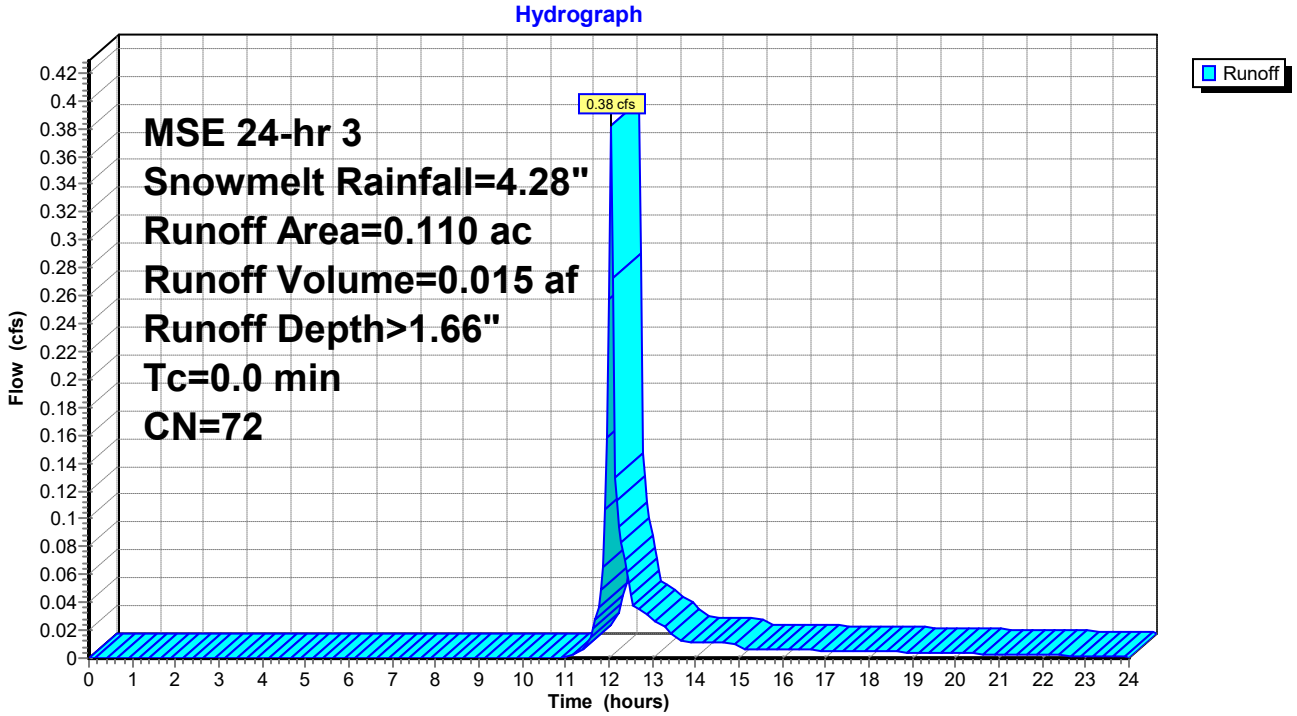
[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 0.38 cfs @ 12.05 hrs, Volume= 0.015 af, Depth> 1.66"
Routed to Reach 1PR : Total Offsite Drainage - South

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

Area (ac)	CN	Description
0.110	72	Woods/grass comb., Good, HSG C
0.110		100.00% Pervious Area

Subcatchment 8P: Direct Drainage Off site south



Summary for Subcatchment 9P:

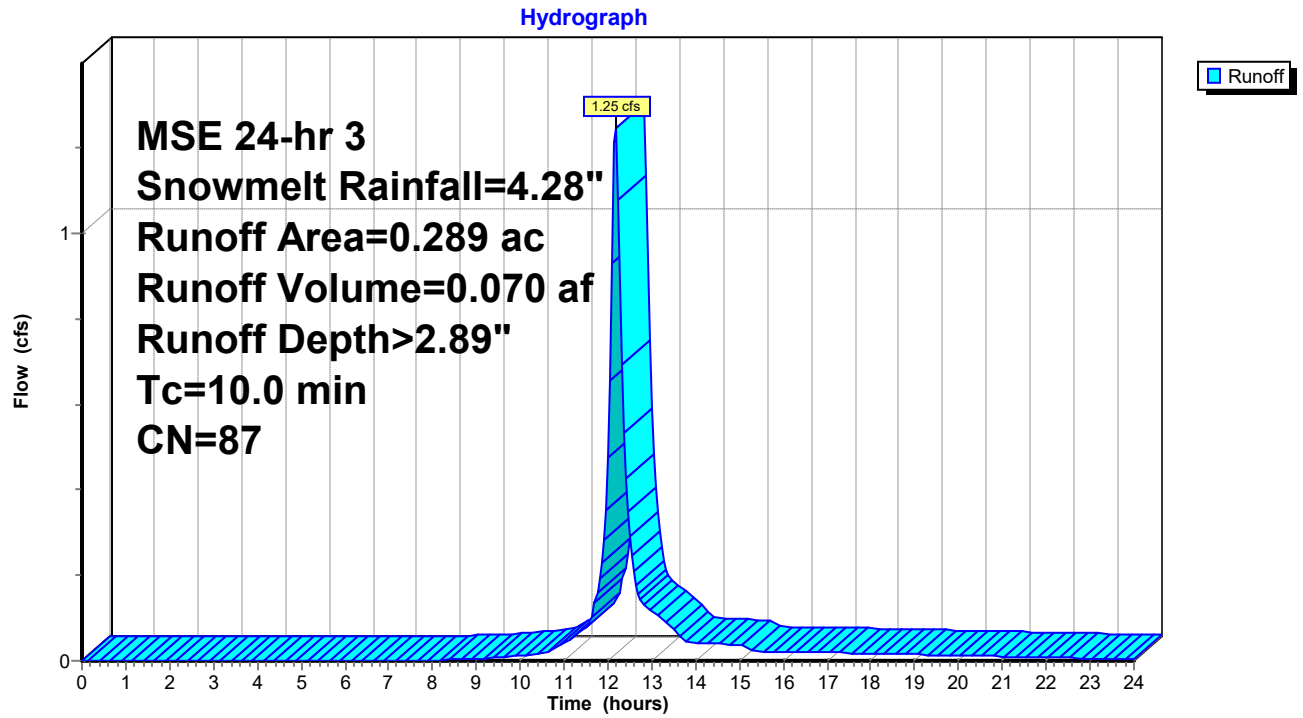
Runoff = 1.25 cfs @ 12.17 hrs, Volume= 0.070 af, Depth> 2.89"
Routed to Pond 9PP : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
MSE 24-hr 3 Snowmelt Rainfall=4.28"

