DRAINAGE REPORT

PREPARED FOR:
ANDERSON WELDING, LLC
COLONIAL WAY
BARRINGTON, NH
STRAFFORD COUNTY

MARCH 2020

PREPARED BY:

NORWAY PLAINS ASSOCIATES, INC.

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N.H. Reg. #10026

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TABLE OF CONTENTS

TABLES

APPENDICES

FIGURES & PLANS

USGS QUADRANGLE
1" = 2000'

FIGURE 1

Tax Map 220, Lot 29

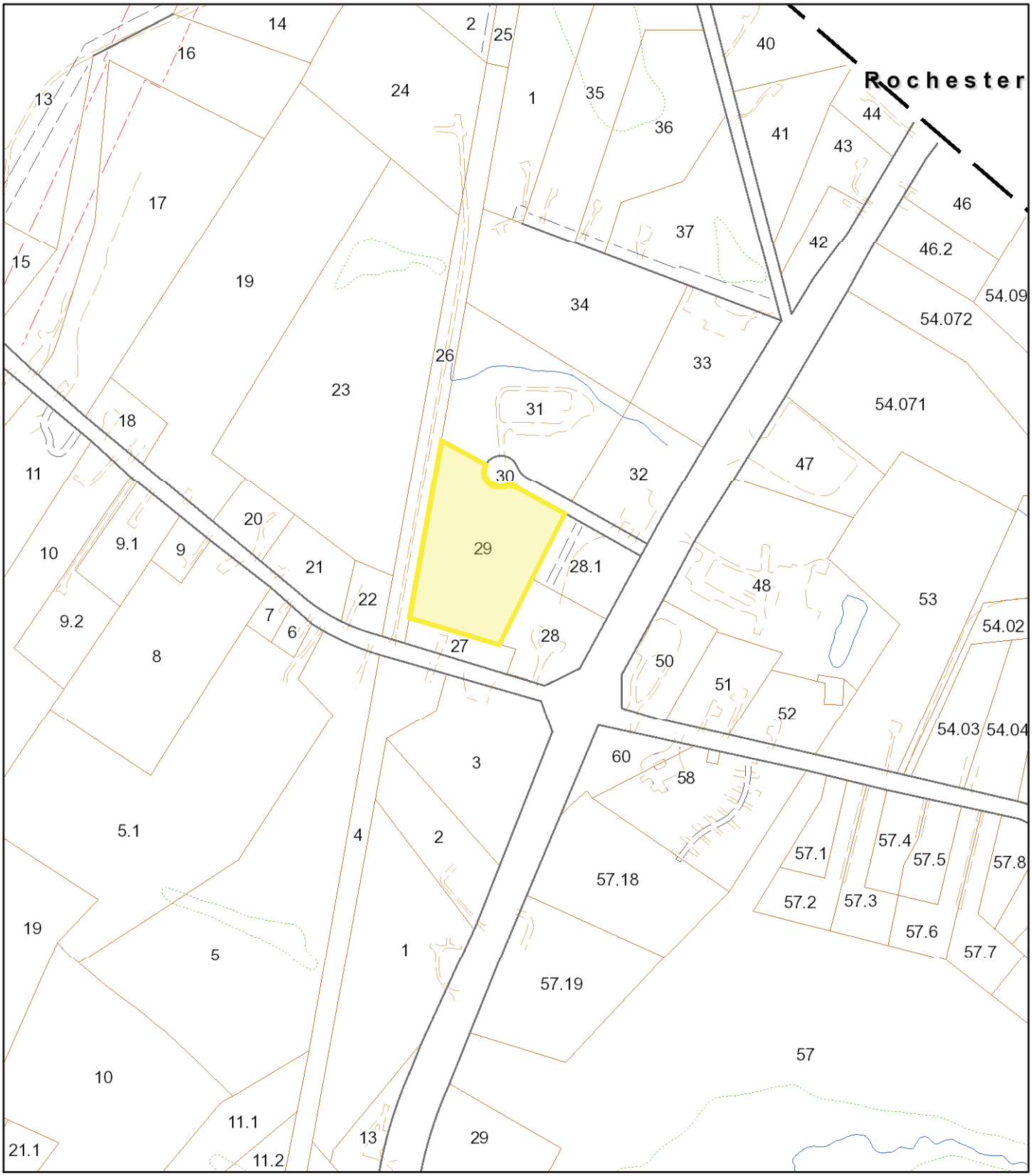
Barrington, NH

1 inch = 500 Feet

0 500 1000 1500

March 27, 2020

FIGURE 2



1.0 INTRODUCTION:

This drainage report has been prepared as a supporting document to "PROPOSED WELDING AND FABRICATION FACILITY FOR ANDERSON WELDING LLC".

The purpose of any drainage analysis is to apply current mathematical stormwater modeling techniques used in the fields of Civil and Environmental Engineering, to predict the effect a proposed construction project will have on the subject parcel, those parcels directly abutting the project and any downstream property and or drainage structures such as culverts, closed drainage systems, dams, etc.

Then, through an iterative process using the modeling discussed above, a design that provides adequate control of stormwater minimizing and or eliminating impacts to surrounding wetlands, abutting properties and any downstream drainage structures (i.e. municipal culverts, bridges, etc.) is arrived at. The Pre-development drainage analysis reflects the modeling performed for the Pre-development surface drainage for the land in its existing state prior to the redevelopment of this parcel in the past 10 years. The Post-development drainage analysis reflects the results of the final drainage design and provides surface drainage values to compare to the Pre-development values. In this way, the design engineer and any review agents are provided the necessary information to decide if the proposed design is adequate.

1.1 REVISIONS:

05-22-2020: Update Post development analysis table, Detention Basin table, and Comparison table. Revise Inspection and Maintenance Manual. Add riprap apron sizing to the appendices.

2.0 SITE AND PROJECT DESCRIPTION:

2.1 PROJECT LOCATION:

The site is located on the south side of Colonial Way. Please refer to Figure 1 for a pictorial placement of the project area. The parcel is known as Tax Map 220, Lot 29 on the Barrington Assessing maps.

2.2 EXISTING SITE FEATURES:

The existing 5.59-acre parcel is situated on the southern end of Colonial Way. Please refer to Figure 2, Town of Barrington Tax Map sketch. The lot is currently undeveloped. The site consists of woodland. There are two large wetland complexes on the property, one near the northwestern property corner and the other on the eastern property line.

The Natural Resources Conservation Services (NRCS) soils report for the parcel indicates the underlying soils to be Saugatuck loamy sand. The complete report can be found in Appendix A-3.

Map Unit Symbol	Soil Series	Hydrological Group
Sb	Saugatuck	D

2.3 PROJECT DESCRIPTION:

Anderson Welding LLC is proposing to construct a 60' by 100' buildings, with associated parking spaces and access driveway. A paved drive will be constructed starting from the existing pavement on Colonial Way. A paved parking lot will accommodate 12 vehicles. There will be a paved area large enough for trucks to carry in

NAIP AERIAL PHOTOGRAPGH

1" = 2000'

FIGURE 3

material and take out finished product from the facility. The back portion of the parking lot, approximately 14,260 square feet, will be gravel initially and paved at a later date. The area has been analyzed as if it were pavement.

A grassed treatment swale and detention basin will be constructed on the southern side of the developed area to collect and treat the stormwater generated from the site. An outlet structure has been designed to slow the peak rate of runoff from the site. It is also designed to have the detention pond drain within 72 hours.

The following sections of this report are a discussion of the hydrologic analysis performed for the design to insure it works correctly and a discussion of each major portion of the design.

3.0 METHODOLOGY:

The drainage analysis is based on "Urban Hydrology for Small Watersheds", as written by the U.S. Soil Conservation Service (S.C.S.) and released as Technical Release 55, June 1986. The computer analysis is based on the S.C.S. TR-20 and the stormwater modeling software HYDROCAD™ release 10.00, written by Applied Microcomputer Systems of Chocorua, New Hampshire, was used. The drainage analysis is based on information compiled from the following resources:

- "PROPOSED WELDING AND FABRICATION FACILITY" plan set prepared for Anderson Welding, LLC.
- USGS Topographic Map – Barrington Quadrangle;
- Natural Resources Conservation Service (NRCS) Soils Report;
- "Pre- and Post-Development Drainage Plans, Colonial Way, Barrington, Strafford County, NH".

As stated in the introduction the purpose of this report is to provide information supporting the design of the stormwater control measures employed by this project. A number of sources of information were consulted to prepare the calculations for this infrastructure to check its sufficiency. The USGS Map, Aerial Photos, and the NRCS Soils Maps for Strafford County were also consulted. A number of Site visits were performed to confirm site conditions.

The 2, 10 and 50-year storm events have been used to model the stormwater runoff and to determine adequacy of the chosen stormwater control methods. See Appendix A-9 for Extreme Precipitation Tables and other references used in the design and analysis.

Whenever a subcatchment returned Times of Concentration (Tc) below the minimum allowed by TR-55 (TR-55 minimum Tc = 0.1hour = 6 minutes); the Tc values were set in HydroCAD to automatically return a Tc of 6 minutes to insure proper modeling.

A codified system was used to number the subcatchments, reaches and ponds in the drainage analyses. The following Table lists prefixes and their meanings.

3.1 REACH STRUCTURE PREFIXES:

Prefix	Explanation
POA #	Denotes a reach used as a Point of Analysis

3.2 POND STRUCTURE PREFIXES:

Prefix	Explanation
TS	Treatment Swale
DB	Detention Basin
P	Pond

4.0 PRE-DEVELOPMENT DRAINAGE ANALYSIS:

The area being developed or draining into the developed area was divided into four (4) subcatchments, which flows to four (4) Points of Analysis (POA) located around the parcel.

- Subcatchment 1 is a portion of the property along the western property line that drains into a small wetland depression. The depression is POA #1, and the stormwater will remain on the property.
- Subcatchment 2 is the southern section of the property that drains to the southeast property corner, which is POA #2
- Subcatchment 3 is the northeast section of the property that drains to the culvert under Colonial Way. This culvert will be considered POA #3.
- Subcatchment 4 is the wetland complex near the northwest property corner that drains to POA #4, this stormwater remains on the property.

Table 1 below, summarizes the Pre-Development Runoff occurring during the different storm events for all of the Subcatchments and at the POA's.

Complete HydroCAD model data for the Pre-development can be found in Appendix A-7. For a graphical depiction of the Watershed analyzed, flow paths; subcatchments and POA's refer to the Pre-Development Drainage Plan, Figure D-2 in the pocket at the rear of the report.

TABLE 1: PRE-DEVELOPMENT DRAINAGE ANALYSIS RESULTS SUMMARY:

Subcatchment	Area (Ac.)	CN	2-yr Storm (cfs)	10-yr Storm (cfs)	50-yr Storm (cfs)
1	0.672	77	0.5	1.1	2.1
2	1.975	77	1.3	2.7	5.0
3	1.509	79	0.9	1.8	3.2
4	1.710	77	1.0	2.2	4.2
Total	**5.866**				
POA 1			0.5	1.1	2.1
POA 2			1.3	2.7	5.0
POA 3			0.4	1.2	2.3
POA 4			1.0	2.2	4.2

5.0 POST-DEVELOPMENT DRAINAGE ANALYSIS:

Due to the proposed development of the parcel, the post-development drainage was performed by analyzing a total of seven (7) subcatchments, which drain to the same four (4) points of analysis. The Post-Development Subcatchments are as follows:

- Subcatchments 1 is generally the same as the pre-development subcatchment, though it is slightly smaller.
- Subcatchment 2 is the area not effected by the development along the southern property line, it is similar to the pre subcatchment, but much smaller.
- Subcatchment 3 consists of a portion of the wetland complex on along the eastern property line as well as a small portion of the proposed driveway. This area will drain to POA #3.
- Subcatchments 4 is the back half of the proposed building, a portion of the parking lot and the proposed drainage ditch behind the building. This subcatchment will travel to the treatment swale and into the detention basin, eventually outletting towards POA #3.

- Subcatchments 5 is the other half of the proposed building and the rest of the pavement. This area is graded to drain into the treatment swale to the detention basin. It will drain to POA #3.
- Subcatchment 6 is the treatment swale and detention basin area. This subcatchment drains to POA #3.
- Lastly, subcatchment 7 is the area in the northwest property corner that does not get effected by the development, it is similar to subcatchment 4 in the pre development analysis.

Table 3, below summarizes the Post-Development Runoff occurring during the different storm events for all of the Subcatchments and at the POA's.

Complete HydroCAD model data for the Post-development can be found in Appendix A-7. For a graphical depiction of the Watershed analyzed, flow paths; subcatchments and POA's refer to the Post-Development Drainage Plan, Figure D-3 in the pocket at the rear of the report.