	Area (ac)	CN	Description
*	0.120	98	
	0.169	79	<50% Grass cover, Poor, HSG B
	0.289	87	Weighted Average
	0.169		58.48% Pervious Area
	0.120		41.52% Impervious Area

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

Subcatchment 9P:



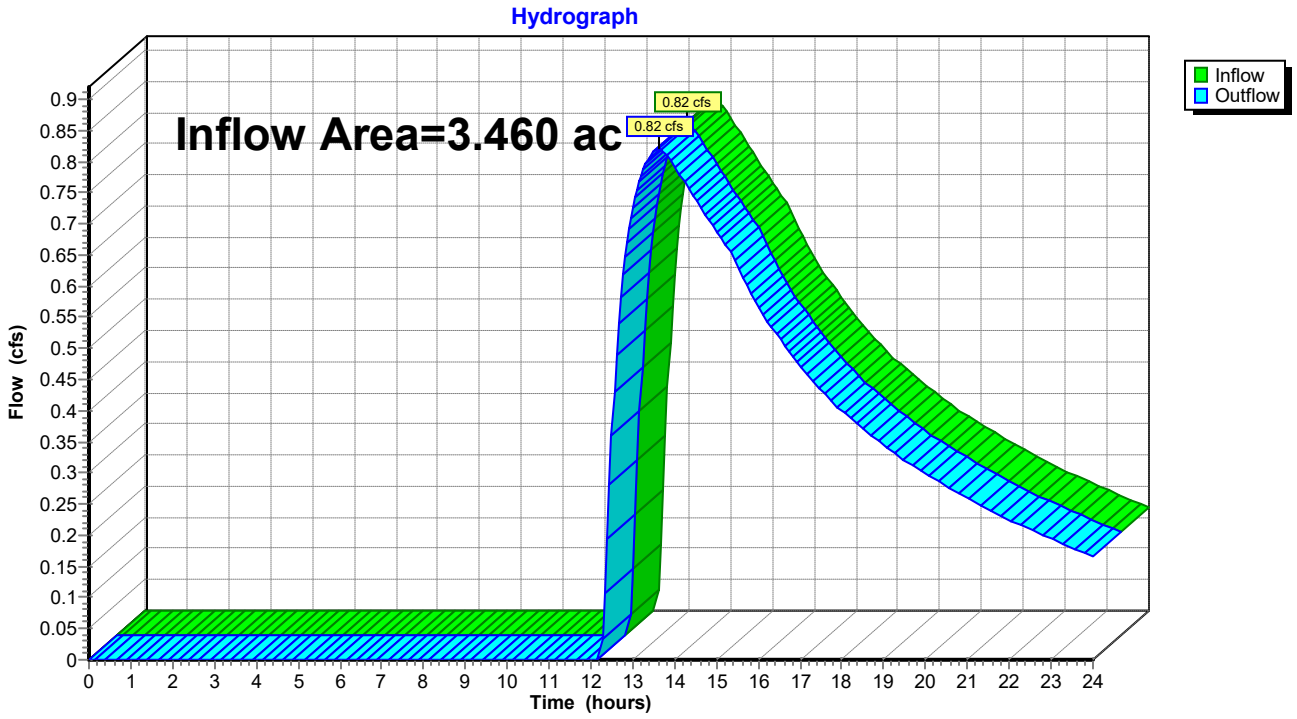
Summary for Reach 1ER: Drainage through Wetland Culvert

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 1.45" for Snowmelt event
Inflow = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af
Outflow = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1ER: Drainage through Wetland Culvert



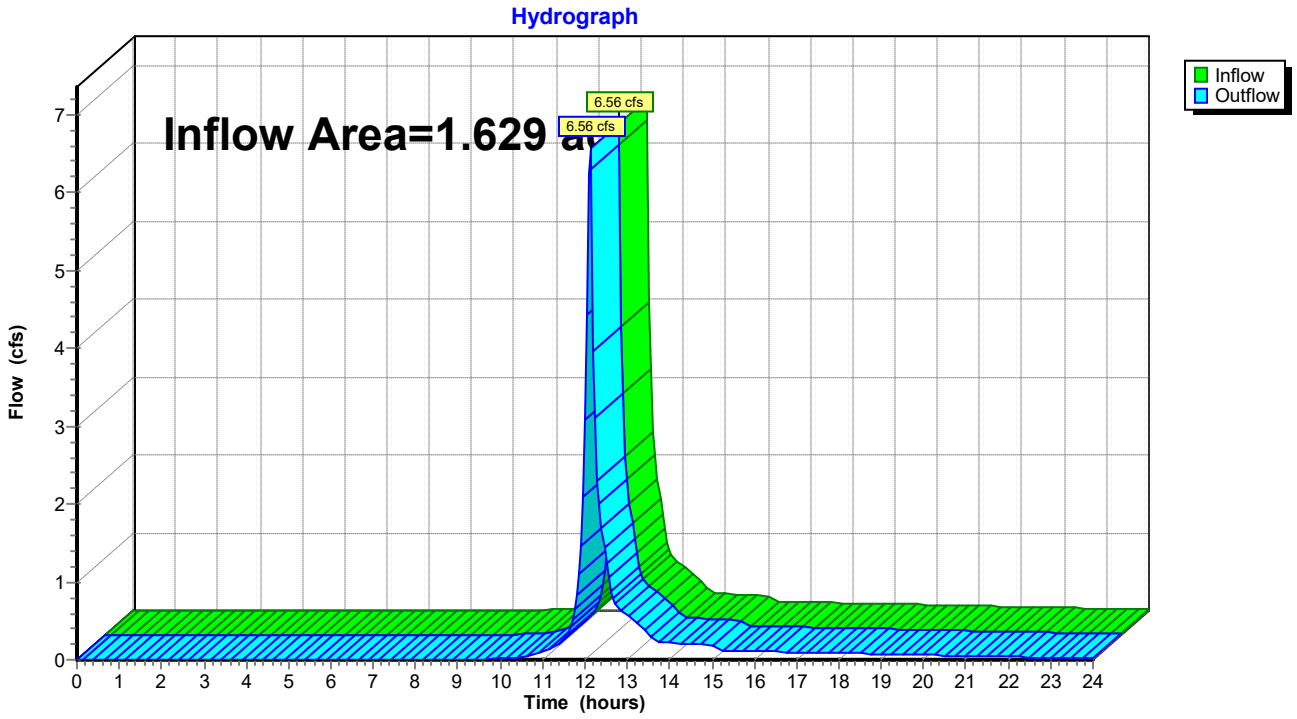
Summary for Reach 1PR: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.629 ac, 13.51% Impervious, Inflow Depth > 2.33" for Snowmelt event
Inflow = 6.56 cfs @ 12.13 hrs, Volume= 0.316 af
Outflow = 6.56 cfs @ 12.13 hrs, Volume= 0.316 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 1PR: Total Offsite Drainage - South



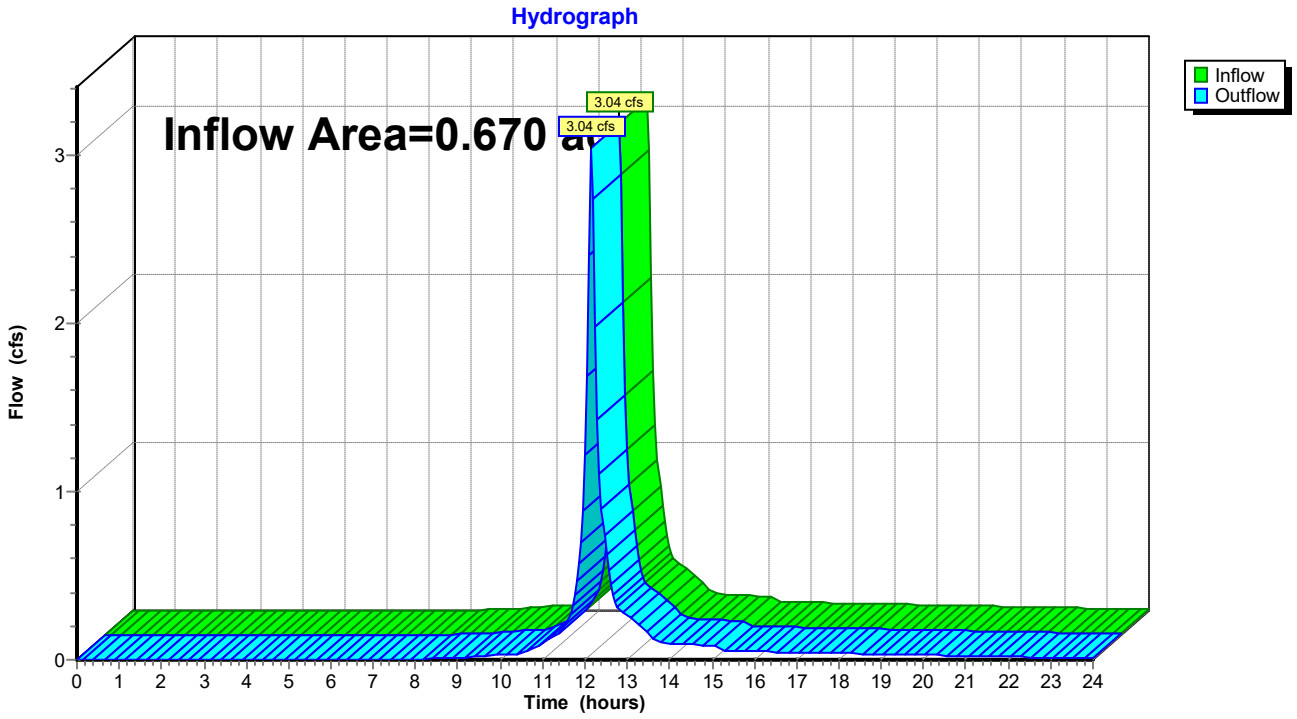
Summary for Reach 2ER: Existing Offisite Drainage North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.670 ac, 22.39% Impervious, Inflow Depth > 2.89" for Snowmelt event
Inflow = 3.04 cfs @ 12.16 hrs, Volume= 0.162 af
Outflow = 3.04 cfs @ 12.16 hrs, Volume= 0.162 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2ER: Existing Offisite Drainage North



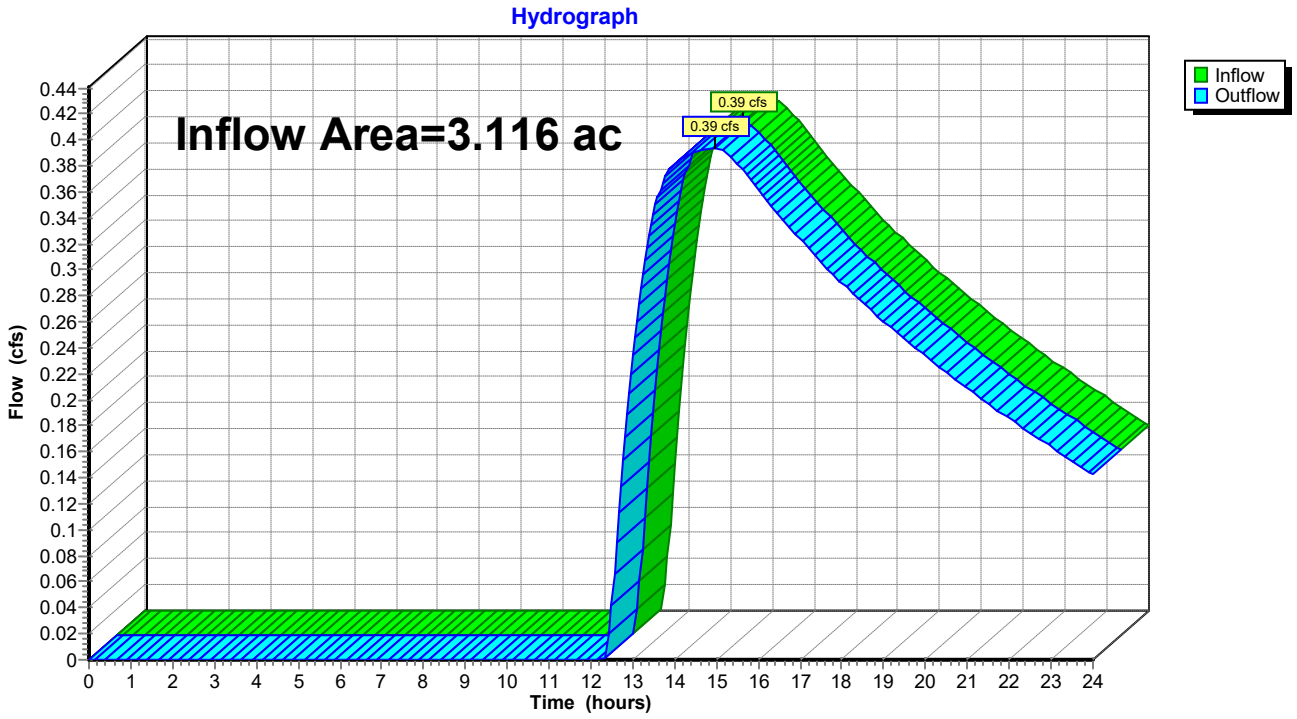
Summary for Reach 2PR: Wetland Outlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 0.99" for Snowmelt event
Inflow = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af
Outflow = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 2PR: Wetland Outlet