TABLE 2: POST-DEVELOPMENT DRAINAGE ANALYSIS RESULTS SUMMARY:

	Area		2-yr Storm	10-yr Storm	50-yr Storm
Subcatchment	**(Ac.)**	**CN**	**(cfs)**	**(cfs)**	**(cfs)**
1	0.616	77	0.5	1.0	1.9
2	1.403	78	1.2	2.5	4.6
3	1.221	81	0.8	1.5	2.6
4	0.204	91	0.5	0.8	1.3
5	0.486	97	1.4	2.1	3.2
6	0.428	80	0.6	1.3	2.3
7	1.508	77	0.9	2.0	3.7
Total	**5.866**				
POA 1			0.5	1.0	1.9
POA 2			1.2	2.5	4.6
POA 3			0.3	1.0	2.1
POA 4			0.9	2.0	3.7

5.1 STORMWATER CONTROL AND TREATMENT PRACTICES:

5.1.1 DETENTION BASIN:

This stormwater management design employs an open Detention Basin to reduce the overall peak runoff rate generated by the development.

The Detention basin has a vegetated bottom with an outlet structure. The structure will allow stormwater to drain towards the wetland complex at a slower rate.

TABLE 3: DENTENTION BASIN SUMMARY:

Structure	2-yr Storm			10-yr Storm			50-yr Storm		
	Q_{in}	Q_{out}	Freeboard	Q_{in}	Q_{out}	Freeboard	Q_{in}	Q_{out}	Freeboard
	(cfs)	(cfs)	(ft)	(cfs)	(cfs)	(ft)	(cfs)	(cfs)	(ft)
Detention Basin	**2.1**	**0.0**	**2.74**	**3.6**	**0.1**	**1.98**	**5.9**	**0.3**	**1.30**

*Qout is the stormwater leaving the system via the outlet structure.
** Freeboard measured to the berm elevation = 204.0'.

Details and specifications for the Detention Basin can be found on sheet C-7 of the plan set.

5.1.2 TREATMENT SWALES:

A treatment swale has been designed to provide treatment for the stormwater runoff from the proposed development. The swale is 6' wide and grassed lined. It will have a slope of 0.5% that will outlet into the proposed detention basin.

TABLE 4: TREATMENT SWALE SUMMARY:

Structure	Length	Slope	Bottom Width	Water Depth at Water Quality Flow (WQF)	Hydraulic Residence Time during WQF	Water Depth at 10-year Storm Event
	(ft)	(ft/ft)	(ft)	(in.)	(min.)	(in.)
Treatment Swale	**165**	**0.005**	**6**	**3.6**	**10.0**	**13**

Details and specifications for the Treatment Swale can be found in the plan sets. A BMP Worksheet for the treatment swale practice can be found in Appendix A-6.

6.0 COMPARISON AND CONCLUSION

6.1 COMPARISON

The following table presents a comparison of the results of the pre-development drainage analysis and the post-development drainage analysis ant the Points of Analysis that are used to collect information about on-site infiltration.

TABLE 5: COMPARISON; PRE- & POST-DEVELOPMENT POA'S:

	2-yr Storm	10-yr Storm	50-yr Storm
POA 1 Pre	0.5	1.1	2.1
POA 1 Post	0.5	1.0	1.9
Change	**0.0**	**-0.1**	**-0.2**
POA 2 Pre	1.3	2.7	5.0
POA 2 Post	1.2	2.5	4.6
Change	**-0.1**	**-0.2**	**-0.4**
POA 3 Pre	0.4	1.2	2.3
POA 3 Post	0.3	1.0	2.1
Change	**-0.1**	**-0.2**	**-0.2**
POA 4 Pre	1.0	2.2	4.2
POA 4 Post	0.9	2.0	3.7
Change	**-0.1**	**-0.2**	**-0.5**

As can be seen from the comparison table above, the peak stormwater runoff rates at all storm events have been reduced or maintained. The reductions the result of capturing the stormwater runoff generated by the development and directing it into the treatment swale and detention basin. The basin attenuated the peak runoff and released it at a controlled rate via the outlet control structure.

6.2 CONCLUSION:

As seen in the preceding sections, through implementation of effective stormwater controls, the peak rate of discharge for the Post-development stormwater leaving the site is less than or equal to the Pre-development conditions for all storm events. This was accomplished using a detention basin with an outlet structure to control the rate at which stormwater discharges from the basin. Unfortunately, there is an increase in volume leaving the site due to the inability to infiltrate into the soils on the site. The volume increases will not have a negative effect on abutting properties.

Proper temporary erosion control has been designed for the project during construction to maintain stormwater runoff quality down gradient, and maintain the sites contribution to offsite drainage systems at current levels. It is felt that this design meets current Best Management Practices for stormwater control and provides a responsible stormwater management plan for the proposed work.

APPENDICES

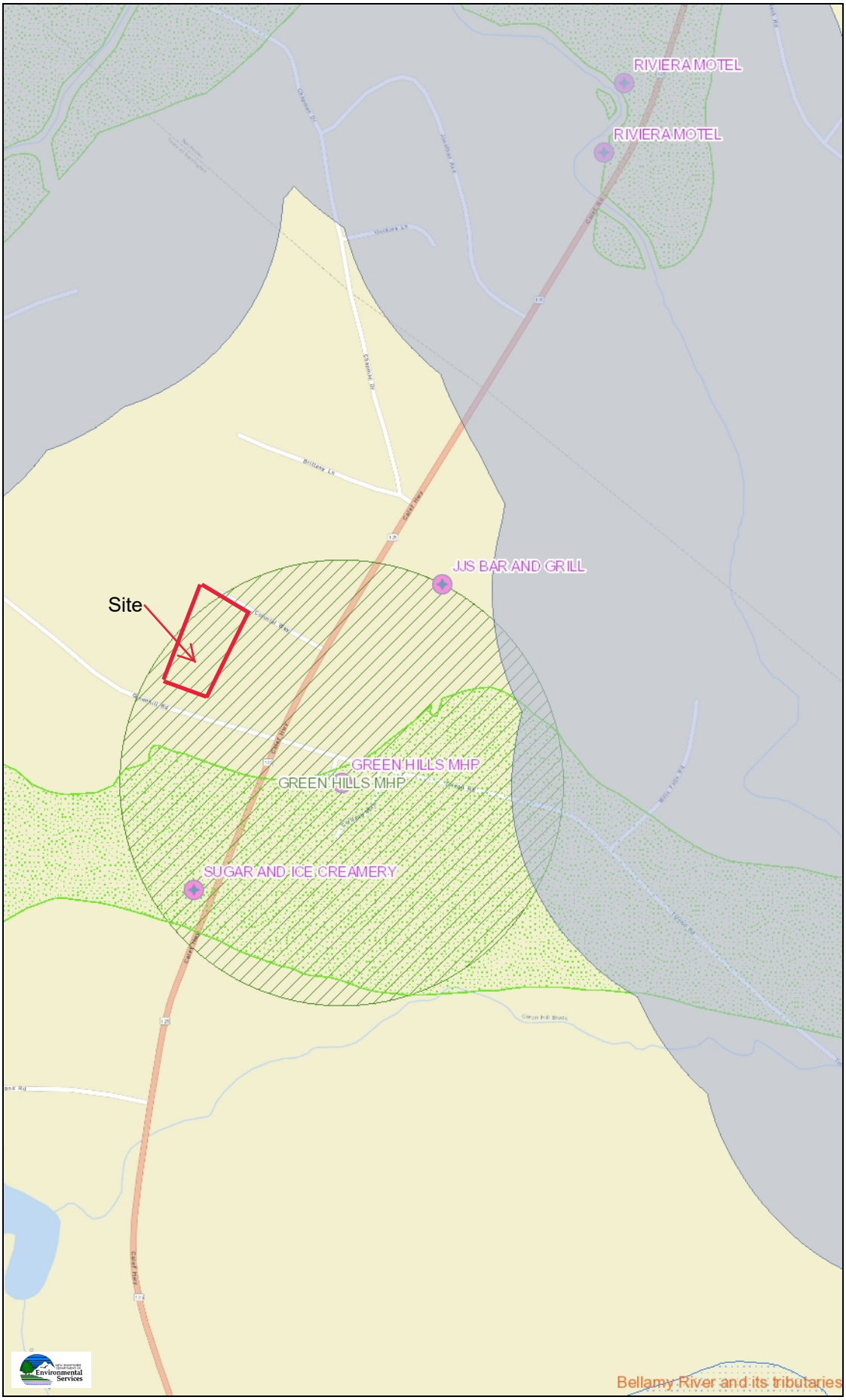
FIGURES & PLANS

APPENDIX A-1

WEB GIS WITH “SURFACE WATER IMPAIRMENT”, “AOT” LAYERS ON

Web GIS

Colonial Way, Barrington, NH



Legend

- Coastal and Great Bay Region Communities
- Designated Rivers Quartermile Buffer
- Public Water Supply Wells
- Groundwater Classification Areas GA1
- Groundwater Classification Areas GA2
- Water Supply Intake Protection Areas
- Wellhead Protection Areas
- Class A Lakes with a Quarter Mile Buffer
- Class A - All Features
- All Lakes, with a Quarter Mile Buffer
- Outstanding Resource Water Watersheds
- Surface Waters with Impairments 2016 with Quarter Mile Buffer
- Watersheds with Chloride Impairments 2016
- Site

Map Scale

1: 10,000

Map Generated: 3/24/2020

Notes

APPENDIX A-2

NATURAL HERITAGE BUREAU (NHB) LETTER

New Hampshire Natural Heritage Bureau

To: Hilary Lamontagne
P.O. Box 249
Rochester, NH 03866

Date: 3/24/2020

From: NH Natural Heritage Bureau

Re: Review by NH Natural Heritage Bureau of request dated 3/24/2020

NHB File ID: NHB20-0839 Applicant: Hilary Lamontagne

Location: Tax Map(s)/Lot(s): Tax Map 220, Lot 29
Barrington

Project Description: The project is to construct a welding and fabrication facility with associated parking and stormwater management practices.

The NH Natural Heritage database has been checked for records of rare species and exemplary natural communities near the area mapped below. The species considered include those listed as Threatened or Endangered by either the state of New Hampshire or the federal government. We currently have no recorded occurrences for sensitive species near this project area.

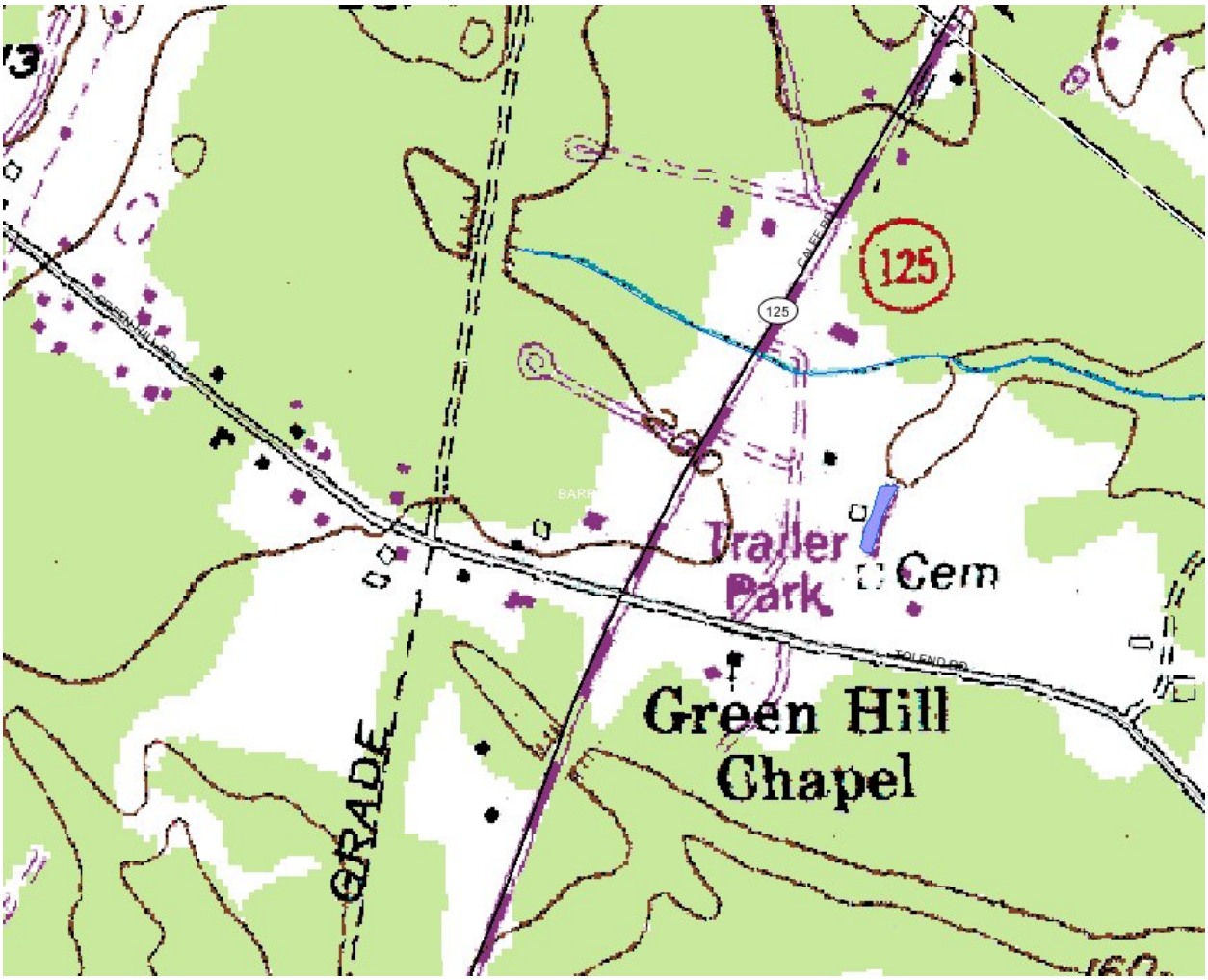
A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. An on-site survey would provide better information on what species and communities are indeed present.