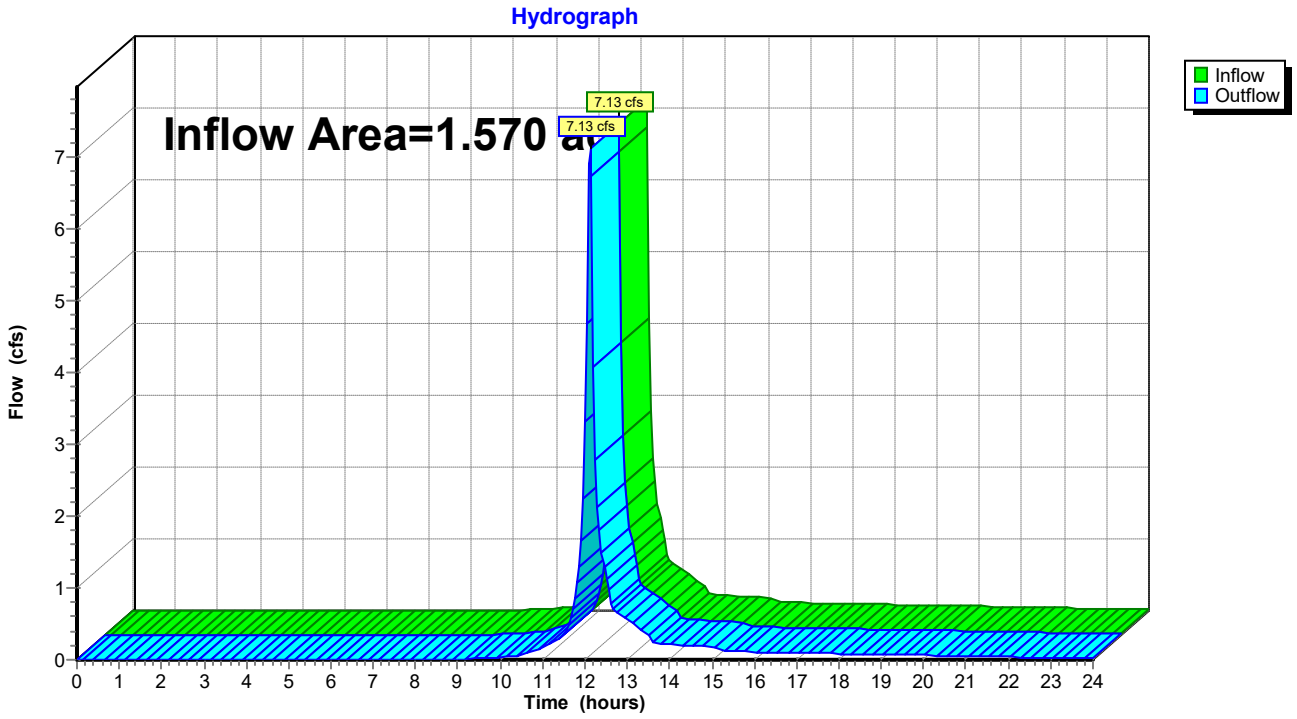
Summary for Reach 3ER: Total Offsite Drainage - South

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.570 ac, 8.92% Impervious, Inflow Depth > 2.53" for Snowmelt event
Inflow = 7.13 cfs @ 12.12 hrs, Volume= 0.331 af
Outflow = 7.13 cfs @ 12.12 hrs, Volume= 0.331 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3ER: Total Offsite Drainage - South



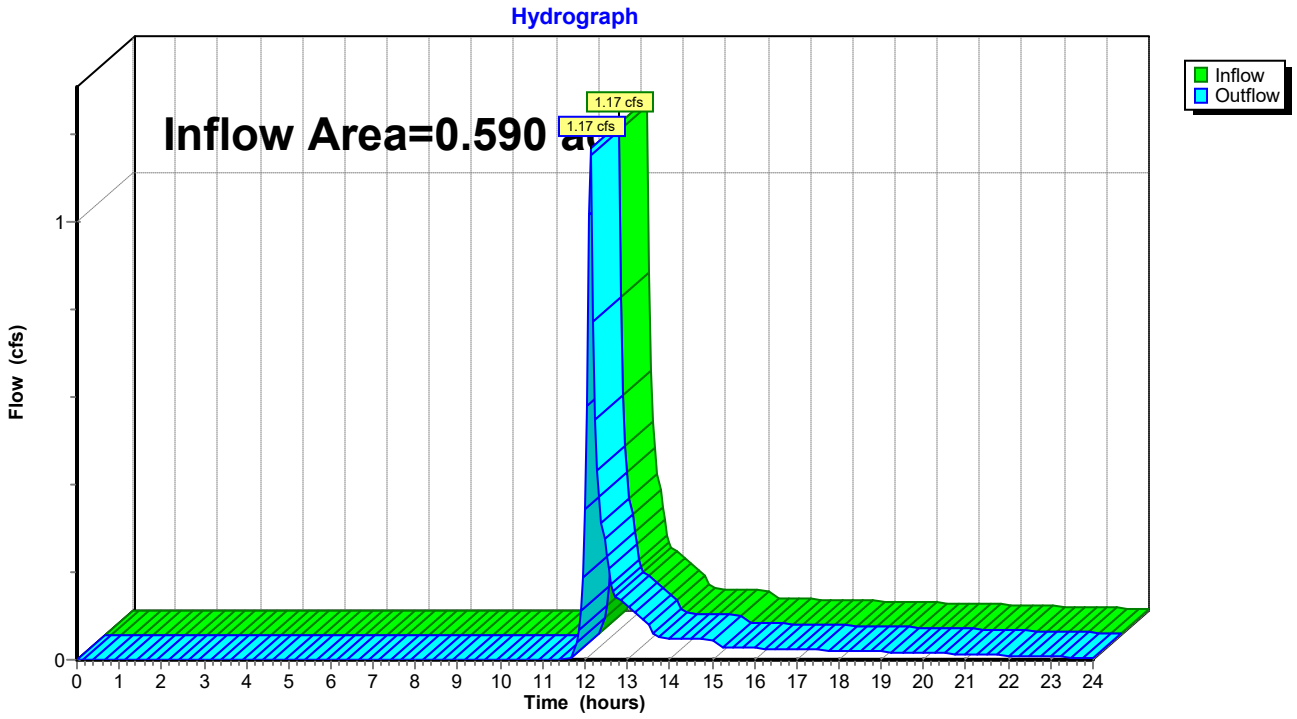
Summary for Reach 3PR: Offsite North

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.590 ac, 8.47% Impervious, Inflow Depth > 1.13" for Snowmelt event
Inflow = 1.17 cfs @ 12.14 hrs, Volume= 0.056 af
Outflow = 1.17 cfs @ 12.14 hrs, Volume= 0.056 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach 3PR: Offsite North



Summary for Pond 1EP: Wetland

Inflow Area = 3.460 ac, 4.62% Impervious, Inflow Depth > 2.89" for Snowmelt event
Inflow = 12.38 cfs @ 12.24 hrs, Volume= 0.834 af
Outflow = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af, Atten= 93%, Lag= 83.1 min
Primary = 0.82 cfs @ 13.63 hrs, Volume= 0.418 af
Routed to Reach 1ER : Drainage through Wetland Culvert

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 921.33' @ 13.63 hrs Surf.Area= 0.533 ac Storage= 0.581 af

Plug-Flow detention time= 286.5 min calculated for 0.417 af (50% of inflow)
Center-of-Mass det. time= 206.4 min (1,004.2 - 797.7)

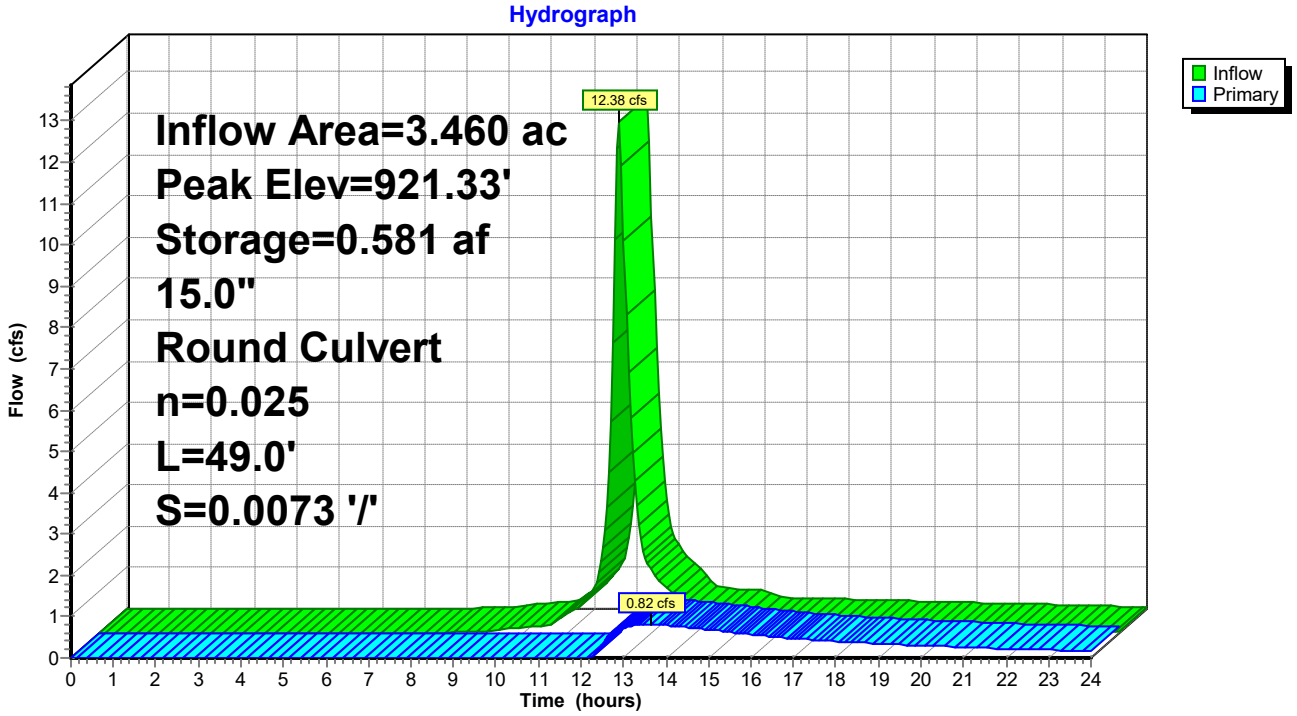
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 1.23 sf

Primary OutFlow Max=0.82 cfs @ 13.63 hrs HW=921.33' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.82 cfs @ 2.11 fps)

Pond 1EP: Wetland



Summary for Pond 1PP: Chambers

Inflow Area = 1.145 ac, 91.27% Impervious, Inflow Depth > 3.70" for Snowmelt event
Inflow = 5.77 cfs @ 12.17 hrs, Volume= 0.353 af
Outflow = 4.52 cfs @ 12.25 hrs, Volume= 0.295 af, Atten= 22%, Lag= 4.5 min
Primary = 4.52 cfs @ 12.25 hrs, Volume= 0.295 af
Routed to Pond 2PP : Wetland

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 923.30' @ 12.25 hrs Surf.Area= 0.072 ac Storage= 0.110 af

Plug-Flow detention time= 104.0 min calculated for 0.294 af (83% of inflow)
Center-of-Mass det. time= 51.0 min (813.0 - 761.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	920.00'	0.000 af	**30.00'W x 104.00'L x 5.00'H Field A** 0.358 af Overall - 0.147 af Embedded = 0.211 af x 0.0% Voids
#2A	920.50'	0.147 af	**CMP Round 48** x 25 Inside #1 Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf Overall Size= 48.0"W x 48.0"H x 20.00'L Row Length Adjustment= +2.00' x 12.57 sf x 5 rows
		0.147 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	922.10'	**15.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.50 cfs @ 12.25 hrs HW=923.30' TW=920.56' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 4.50 cfs @ 3.72 fps)

Pond 1PP: Chambers - Chamber Wizard Field A

Chamber Model = CMP Round 48 (Round Corrugated Metal Pipe)
Effective Size= 48.0"W x 48.0"H => 12.57 sf x 20.00'L = 251.3 cf
Overall Size= 48.0"W x 48.0"H x 20.00'L
Row Length Adjustment= +2.00' x 12.57 sf x 5 rows

48.0" Wide + 24.0" Spacing = 72.0" C-C Row Spacing

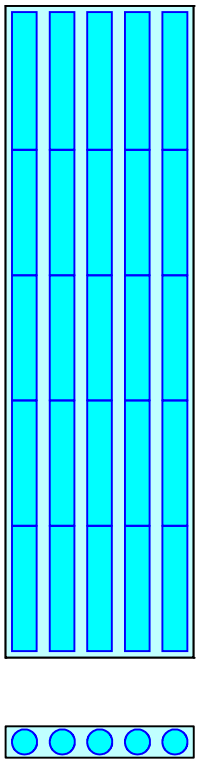
5 Chambers/Row x 20.00' Long +2.00' Row Adjustment = 102.00' Row Length +12.0" End Stone x 2 = 104.00' Base Length
5 Rows x 48.0" Wide + 24.0" Spacing x 4 + 12.0" Side Stone x 2 = 30.00' Base Width
6.0" Stone Base + 48.0" Chamber Height + 6.0" Stone Cover = 5.00' Field Height