This report is valid through 3/23/2021.

Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

DRED/NHB
172 Pembroke Road
Concord NH 03301

MAP OF PROJECT BOUNDARIES FOR NHB FILE ID: NHB20-0839



Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

DRED/NHB
172 Pembroke Road
Concord NH 03301

APPENDIX A-3

NRSC CUSTOM SOIL RESOURCE REPORT FOR STRAFFORD COUNTY, NEW HAMPSHIRE

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Strafford County, New Hampshire

Anderson Welding Site Plan

January 20, 2020

Preface

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

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

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

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

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

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

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

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,250 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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

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

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

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

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

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

Soil Survey Area: Strafford County, New Hampshire
Survey Area Data: Version 19, Sep 16, 2019

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

Date(s) aerial images were photographed: Dec 31, 2009—Sep 9, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Sb	Saugatuck loamy sand	5.0	100.0%
Totals for Area of Interest		**5.0**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

Strafford County, New Hampshire

Sb—Saugatuck loamy sand

Map Unit Setting

National map unit symbol: 9d8r
Elevation: 300 to 1,000 feet
Mean annual precipitation: 27 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 125 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Saugatuck

Setting

Landform: Outwash terraces
Parent material: Outwash

Typical profile

H1 - 0 to 4 inches: loamy sand
H2 - 4 to 7 inches: sand
H3 - 7 to 26 inches: loamy sand
H4 - 26 to 42 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 10 to 16 inches to undefined
Natural drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: About 0 to 12 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Not named wet

Percent of map unit: 15 percent
Landform: Outwash terraces
Hydric soil rating: Yes

APPENDIX A-4

AERIAL PHOTOGRAPH (1” = 2000’ SCALE WITH SITE BOUNDARIES OUTLINED)

NAIP AERIAL PHOTOGRAPGH

1" = 2000'

APPENDIX A-5:

PHOTOGRAPHS REPRESENTATIVE OF THE SITE

Photographs Representative of Site

Photo 1: Looking into the site from Colonial Way, taken March 16, 2020.

Photo 2: Looking West into the property, taken March 16, 2020.

Photographs Representative of Site

Photo 3: Looking south standing on the property, taken March 16, 2020.

Photo 4: Looking West standing in the middle of the property, taken March 16, 2020.

Photographs Representative of Site

Photo 5: Standing on Colonial Way looking into the wetland complex on the eastern property line, taken March 16, 2020.

Photo 6: Standing on the property looking east at the wetland complex, take March 16, 2020.

APPENDIX A-6

GROUNDWATER RECHARGE VOLUME CALCULATIONS & NHDES ALTERATION OF TERRAIN BMP WORKSHEETS FOR ALL TREATMENT PRACTICES

TREATMENT SWALE DESIGN CRITERIA
(Env-Wq 1508.08)

Node Name: Treatment Swale #1 - TS 1

Enter the node name in the drainage analysis (e.g., reach TS 5), if applicable.
If treatment swale is downstream of a detention structure, do not use this worksheet.

YES	Yes/No	Have you reviewed the restrictions on unlined swales outlined in Env-Wq 1508.08(a)?	
YES	Yes/No	Is the system lined? (Required if not treated or if above SHWT)	
0.73	ac	A = Area draining to the practice	
0.60	ac	A_I = Impervious area draining to the practice	
7.4	minutes	T_c = Time of Concentration	
0.82	decimal	I = percent impervious area draining to the practice, in decimal form	
0.79	unitless	Rv = Runoff coefficient = 0.05 + (0.9 x I)	
0.58	ac-in	WQV= 1" x Rv x A	
2,093	cf	WQV conversion (ac-in x 43,560 sf/ac x 1ft/12")	
1	inches	P = amount of rainfall. For WQF in NH, P = 1".	
0.79	inches	D_{WQ} = water quality depth. D_{WQ} = WQV/A	
98	unitless	CN = unit peak discharge curve number. $CN = 1000/(10+5P+10Q-10*[Q^2 + 1.25*Q*P]^{0.5})$	
0.21	inches	S = potential maximum retention. S = (1000/CN) - 10	
0.042	inches	Ia = initial abstraction. Ia = 0.2S	
634	cfs/mi^2/in	qu = unit peak discharge. Obtain this value from TR-55 exhibits 4-II and 4-III	
0.57	cfs	$WQF = q_u$ x WQV. Conversion: to convert "cfs/mi^2/in * ac-in" to "cfs" multiply by 1mi^2/640ac	
165.00	feet	L = swale length [1]	← **≥ 100'**
6.00	feet	w = bottom of the swale width[2]	← **0 - 8 feet**
199.40	feet	E_{SHWT} = elevation of SHWT. If none found, use the lowest elev. of test pit	
203.20	feet	E_{BTM} = elevation of the bottom of the practice	← **≥ E_{SHWT}**
3.0	:1	SS_{RIGHT} = right Side slope	← **≥3:1**
3.0	:1	SS_{LEFT} = left Side slope	← **≥3:1**
0.005	ft/ft	S = slope of swale in decimal form[3]	← **0.005 - .05**
3.6	inches	d = flow depth in swale at WQF (attach stage-discharge table)	← **≤ 4"**
0.15	unitless	d must be < 4", therefore Manning's n = 0.15	
2.07	ft^2	Cross-sectional area check (assume trapezoidal channel)	
7.90	feet	Check wetted perimeter	
0.60	cfs	WQF_{check}.[4]	← **WQF_{check} = WQF**
4%		Percent difference between WQF_{check} and WQF [4]	← **+/- 10%**
10	minutes	HRT = hydraulic residence time during the WQF	← **≥ 10 min**
203.87	ft	Peak elevation of the 10-year storm event[5]	
204.00	ft	Elevation of the top of the swale	
YES	Yes/No	10 peak elevation ≤ the top of swale	← **yes**

1. Any portion of the swale that is in a roadside ditch shall not count towards the swale length.
2. Widths up to 16' allowed if a dividing berm or structure is used such that neither width is more than 8'.
3. If > 0.02 (2%) then check dams are required. No additional detention time is credited for check dams.
4. The WQF_{check} & WQF should be near equal (within 10%) if you have selected the correct depth off the stage-discharge table and are using n = 0.15 for low flows in swale. If the depth is inaccurate the HRT will be incorrect.
5. If the swale does not discharge the 50-year storm without overtopping, hydrologic routing of secondary discharge to a different node may be necessary.

Designer's Notes:

Project Name: Anderson Welding Project Location.: Tax Map 220 Lot 29, Barrington NH
Project No.: 19216 Date: 3/20/2020 By: SL Chk'd By: HL

Treatment Swale Manning's 'n' Calculator:

Treatment Swale Location: **TS#1**

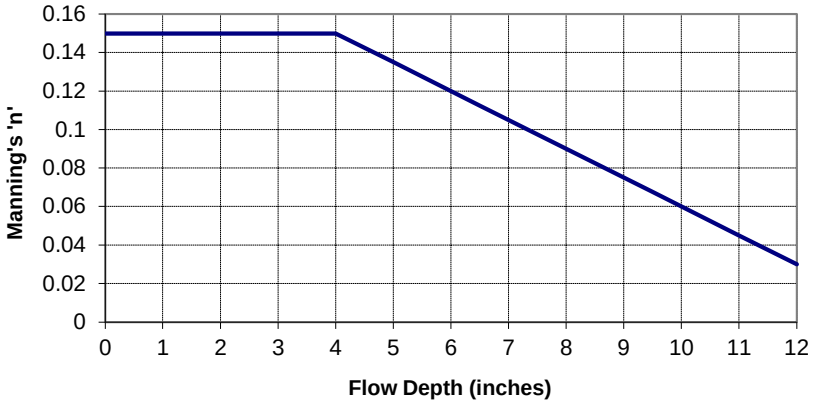
DOWNSTREAM CHANNEL HYDRAULICS:

	Q (required) =	**0.60**	**cfs** ←		**From BMP Worksheet**
	Channel Bottom Width =	**6**	**ft.**		
	Slope (along channel) =	**0.005**	**ft/ft**		
	Left Side Slope =	**3**	**h:v ang. =**	18.43	deg.
	Right Side Slope =	**3**	**h:v ang. =**	18.43	deg.
3.612	**Depth of Flow (DF) =**	**0.30**	**ft.** ←		**Iterative User Input**
	Manning's 'n' =	**0.150**			
	Area =	2.08	sq.ft.		
	Wetted Perimeter =	7.90	ft.		
	Hydraulic Radius =	0.26	ft.		
	Top Width (T) =	7.81	ft.		
	Velocity =	0.29	ft/sec		
	Q (determined) =	0.60	cfs		

Treatment Swale Manning's 'n':

(Equ. VT Stormwater Management Manual p. 187, Claytor and Schueler, 1986)

Manning's 'n" Value vs. Flow Depth



Trapazoidal Channel:

n(based on DF) = ((0.03-0.15)/(1ft-0.33ft))*(DF-0.33ft)+0.15 **n = 0.150**

FORMULAE USED:

(Reference NHDES Erosion Control Handbook, Pages 7-114, 7-115, King's Handbook of Hydrology,
NCHRP Report, 108, Civil Engineering Reference Manual for the PE Exam,
VT Stormwater Management Manual, p.187)

Note: This spreadsheet was generated using the print-out "Open Channel Flow Design/Analysis"
prepared by Ed Minick of the Rockingham County Conservation District as a guide.

Manning's Uniform Channel Flow: Q = 1.486*(A x r^(2/3) x s^(1/2)) / n
Manning's 'n' value: n(based on DF) = ((0.03-0.15)/(1ft-0.33ft))*(DF-0.33ft)+0.15

Stage-Discharge for Reach TS1: TS

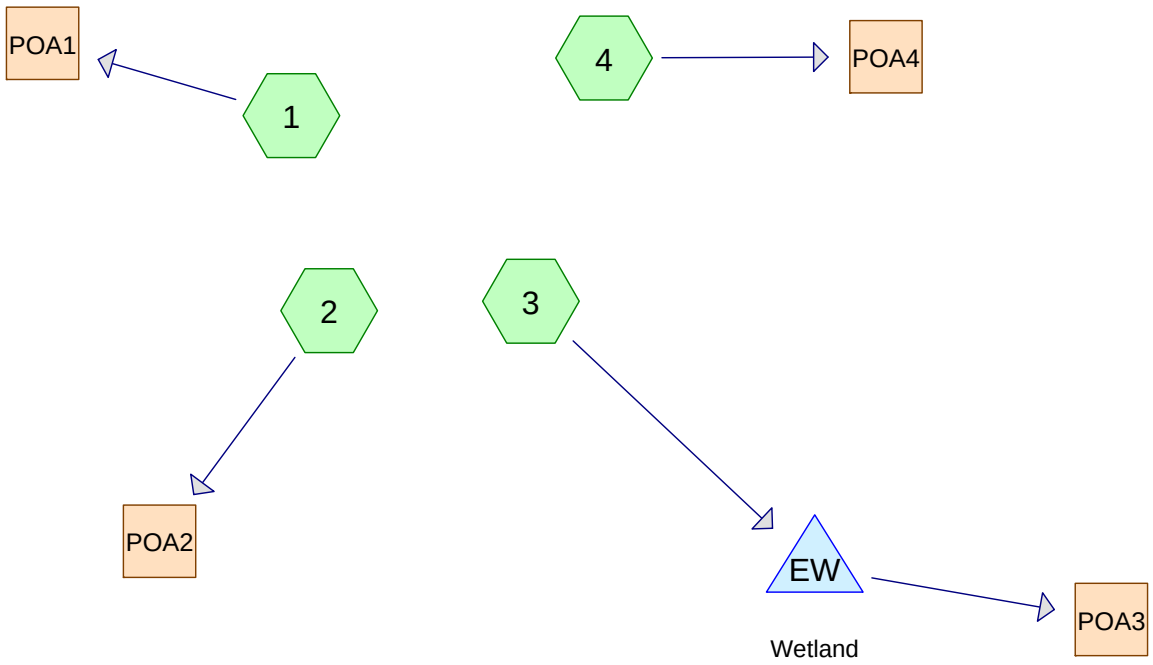
Elevation (feet)	Discharge (cfs)	Elevation (feet)	Discharge (cfs)
203.20	0.0	203.73	1.6
203.21	0.0	203.74	1.7
203.22	0.0	203.75	1.7
203.23	0.0	203.76	1.8
203.24	0.0	203.77	1.8
203.25	0.0	203.78	1.9
203.26	0.0	203.79	1.9
203.27	0.1	203.80	2.0
203.28	0.1	203.81	2.1
203.29	0.1	203.82	2.1
203.30	0.1	203.83	2.2
203.31	0.1	203.84	2.2
203.32	0.1	203.85	2.3
203.33	0.1	203.86	2.4
203.34	0.2	203.87	2.4
203.35	0.2	203.88	2.5
203.36	0.2	203.89	2.6
203.37	0.2	203.90	2.6
203.38	0.2	203.91	2.7
203.39	0.3	203.92	2.8
203.40	0.3	203.93	2.8
203.41	0.3	203.94	2.9
203.42	0.3	203.95	3.0
203.43	0.4	203.96	3.1
203.44	0.4	203.97	3.1
203.45	0.4	203.98	3.2
203.46	0.5	203.99	3.3
203.47	0.5	204.00	3.4
203.48	0.5	204.01	3.4
203.49	0.6	204.02	3.5
203.50	0.6	204.03	3.6
203.51	0.6	204.04	3.7
203.52	0.7	204.05	3.8
203.53	0.7	204.06	3.8
203.54	0.7	204.07	3.9
203.55	0.8	204.08	4.0
203.56	0.8	204.09	4.1
203.57	0.9	204.10	4.2
203.58	0.9	204.11	4.3
203.59	0.9	204.12	4.4
203.60	1.0	204.13	4.4
203.61	1.0	204.14	4.5
203.62	1.1	204.15	4.6
203.63	1.1	204.16	4.7
203.64	1.2	204.17	4.8
203.65	1.2	204.18	4.9
203.66	1.2	204.19	5.0
203.67	1.3	204.20	**5.1**
203.68	1.3		
203.69	1.4		
203.70	1.4		
203.71	1.5		
203.72	1.5		

APPENDIX A-7

DRAINAGE ANALYSIS

APPENDIX A-7.1:

PRE-DEVELOPMENT DIAGRAM, AREA LISTINGS AND SOIL LISTINGS



Subcat Reach Pond Link

Routing Diagram for PRE

Prepared by Norway Plains Associates, Inc., Printed 3/26/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.133	80	>75% Grass cover, Good, HSG D (2)
0.002	98	Building, HSG D (2)
0.171	98	Pavement, HSG D (3)
5.560	77	Woods, Good, HSG D (1, 2, 3, 4)
5.866	**78**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
5.866	HSG D	1, 2, 3, 4
0.000	Other	
5.866		**TOTAL AREA**

APPENDIX A-7.2:

2-YR, 10-YR, AND 50-YR PRE-DEVELOPMENT NODE LISTING

Time span=1.00-72.00 hrs, dt=0.05 hrs, 1421 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 1: Runoff Area=0.672 ac 0.00% Impervious Runoff Depth=1.13"
Flow Length=153' Tc=24.7 min CN=77 Runoff=0.5 cfs 0.06 af

Subcatchment 2: Runoff Area=1.975 ac 0.10% Impervious Runoff Depth=1.13"
Flow Length=522' Tc=38.8 min CN=77 Runoff=1.3 cfs 0.19 af

Subcatchment 3: Runoff Area=1.509 ac 11.33% Impervious Runoff Depth=1.25"
Flow Length=340' Tc=58.0 min CN=79 Runoff=0.9 cfs 0.16 af

Subcatchment 4: Runoff Area=1.710 ac 0.00% Impervious Runoff Depth=1.13"
Flow Length=273' Tc=41.9 min CN=77 Runoff=1.0 cfs 0.16 af

Reach POA1: Inflow=0.5 cfs 0.06 af
Outflow=0.5 cfs 0.06 af

Reach POA2: Inflow=1.3 cfs 0.19 af
Outflow=1.3 cfs 0.19 af

Reach POA3: Inflow=0.4 cfs 0.13 af
Outflow=0.4 cfs 0.13 af

Reach POA4: Inflow=1.0 cfs 0.16 af
Outflow=1.0 cfs 0.16 af

Pond EW: Wetland Peak Elev=199.57' Storage=2,699 cf Inflow=0.9 cfs 0.16 af
12.0" Round Culvert n=0.025 L=50.0' S=0.0246 '/' Outflow=0.4 cfs 0.13 af

Total Runoff Area = 5.866 ac Runoff Volume = 0.57 af Average Runoff Depth = 1.16"
97.05% Pervious = 5.693 ac 2.95% Impervious = 0.173 ac

Time span=1.00-72.00 hrs, dt=0.05 hrs, 1421 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 1: Runoff Area=0.672 ac 0.00% Impervious Runoff Depth=2.32"
Flow Length=153' Tc=24.7 min CN=77 Runoff=1.1 cfs 0.13 af

Subcatchment 2: Runoff Area=1.975 ac 0.10% Impervious Runoff Depth=2.32"
Flow Length=522' Tc=38.8 min CN=77 Runoff=2.7 cfs 0.38 af

Subcatchment 3: Runoff Area=1.509 ac 11.33% Impervious Runoff Depth=2.49"
Flow Length=340' Tc=58.0 min CN=79 Runoff=1.8 cfs 0.31 af

Subcatchment 4: Runoff Area=1.710 ac 0.00% Impervious Runoff Depth=2.32"
Flow Length=273' Tc=41.9 min CN=77 Runoff=2.2 cfs 0.33 af

Reach POA1: Inflow=1.1 cfs 0.13 af
Outflow=1.1 cfs 0.13 af

Reach POA2: Inflow=2.7 cfs 0.38 af
Outflow=2.7 cfs 0.38 af

Reach POA3: Inflow=1.2 cfs 0.29 af
Outflow=1.2 cfs 0.29 af

Reach POA4: Inflow=2.2 cfs 0.33 af
Outflow=2.2 cfs 0.33 af

Pond EW: Wetland Peak Elev=199.88' Storage=4,251 cf Inflow=1.8 cfs 0.31 af
12.0" Round Culvert n=0.025 L=50.0' S=0.0246 '/' Outflow=1.2 cfs 0.29 af

Total Runoff Area = 5.866 ac Runoff Volume = 1.16 af Average Runoff Depth = 2.37"
97.05% Pervious = 5.693 ac 2.95% Impervious = 0.173 ac

Time span=1.00-72.00 hrs, dt=0.05 hrs, 1421 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 1: Runoff Area=0.672 ac 0.00% Impervious Runoff Depth=4.36"
Flow Length=153' Tc=24.7 min CN=77 Runoff=2.1 cfs 0.24 af

Subcatchment 2: Runoff Area=1.975 ac 0.10% Impervious Runoff Depth=4.36"
Flow Length=522' Tc=38.8 min CN=77 Runoff=5.0 cfs 0.72 af

Subcatchment 3: Runoff Area=1.509 ac 11.33% Impervious Runoff Depth=4.58"
Flow Length=340' Tc=58.0 min CN=79 Runoff=3.2 cfs 0.58 af

Subcatchment 4: Runoff Area=1.710 ac 0.00% Impervious Runoff Depth=4.36"
Flow Length=273' Tc=41.9 min CN=77 Runoff=4.2 cfs 0.62 af

Reach POA1: Inflow=2.1 cfs 0.24 af
Outflow=2.1 cfs 0.24 af

Reach POA2: Inflow=5.0 cfs 0.72 af
Outflow=5.0 cfs 0.72 af

Reach POA3: Inflow=2.3 cfs 0.55 af
Outflow=2.3 cfs 0.55 af

Reach POA4: Inflow=4.2 cfs 0.62 af
Outflow=4.2 cfs 0.62 af

Pond EW: Wetland Peak Elev=200.31' Storage=6,586 cf Inflow=3.2 cfs 0.58 af
12.0" Round Culvert n=0.025 L=50.0' S=0.0246 '/' Outflow=2.3 cfs 0.55 af

Total Runoff Area = 5.866 ac Runoff Volume = 2.16 af Average Runoff Depth = 4.41"
97.05% Pervious = 5.693 ac 2.95% Impervious = 0.173 ac

APPENDIX A-7.3:

10-YR PRE-DEVELOPMENT STORMDATA & HYDROGRAPHS

Summary for Subcatchment 1:

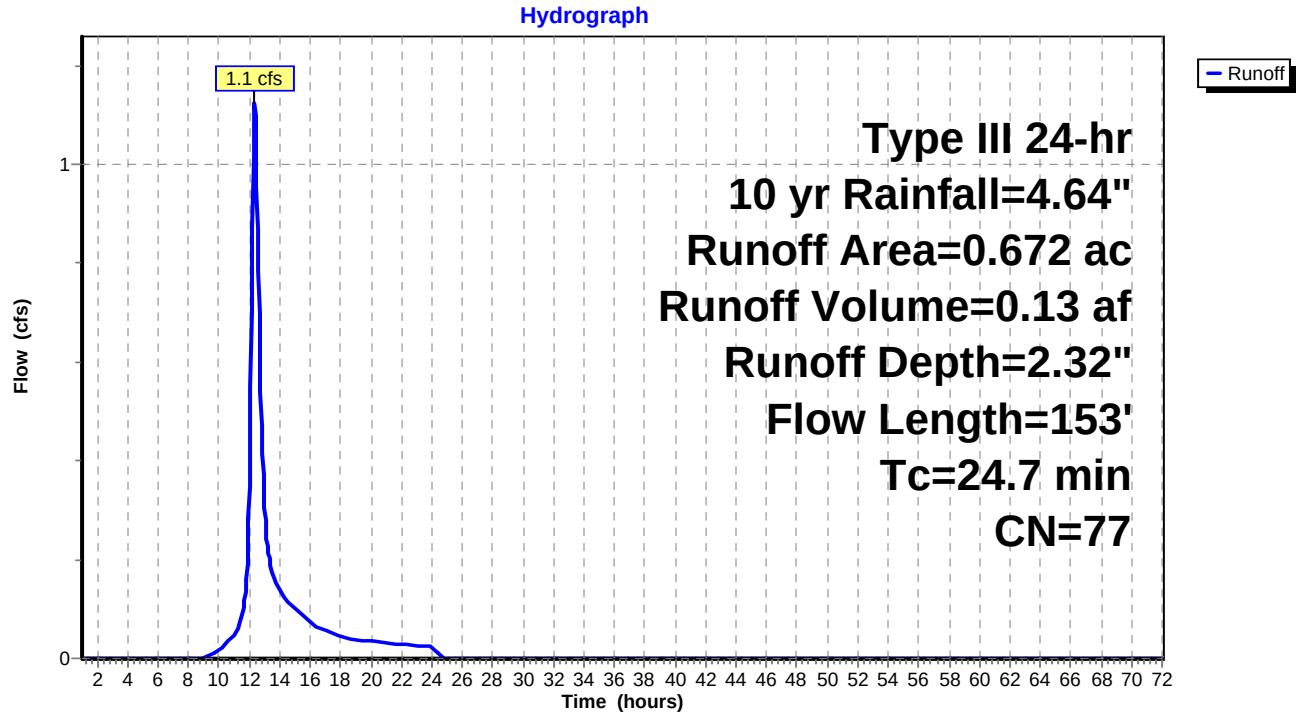
Runoff = 1.1 cfs @ 12.35 hrs, Volume= 0.13 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

Area (ac)	CN	Description
0.672	77	Woods, Good, HSG D
0.672		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	50	0.0132	0.06		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
2.0	53	0.0077	0.44		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
7.9	50	0.0018	0.11		**Shallow Concentrated Flow, C-->D** Forest w/Heavy Litter Kv= 2.5 fps
24.7	153	Total			

Subcatchment 1:



Summary for Subcatchment 2:

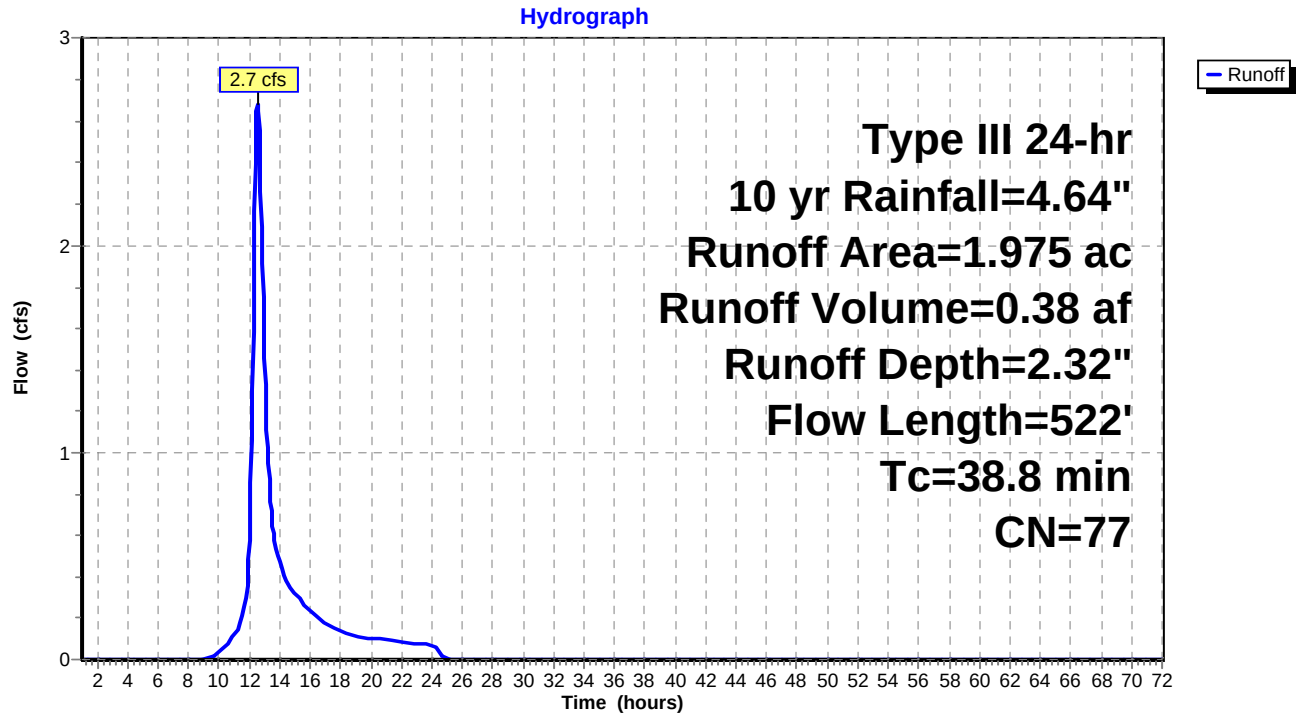
Runoff = 2.7 cfs @ 12.55 hrs, Volume= 0.38 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

	Area (ac)	CN	Description
	1.840	77	Woods, Good, HSG D
	0.133	80	>75% Grass cover, Good, HSG D
*	0.002	98	Building, HSG D
	1.975	77	Weighted Average
	1.973		99.90% Pervious Area
	0.002		0.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.2	50	0.0124	0.05		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
10.4	265	0.0072	0.42		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
2.1	58	0.0084	0.46		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
11.1	149	0.0080	0.22		**Shallow Concentrated Flow, D-->E** Forest w/Heavy Litter Kv= 2.5 fps
38.8	522	Total			

Subcatchment 2:



Summary for Subcatchment 3:

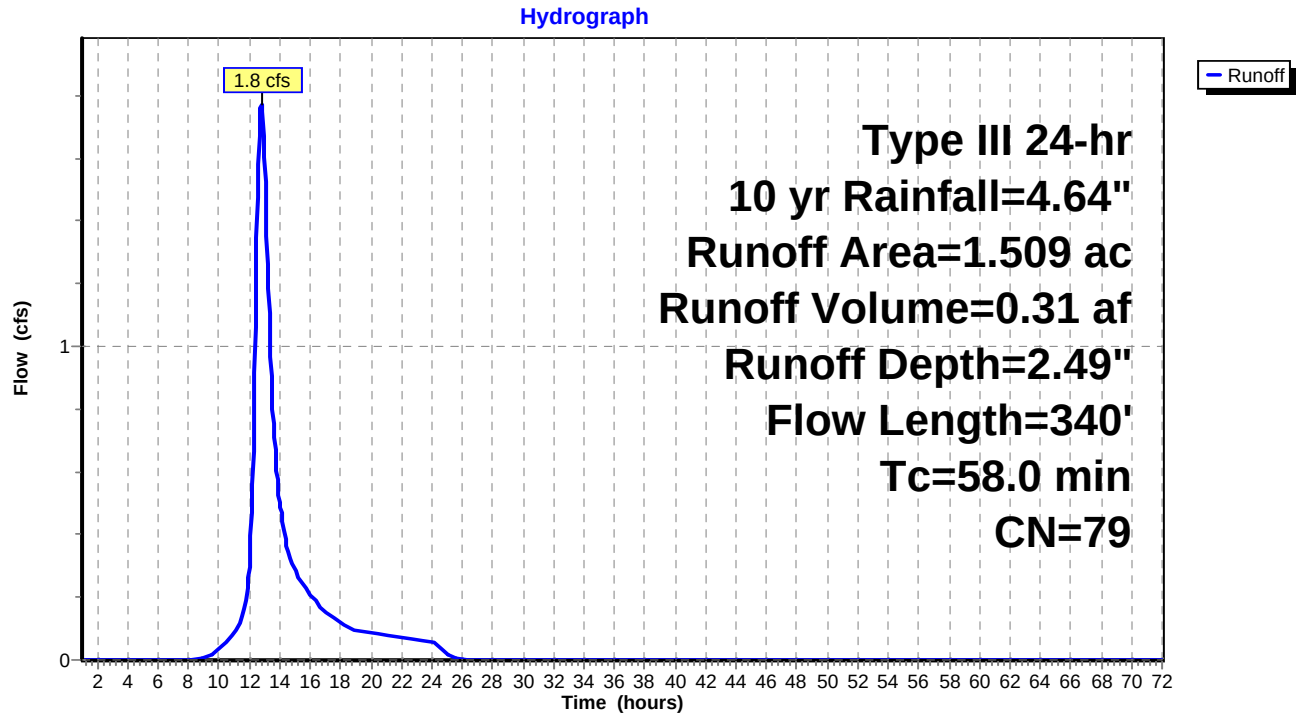
Runoff = 1.8 cfs @ 12.80 hrs, Volume= 0.31 af, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

	Area (ac)	CN	Description
	1.338	77	Woods, Good, HSG D
*	0.171	98	Pavement, HSG D
	1.509	79	Weighted Average
	1.338		88.67% Pervious Area
	0.171		11.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	50	0.0050	0.04		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
3.3	70	0.0050	0.35		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
32.8	220	0.0020	0.11		**Shallow Concentrated Flow, C --> EW** Forest w/Heavy Litter Kv= 2.5 fps
58.0	340	Total			

Subcatchment 3:



Summary for Subcatchment 4:

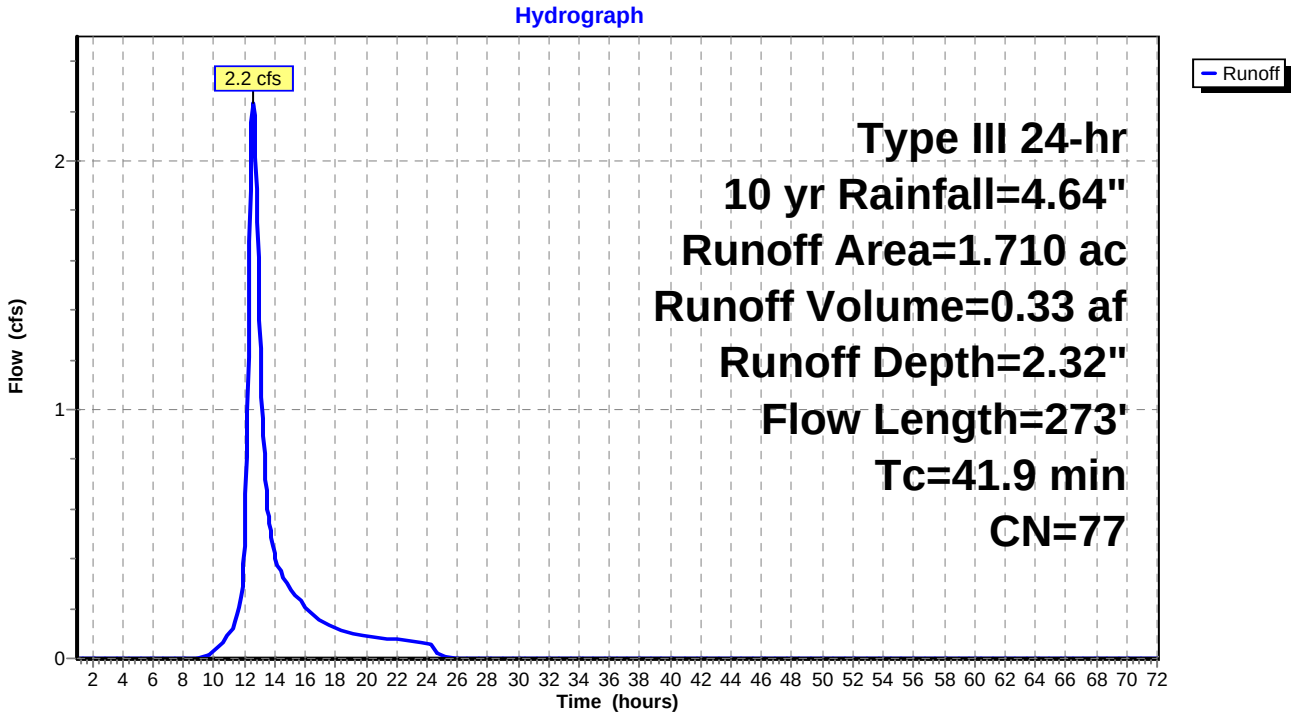
Runoff = 2.2 cfs @ 12.59 hrs, Volume= 0.33 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

Area (ac)	CN	Description
1.710	77	Woods, Good, HSG D
1.710		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	50	0.0026	0.03		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
1.0	35	0.0129	0.57		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
12.5	188	0.0100	0.25		**Shallow Concentrated Flow, C-->D** Forest w/Heavy Litter Kv= 2.5 fps
41.9	273	Total			

Subcatchment 4:



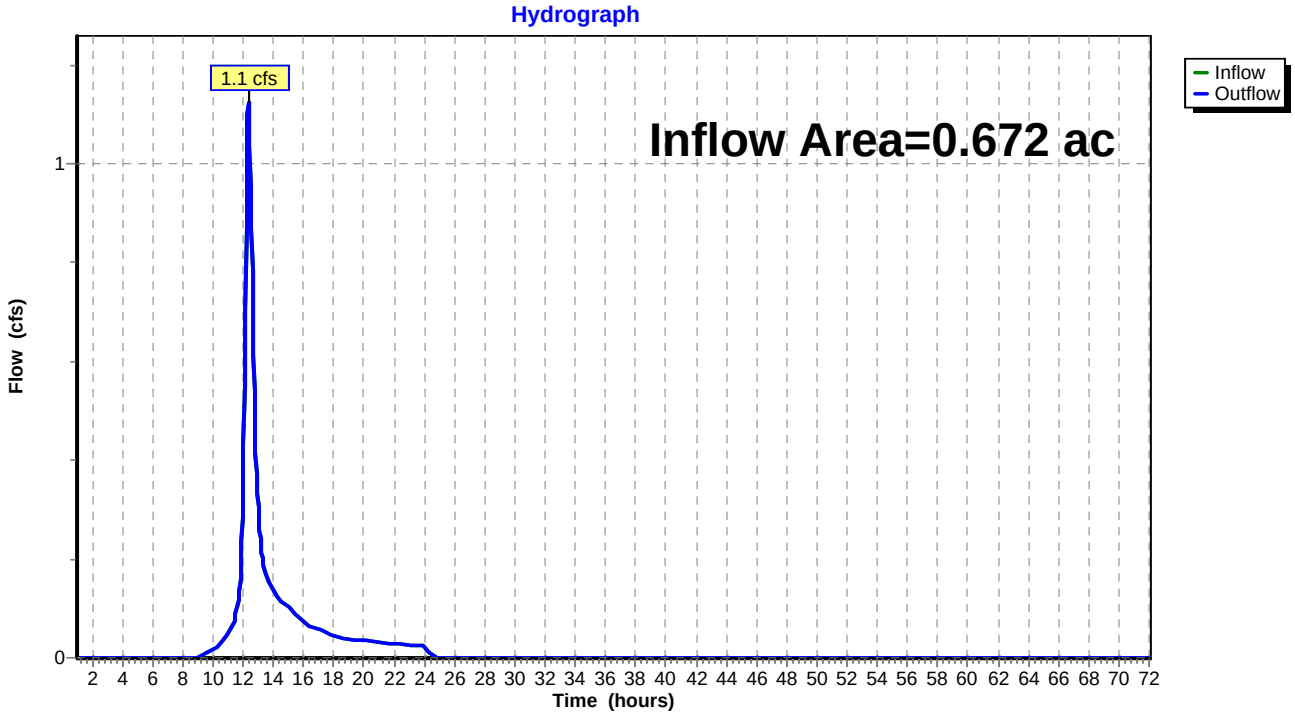
Summary for Reach POA1:

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

Inflow Area = 0.672 ac, 0.00% Impervious, Inflow Depth = 2.32" for 10 yr event
Inflow = 1.1 cfs @ 12.35 hrs, Volume= 0.13 af
Outflow = 1.1 cfs @ 12.35 hrs, Volume= 0.13 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA1:



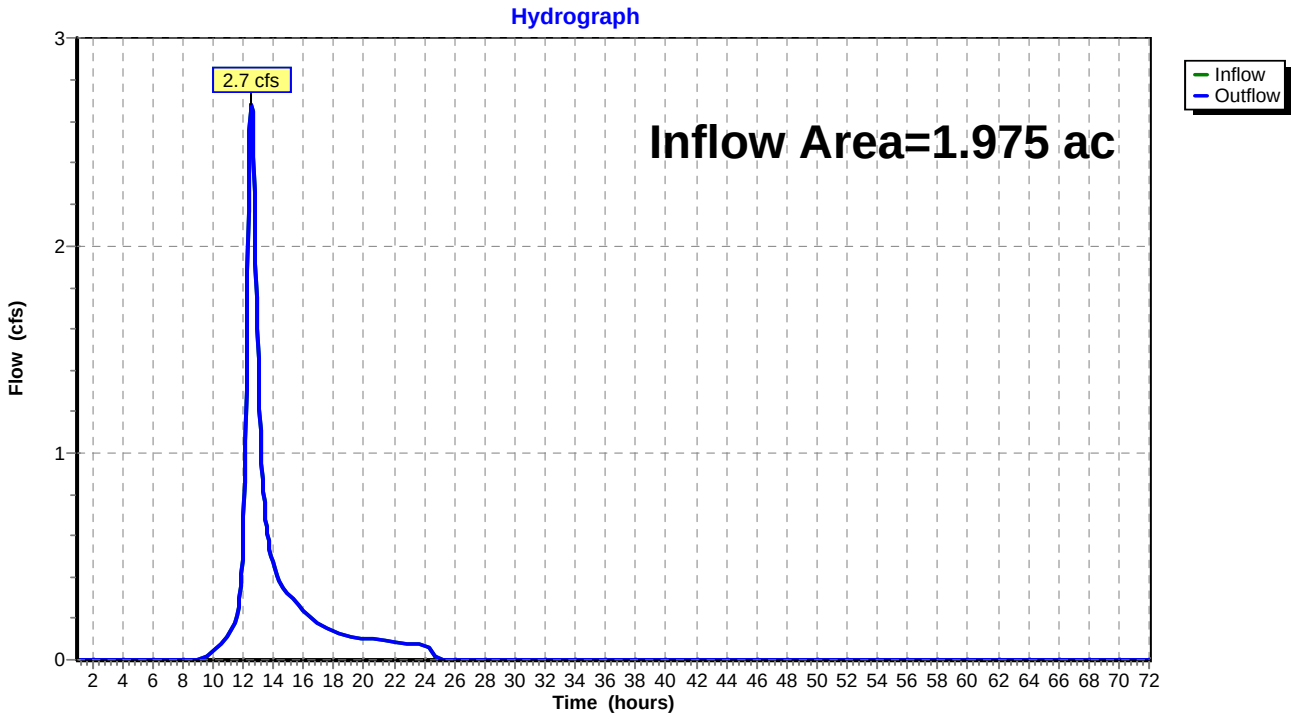
Summary for Reach POA2:

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

Inflow Area = 1.975 ac, 0.10% Impervious, Inflow Depth = 2.32" for 10 yr event
Inflow = 2.7 cfs @ 12.55 hrs, Volume= 0.38 af
Outflow = 2.7 cfs @ 12.55 hrs, Volume= 0.38 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA2:



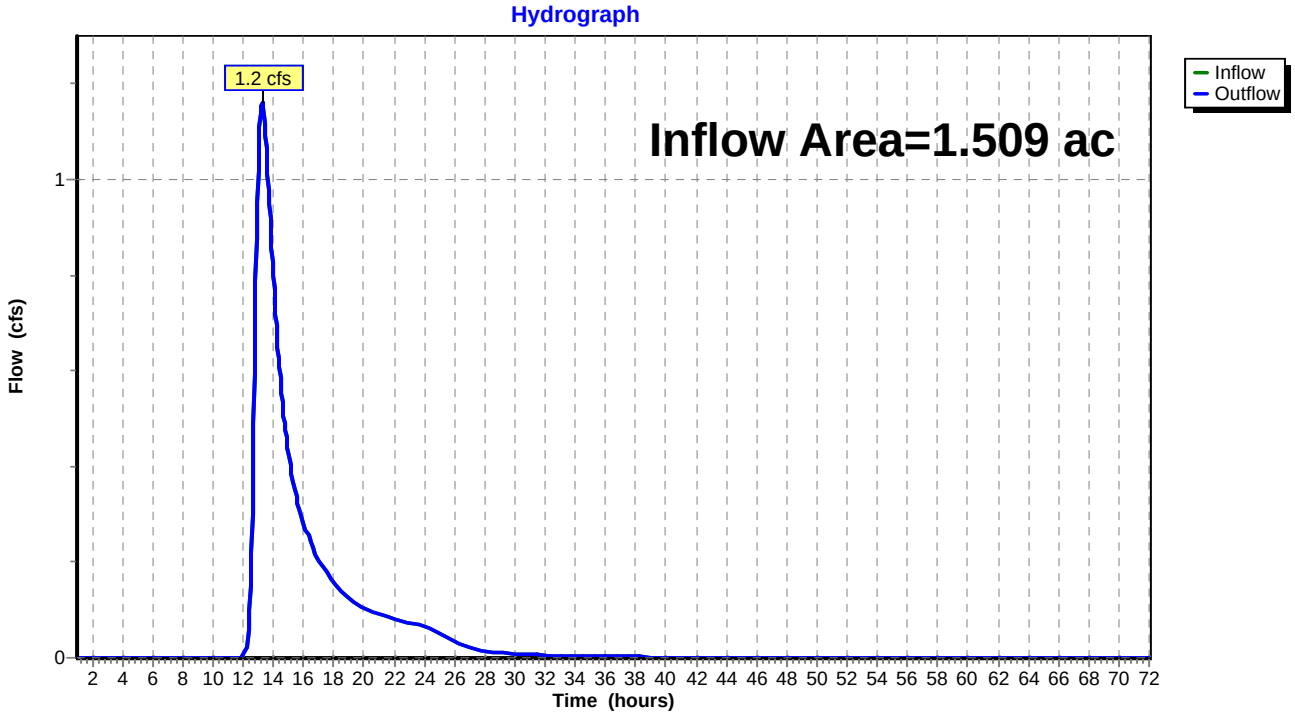
Summary for Reach POA3:

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

Inflow Area = 1.509 ac, 11.33% Impervious, Inflow Depth > 2.29" for 10 yr event
Inflow = 1.2 cfs @ 13.27 hrs, Volume= 0.29 af
Outflow = 1.2 cfs @ 13.27 hrs, Volume= 0.29 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA3:



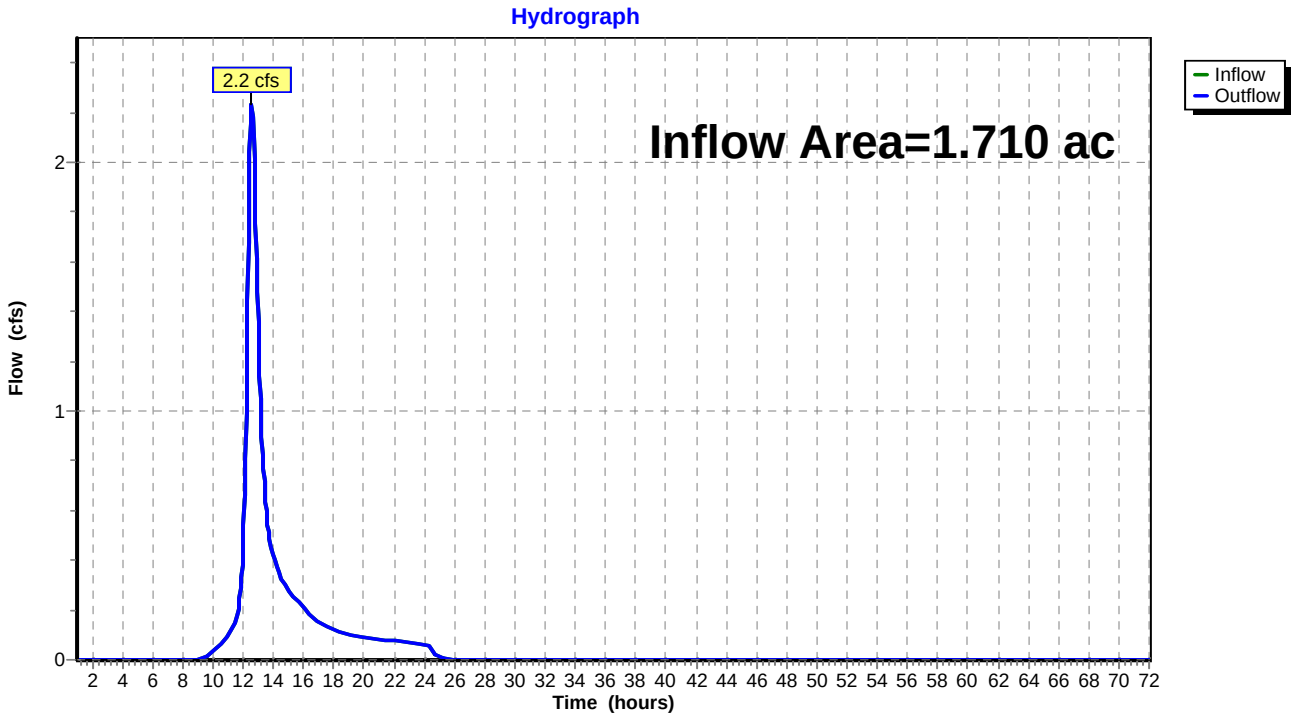
Summary for Reach POA4:

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

Inflow Area = 1.710 ac, 0.00% Impervious, Inflow Depth = 2.32" for 10 yr event
Inflow = 2.2 cfs @ 12.59 hrs, Volume= 0.33 af
Outflow = 2.2 cfs @ 12.59 hrs, Volume= 0.33 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA4:



Summary for Pond EW: Wetland

Inflow Area = 1.509 ac, 11.33% Impervious, Inflow Depth = 2.49" for 10 yr event
Inflow = 1.8 cfs @ 12.80 hrs, Volume= 0.31 af
Outflow = 1.2 cfs @ 13.27 hrs, Volume= 0.29 af, Atten= 34%, Lag= 28.0 min
Primary = 1.2 cfs @ 13.27 hrs, Volume= 0.29 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 199.88' @ 13.27 hrs Surf.Area= 5,201 sf Storage= 4,251 cf

Plug-Flow detention time= 144.7 min calculated for 0.29 af (92% of inflow)
Center-of-Mass det. time= 105.5 min (981.5 - 876.0)

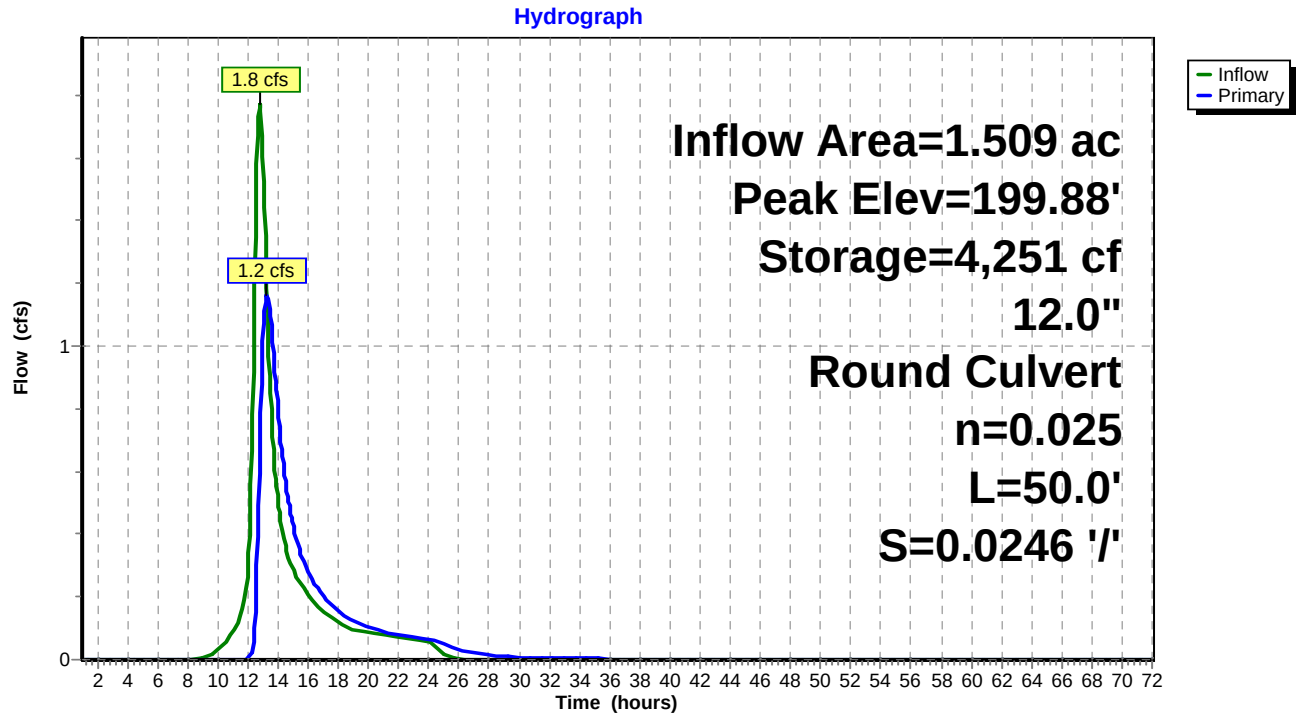
Volume	Invert	Avail.Storage	Storage Description
#1	199.00'	7,650 cf	**wetland pond (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
199.00	4,500	0	0
200.00	5,300	4,900	4,900
200.50	5,700	2,750	7,650