25 Chambers x 251.3 cf +2.00' Row Adjustment x 12.57 sf x 5 Rows = 6,408.8 cf Chamber Storage

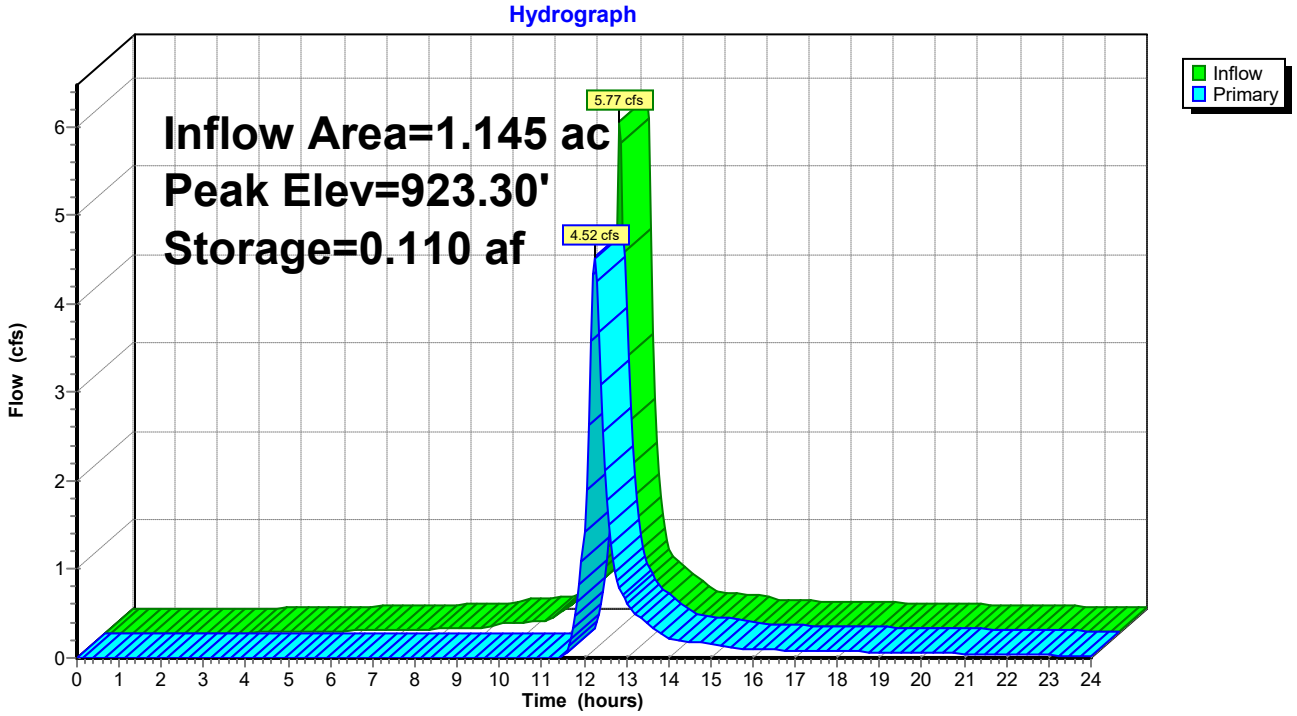
15,600.0 cf Field - 6,408.8 cf Chambers = 9,191.2 cf Stone x 0.0% Voids = 0.0 cf Stone Storage

Chamber Storage = 6,408.8 cf = 0.147 af
Overall Storage Efficiency = 41.1%
Overall System Size = 104.00' x 30.00' x 5.00'

25 Chambers
577.8 cy Field
340.4 cy Stone



Pond 1PP: Chambers



Summary for Pond 2PP: Wetland

Inflow Area = 3.116 ac, 34.50% Impervious, Inflow Depth > 2.55" for Snowmelt event
Inflow = 10.12 cfs @ 12.21 hrs, Volume= 0.663 af
Outflow = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af, Atten= 96%, Lag= 166.6 min
Primary = 0.39 cfs @ 14.98 hrs, Volume= 0.256 af
Routed to Reach 2PR : Wetland Outlet

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 921.15' @ 14.98 hrs Surf.Area= 0.506 ac Storage= 0.485 af

Plug-Flow detention time= 326.9 min calculated for 0.255 af (39% of inflow)
Center-of-Mass det. time= 240.0 min (1,051.4 - 811.4)

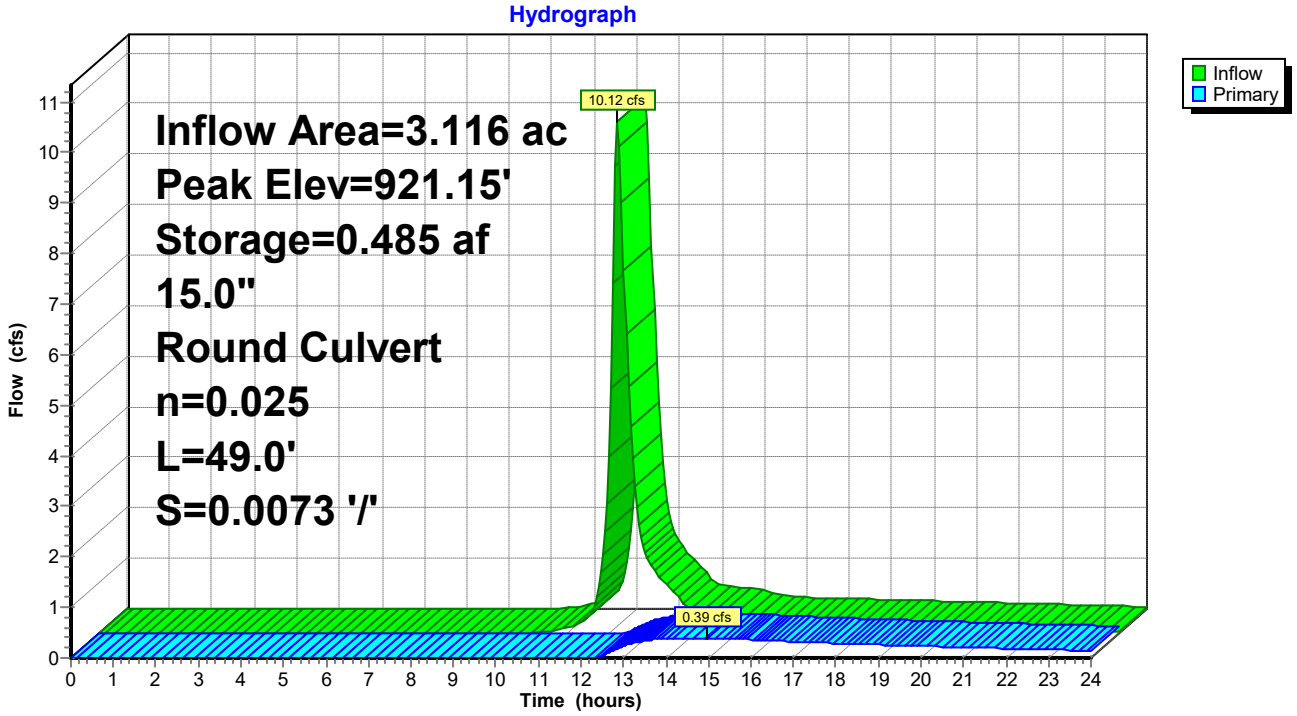
Volume	Invert	Avail.Storage	Storage Description
#1	920.00'	2.600 af	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
920.00	0.340	0.000	0.000
922.00	0.630	0.970	0.970
924.00	1.000	1.630	2.600