Device	Routing	Invert	Outlet Devices
#1	Primary	199.23'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 199.23' / 198.00' S= 0.0246 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

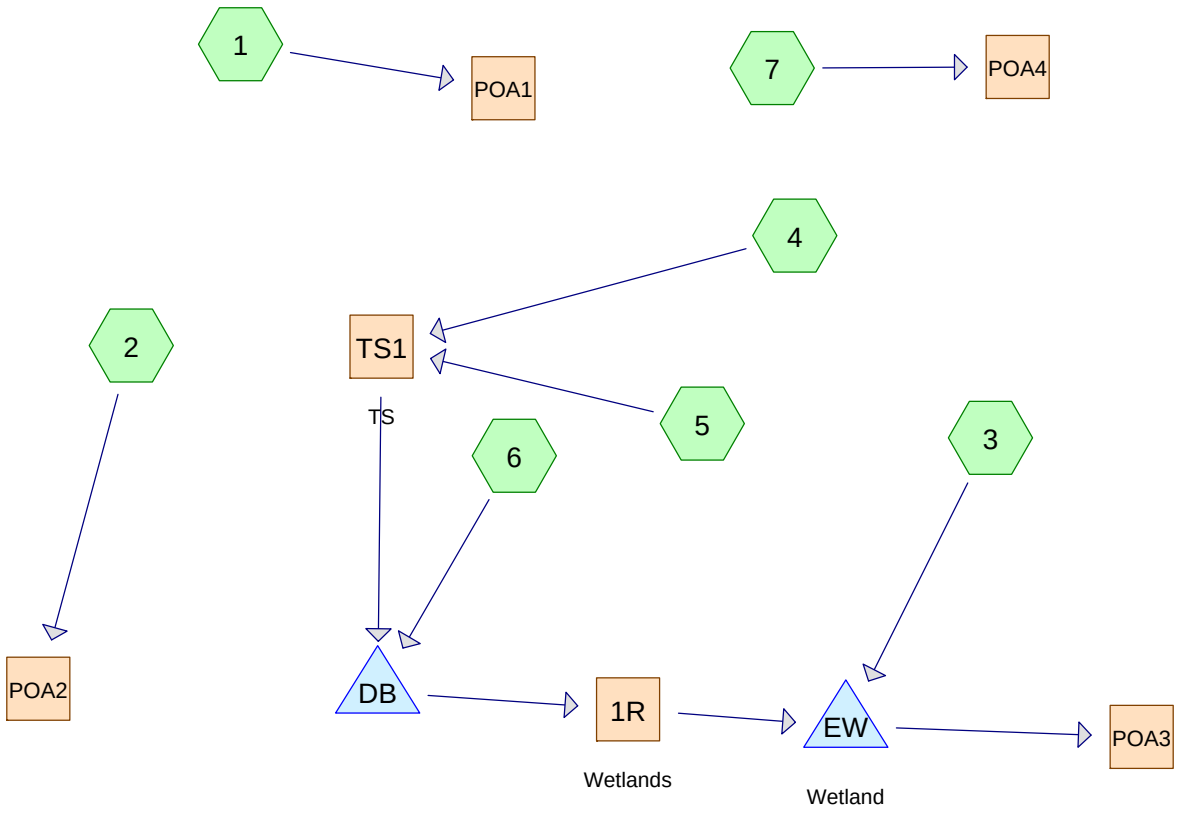
Primary OutFlow Max=1.2 cfs @ 13.27 hrs HW=199.88' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 1.2 cfs @ 2.16 fps)

Pond EW: Wetland



APPENDIX A-7.4:

POST-DEVELOPMENT DIAGRAM, AREA LISTINGS AND SOIL LISTINGS



Subcat Reach Pond Link

Routing Diagram for POST

Prepared by Norway Plains Associates, Inc., Printed 3/26/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.224	80	>75% Grass cover, Good, HSG D (1, 2, 3, 4, 5, 6, 7)
0.140	98	Building, HSG D (2, 4, 5)
0.658	98	Pavement, HSG D (3, 4, 5)
3.844	77	Woods, Good, HSG D (1, 2, 3, 6, 7)
5.866	**80**	**TOTAL AREA**

Soil Listing (all nodes)

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

APPENDIX A-7.5:

2-YR, 10-YR, AND 50-YR POST-DEVELOPMENT NODE LISTING

Time span=1.00-72.00 hrs, dt=0.05 hrs, 1421 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 1: Runoff Area=0.616 ac 0.00% Impervious Runoff Depth=1.13"
Flow Length=153' Tc=24.7 min CN=77 Runoff=0.5 cfs 0.06 af

Subcatchment 2: Runoff Area=1.403 ac 0.14% Impervious Runoff Depth=1.19"
Flow Length=358' Tc=23.8 min CN=78 Runoff=1.2 cfs 0.14 af

Subcatchment 3: Runoff Area=1.221 ac 16.95% Impervious Runoff Depth=1.38"
Flow Length=270' Tc=61.7 min CN=81 Runoff=0.8 cfs 0.14 af

Subcatchment 4: Runoff Area=0.204 ac 62.75% Impervious Runoff Depth=2.15"
Flow Length=194' Slope=0.0050 '/' Tc=6.0 min CN=91 Runoff=0.5 cfs 0.04 af

Subcatchment 5: Runoff Area=0.486 ac 94.86% Impervious Runoff Depth=2.74"
Flow Length=368' Tc=6.6 min CN=97 Runoff=1.4 cfs 0.11 af

Subcatchment 6: Runoff Area=0.428 ac 0.00% Impervious Runoff Depth=1.31"
Tc=6.0 min CN=80 Runoff=0.6 cfs 0.05 af

Subcatchment 7: Runoff Area=1.508 ac 0.00% Impervious Runoff Depth=1.13"
Flow Length=273' Tc=41.9 min CN=77 Runoff=0.9 cfs 0.14 af

Reach 1R: Wetlands Avg. Flow Depth=0.02' Max Vel=0.10 fps Inflow=0.0 cfs 0.13 af
n=0.050 L=250.0' S=0.0020 '/' Capacity=2.9 cfs Outflow=0.0 cfs 0.13 af

Reach POA1: Inflow=0.5 cfs 0.06 af
Outflow=0.5 cfs 0.06 af

Reach POA2: Inflow=1.2 cfs 0.14 af
Outflow=1.2 cfs 0.14 af

Reach POA3: Inflow=0.3 cfs 0.24 af
Outflow=0.3 cfs 0.24 af

Reach POA4: Inflow=0.9 cfs 0.14 af
Outflow=0.9 cfs 0.14 af

Reach TS1: TS Avg. Flow Depth=0.52' Max Vel=0.39 fps Inflow=1.9 cfs 0.15 af
n=0.150 L=165.0' S=0.0050 '/' Capacity=5.1 cfs Outflow=1.5 cfs 0.15 af

Pond DB: Peak Elev=201.26' Storage=6,742 cf Inflow=2.1 cfs 0.19 af
Primary=0.0 cfs 0.13 af Secondary=0.0 cfs 0.00 af Outflow=0.0 cfs 0.13 af

Pond EW: Wetland Peak Elev=199.55' Storage=2,614 cf Inflow=0.8 cfs 0.27 af
12.0" Round Culvert n=0.025 L=50.0' S=0.0246 '/' Outflow=0.3 cfs 0.24 af

Total Runoff Area = 5.866 ac Runoff Volume = 0.67 af Average Runoff Depth = 1.38"
86.40% Pervious = 5.068 ac 13.60% Impervious = 0.798 ac

Time span=1.00-72.00 hrs, dt=0.05 hrs, 1421 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 1: Runoff Area=0.616 ac 0.00% Impervious Runoff Depth=2.32"
Flow Length=153' Tc=24.7 min CN=77 Runoff=1.0 cfs 0.12 af

Subcatchment 2: Runoff Area=1.403 ac 0.14% Impervious Runoff Depth=2.41"
Flow Length=358' Tc=23.8 min CN=78 Runoff=2.5 cfs 0.28 af

Subcatchment 3: Runoff Area=1.221 ac 16.95% Impervious Runoff Depth=2.67"
Flow Length=270' Tc=61.7 min CN=81 Runoff=1.5 cfs 0.27 af

Subcatchment 4: Runoff Area=0.204 ac 62.75% Impervious Runoff Depth=3.63"
Flow Length=194' Slope=0.0050 '/' Tc=6.0 min CN=91 Runoff=0.8 cfs 0.06 af

Subcatchment 5: Runoff Area=0.486 ac 94.86% Impervious Runoff Depth=4.29"
Flow Length=368' Tc=6.6 min CN=97 Runoff=2.1 cfs 0.17 af

Subcatchment 6: Runoff Area=0.428 ac 0.00% Impervious Runoff Depth=2.58"
Tc=6.0 min CN=80 Runoff=1.3 cfs 0.09 af

Subcatchment 7: Runoff Area=1.508 ac 0.00% Impervious Runoff Depth=2.32"
Flow Length=273' Tc=41.9 min CN=77 Runoff=2.0 cfs 0.29 af

Reach 1R: Wetlands Avg. Flow Depth=0.03' Max Vel=0.12 fps Inflow=0.1 cfs 0.24 af
n=0.050 L=250.0' S=0.0020 '/' Capacity=2.9 cfs Outflow=0.1 cfs 0.24 af

Reach POA1: Inflow=1.0 cfs 0.12 af
Outflow=1.0 cfs 0.12 af

Reach POA2: Inflow=2.5 cfs 0.28 af
Outflow=2.5 cfs 0.28 af

Reach POA3: Inflow=1.0 cfs 0.47 af
Outflow=1.0 cfs 0.47 af

Reach POA4: Inflow=2.0 cfs 0.29 af
Outflow=2.0 cfs 0.29 af

Reach TS1: TS Avg. Flow Depth=0.67' Max Vel=0.46 fps Inflow=2.9 cfs 0.24 af
n=0.150 L=165.0' S=0.0050 '/' Capacity=5.1 cfs Outflow=2.5 cfs 0.24 af

Pond DB: Peak Elev=202.02' Storage=11,661 cf Inflow=3.6 cfs 0.33 af
Primary=0.1 cfs 0.24 af Secondary=0.0 cfs 0.00 af Outflow=0.1 cfs 0.24 af

Pond EW: Wetland Peak Elev=199.82' Storage=3,962 cf Inflow=1.5 cfs 0.51 af
12.0" Round Culvert n=0.025 L=50.0' S=0.0246 '/' Outflow=1.0 cfs 0.47 af

Total Runoff Area = 5.866 ac Runoff Volume = 1.29 af Average Runoff Depth = 2.64"
86.40% Pervious = 5.068 ac 13.60% Impervious = 0.798 ac

Time span=1.00-72.00 hrs, dt=0.05 hrs, 1421 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 1: Runoff Area=0.616 ac 0.00% Impervious Runoff Depth=4.36"
Flow Length=153' Tc=24.7 min CN=77 Runoff=1.9 cfs 0.22 af

Subcatchment 2: Runoff Area=1.403 ac 0.14% Impervious Runoff Depth=4.47"
Flow Length=358' Tc=23.8 min CN=78 Runoff=4.6 cfs 0.52 af

Subcatchment 3: Runoff Area=1.221 ac 16.95% Impervious Runoff Depth=4.80"
Flow Length=270' Tc=61.7 min CN=81 Runoff=2.6 cfs 0.49 af

Subcatchment 4: Runoff Area=0.204 ac 62.75% Impervious Runoff Depth=5.93"
Flow Length=194' Slope=0.0050 '/' Tc=6.0 min CN=91 Runoff=1.3 cfs 0.10 af