Device	Routing	Invert	Outlet Devices
#1	Primary	920.74'	**15.0" Round Culvert** L= 49.0' CMP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 920.74' / 920.38' S= 0.0073 '/' Cc= 0.900 n= 0.025, Flow Area= 1.23 sf

Primary OutFlow Max=0.39 cfs @ 14.98 hrs HW=921.15' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.39 cfs @ 1.70 fps)

Pond 2PP: Wetland



Summary for Pond 9PP: Infiltration Basin

[93] Warning: Storage range exceeded by 0.05'
[90] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow Area = 0.289 ac, 41.52% Impervious, Inflow Depth > 2.89" for Snowmelt event
Inflow = 1.25 cfs @ 12.17 hrs, Volume= 0.070 af
Outflow = 1.36 cfs @ 12.16 hrs, Volume= 0.063 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 9.40 hrs, Volume= 0.004 af
Primary = 1.36 cfs @ 12.16 hrs, Volume= 0.059 af
Routed to Reach 1PR : Total Offsite Drainage - South

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 926.05' @ 12.16 hrs Surf.Area= 1,958 sf Storage= 490 cf

Plug-Flow detention time= 60.1 min calculated for 0.063 af (90% of inflow)
Center-of-Mass det. time= 19.6 min (812.2 - 792.6)

Volume	Invert	Avail.Storage	Storage Description
#1	925.75'	490 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
925.75	1,958	0	0
926.00	1,958	490	490

Device	Routing	Invert	Outlet Devices
#1	Primary	925.90'	**10.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Discarded	925.75'	**0.060 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.00 cfs @ 9.40 hrs HW=925.75' (Free Discharge)
2=Exfiltration (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=1.27 cfs @ 12.16 hrs HW=926.04' TW=0.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Weir Controls 1.27 cfs @ 0.89 fps)

Pond 9PP: Infiltration Basin

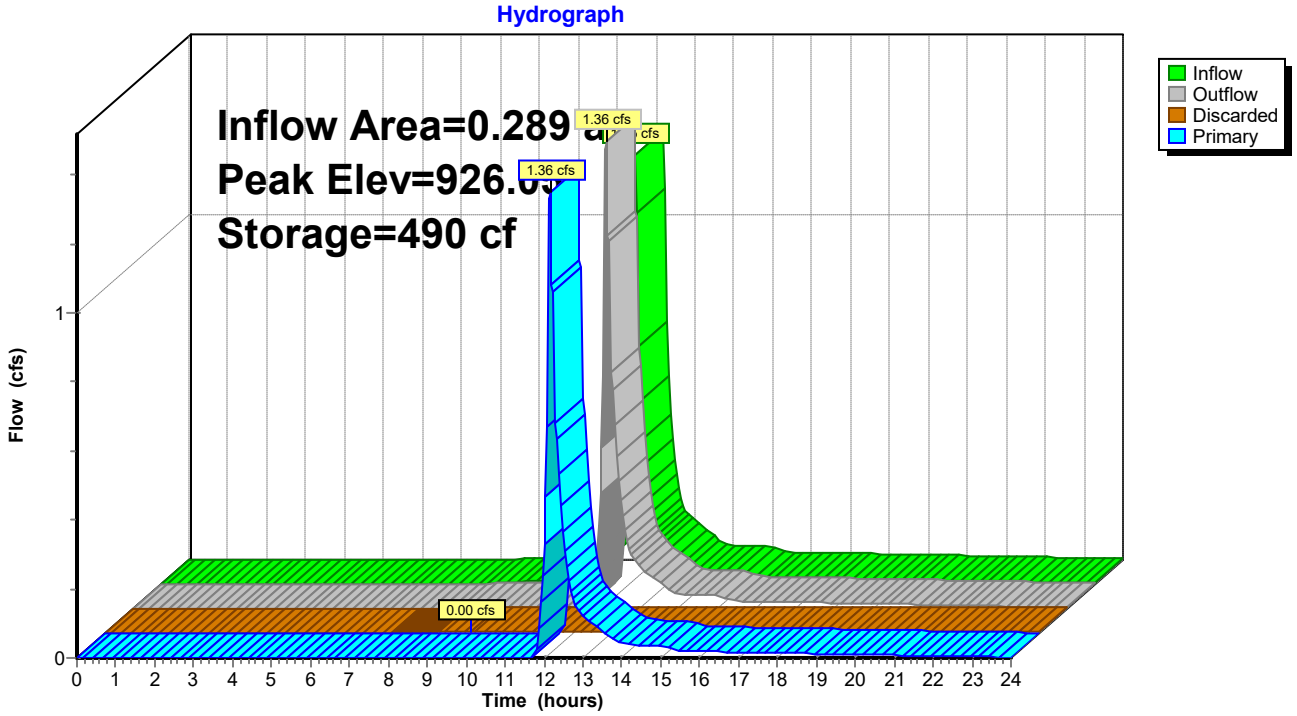


Exhibit 5

MIDS Summary

Project Information

Calculator Version:	Version 4: July 2020
Project Name:	Minnetonka Flats
User Name / Company Name:	Westwood
Date:	1/18/2024
Project Description:	
Construction Permit?:	No

Site Information

Retention Requirement (inches):	0.55
Site's Zip Code:	55345
Annual Rainfall (inches):	30.2
Phosphorus EMC (mg/l):	0.3
TSS EMC (mg/l):	54.5

Total Site Area

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land				0.97	0.97
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed				3.02	3.02
				Impervious Area (acres)	1.35
				Total Area (acres)	5.34

Site Areas Routed to BMPs

Land Cover	A Soils (acres)	B Soils (acres)	C Soils (acres)	D Soils (acres)	Total (acres)
Forest/Open Space - Undisturbed, protected forest/open space or reforested land				0.97	0.97
Managed Turf - disturbed, graded for yards or other turf to be mowed/managed				3.02	3.02
				Impervious Area (acres)	1.35
				Total Area (acres)	5.34

Summary Information

Performance Goal Requirement

Performance goal volume retention requirement:	2695	ft3
Volume removed by BMPs towards performance goal:	2695	ft^3
Percent volume removed towards performance goal	**100**	**%**

Annual Volume and Pollutant Load Reductions

Post development annual runoff volume	4.7248	acre-ft
Annual runoff volume removed by BMPs:	2.1346	acre-ft
Percent annual runoff volume removed:	**45**	**%**
Post development annual particulate P load:	2.1205	lbs
Annual particulate P removed by BMPs:	0.958	lbs
Post development annual dissolved P load:	1.735	lbs
Annual dissolved P removed by BMPs:	0.784	lbs
Total P removed by BMPs	1.742	lbs
Percent annual total phosphorus removed:	**45**	**%**
Post development annual TSS load:	700.4	lbs
Annual TSS removed by BMPs:	316.4	lbs
Percent annual TSS removed:	**45**	**%**

BMP Summary

Performance Goal Summary

BMP Name	BMP Volume Capacity (ft3)	Volume Recieved (ft3)	Volume Retained (ft3)	Volume Outflow (ft3)	Percent Retained (%)
INFILTRATION BASIN 9PP	490	240	240	0	100
Harvest and re-use/Cistern(1PP)	4104	2456	2456	0	100
OFFSITE SOUTH	0	0	0	0	0
EXISTING WETLAND	0	0	0	0	0

Annual Volume Summary

BMP Name	Volume From Direct Watershed (acre-ft)	Volume From Upstream BMPs (acre-ft)	Volume Retained (acre-ft)	Volume outflow (acre-ft)	Percent Retained (%)
INFILTRATION BASIN 9PP	0.3545	0	0.3004	0.0541	85
Harvest and re-use/Cistern(1PP)	3.8278	0	1.8342	1.9936	48
OFFSITE SOUTH	0.5425	0.0541	0	0.5966	0
EXISTING WETLAND	0	1.9936	0	1.9936	0

Particulate Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
INFILTRATION BASIN 9PP	0.1591	0	0.1348	0.0243	85
Harvest and re-use/Cistern(1PP)	1.7179	0	0.8232	0.8947	48
OFFSITE SOUTH	0.2435	0.0243	0	0.2678	0
EXISTING WETLAND	0	0.8947	0	0.8947	0

Dissolved Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
INFILTRATION BASIN 9PP	0.1302	0	0.1103	0.0199	85
Harvest and re-use/Cistern(1PP)	1.4056	0	0.6735	0.7321	48
OFFSITE SOUTH	0.1992	0.0199	0	0.2191	0
EXISTING WETLAND	0	0.7321	0	0.7321	0

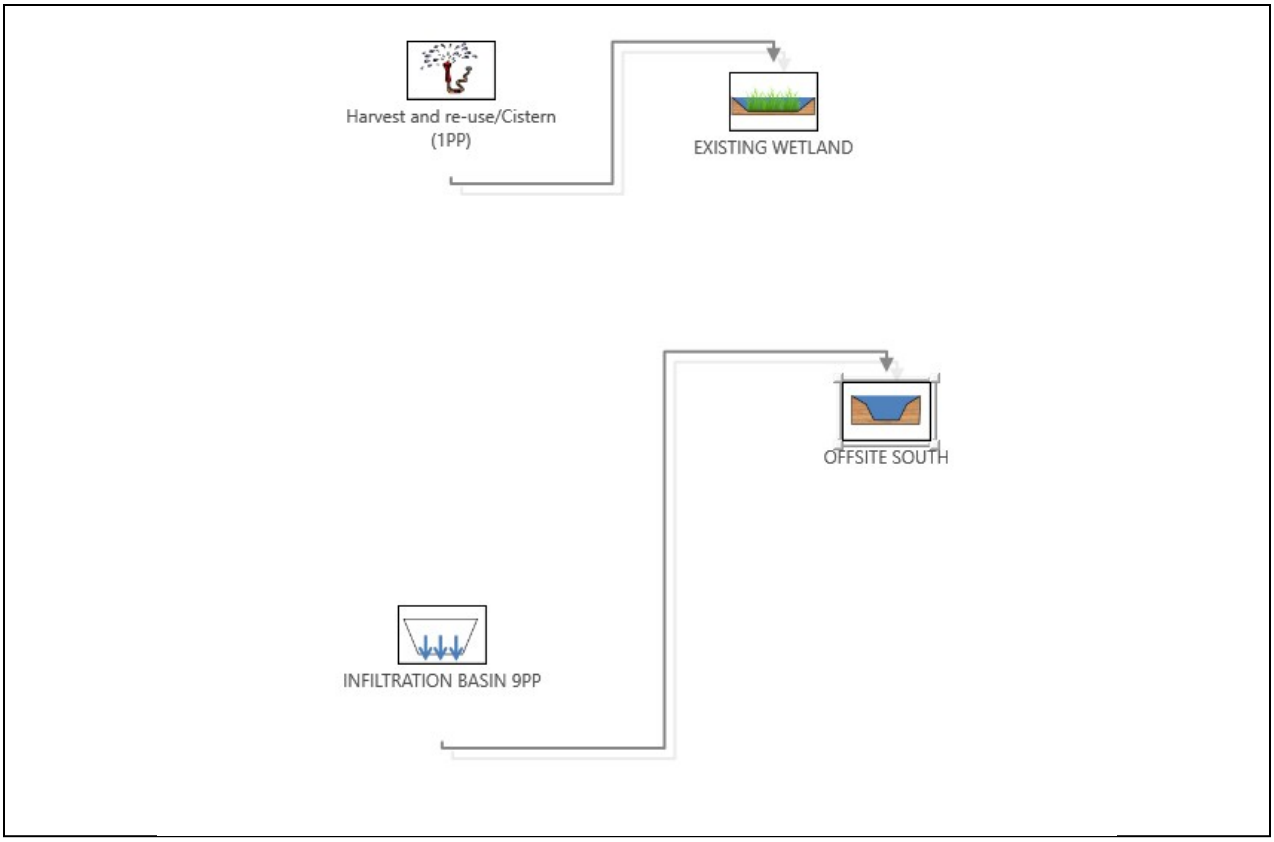
Total Phosphorus Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
INFILTRATION BASIN 9PP	0.2893	0	0.2451	0.0442	85
Harvest and re-use/Cistern(1PP)	3.1235	0	1.4967	1.6268	48
OFFSITE SOUTH	0.4427	0.0442	0	0.4869	0
EXISTING WETLAND	0	1.6268	0	1.6268	0

TSS Summary

BMP Name	Load From Direct Watershed (lbs)	Load From Upstream BMPs (lbs)	Load Retained (lbs)	Outflow Load (lbs)	Percent Retained (%)
INFILTRATION BASIN 9PP	52.55	0	44.52	8.0299999999	85
Harvest and re-use/Cistern(1PP)	567.44	0	271.91	295.53	48
OFFSITE SOUTH	80.42	8.0299999999	0	88.45	0
EXISTING WETLAND	0	295.53	0	295.53	0

BMP Schematic


Harvest and re-use/Cistern
(1PP)
EXISTING WETLAND
OFFSITE SOUTH
INFILTRATION BASIN 9PP