Subcatchment 5: Runoff Area=0.486 ac 94.86% Impervious Runoff Depth>6.63"
Flow Length=368' Tc=6.6 min CN=97 Runoff=3.2 cfs 0.27 af

Subcatchment 6: Runoff Area=0.428 ac 0.00% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=80 Runoff=2.3 cfs 0.17 af

Subcatchment 7: Runoff Area=1.508 ac 0.00% Impervious Runoff Depth=4.36"
Flow Length=273' Tc=41.9 min CN=77 Runoff=3.7 cfs 0.55 af

Reach 1R: Wetlands Avg. Flow Depth=0.06' Max Vel=0.20 fps Inflow=0.3 cfs 0.44 af
n=0.050 L=250.0' S=0.0020 '/' Capacity=2.9 cfs Outflow=0.3 cfs 0.43 af

Reach POA1: Inflow=1.9 cfs 0.22 af
Outflow=1.9 cfs 0.22 af

Reach POA2: Inflow=4.6 cfs 0.52 af
Outflow=4.6 cfs 0.52 af

Reach POA3: Inflow=2.1 cfs 0.89 af
Outflow=2.1 cfs 0.89 af

Reach POA4: Inflow=3.7 cfs 0.55 af
Outflow=3.7 cfs 0.55 af

Reach TS1: TS Avg. Flow Depth=0.86' Max Vel=0.52 fps Inflow=4.5 cfs 0.37 af
n=0.150 L=165.0' S=0.0050 '/' Capacity=5.1 cfs Outflow=3.9 cfs 0.37 af

Pond DB: Peak Elev=202.70' Storage=16,615 cf Inflow=5.9 cfs 0.54 af
Primary=0.3 cfs 0.44 af Secondary=0.0 cfs 0.00 af Outflow=0.3 cfs 0.44 af

Pond EW: Wetland Peak Elev=200.20' Storage=6,002 cf Inflow=2.8 cfs 0.92 af
12.0" Round Culvert n=0.025 L=50.0' S=0.0246 '/' Outflow=2.1 cfs 0.89 af

Total Runoff Area = 5.866 ac Runoff Volume = 2.32 af Average Runoff Depth = 4.74"
86.40% Pervious = 5.068 ac 13.60% Impervious = 0.798 ac

APPENDIX A-7.6:

10-YR POST-DEVELOPMENT STORMDATA & HYDROGRAPHS

Summary for Subcatchment 1:

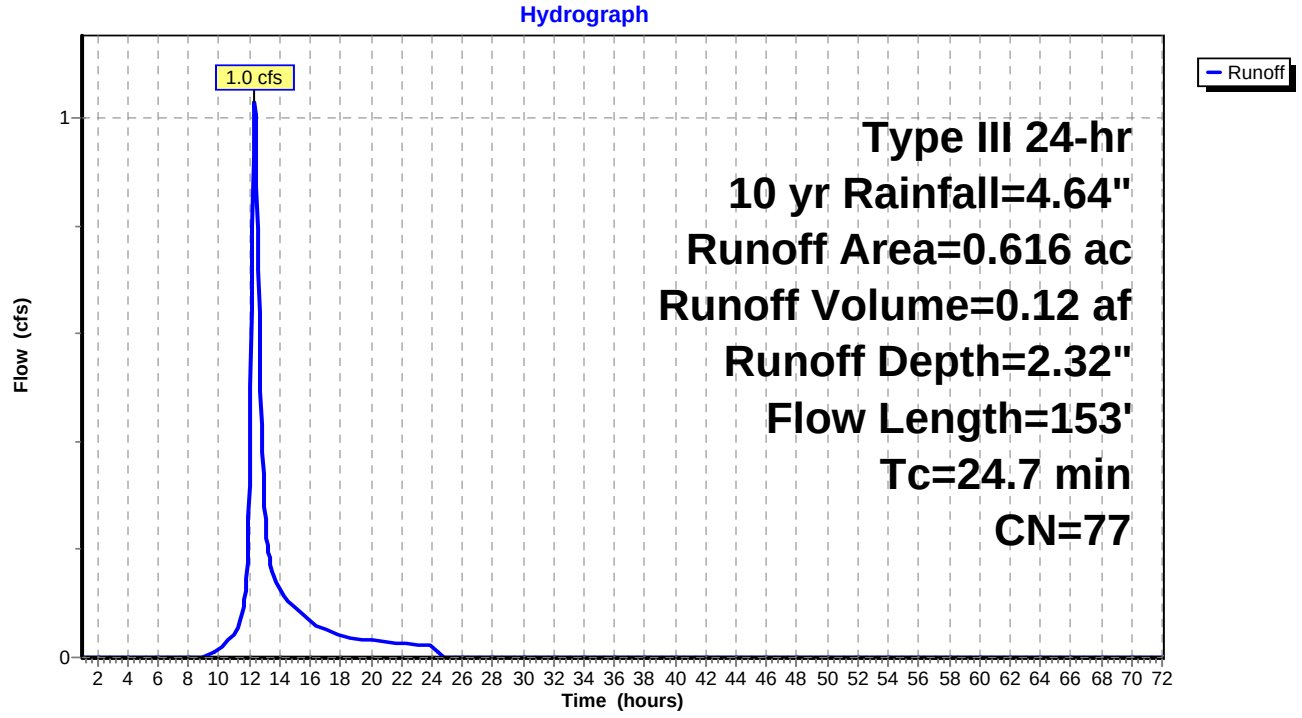
Runoff = 1.0 cfs @ 12.35 hrs, Volume= 0.12 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

Area (ac)	CN	Description
0.593	77	Woods, Good, HSG D
0.023	80	>75% Grass cover, Good, HSG D
0.616	77	Weighted Average
0.616		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.8	50	0.0132	0.06		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
2.0	53	0.0077	0.44		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
7.9	50	0.0018	0.11		**Shallow Concentrated Flow, C-->D** Forest w/Heavy Litter Kv= 2.5 fps
24.7	153	Total			

Subcatchment 1:



Summary for Subcatchment 2:

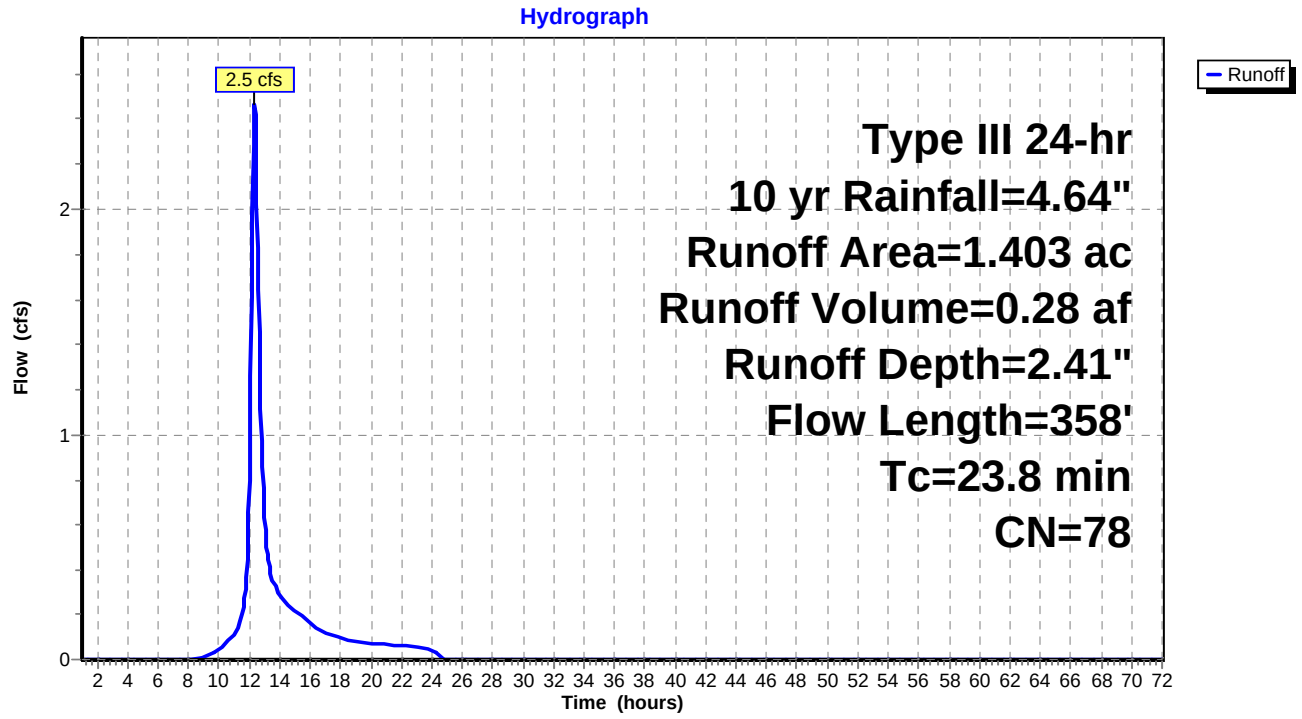
Runoff = 2.5 cfs @ 12.34 hrs, Volume= 0.28 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

	Area (ac)	CN	Description
	1.114	77	Woods, Good, HSG D
	0.287	80	>75% Grass cover, Good, HSG D
*	0.002	98	Building, HSG D
	1.403	78	Weighted Average
	1.401		99.86% Pervious Area
	0.002		0.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	50	0.0772	0.11		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
3.3	101	0.0106	0.51		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
2.1	58	0.0084	0.46		**Shallow Concentrated Flow, C-->D** Woodland Kv= 5.0 fps
11.1	149	0.0080	0.22		**Shallow Concentrated Flow, D-->E** Forest w/Heavy Litter Kv= 2.5 fps
23.8	358	Total			

Subcatchment 2:



Summary for Subcatchment 3:

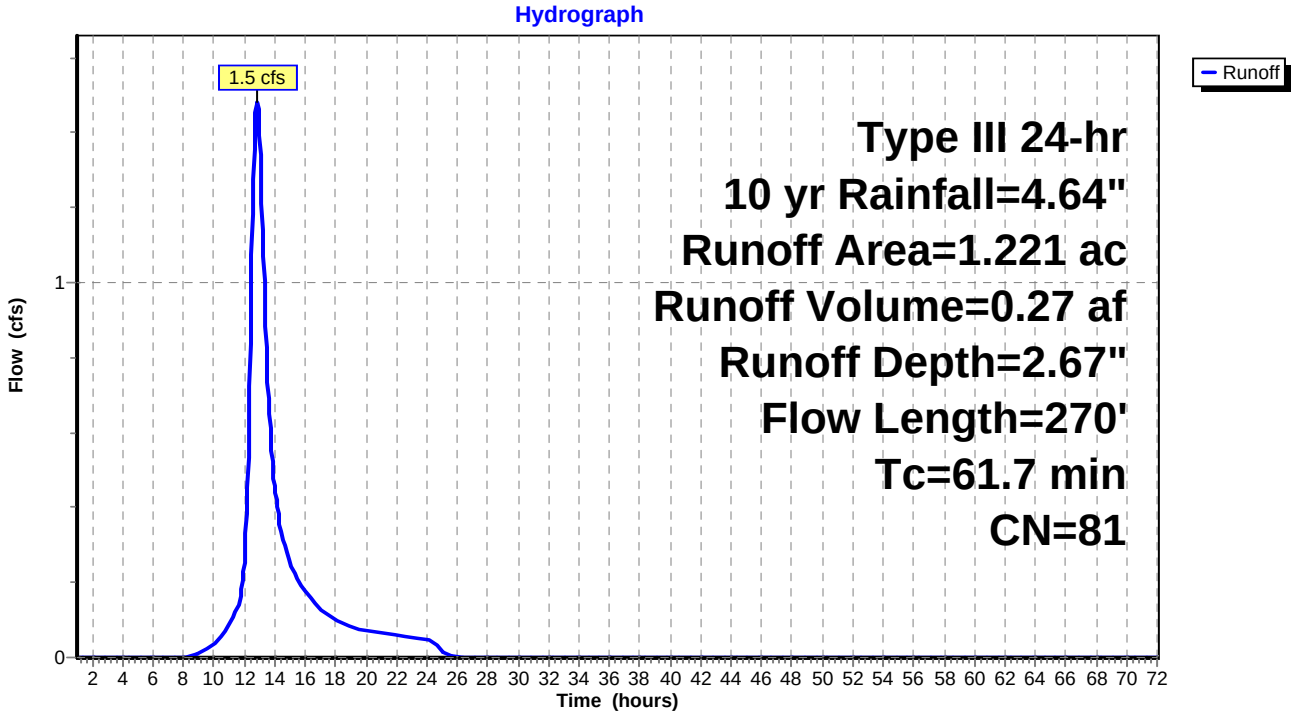
Runoff = 1.5 cfs @ 12.83 hrs, Volume= 0.27 af, Depth= 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

	Area (ac)	CN	Description
	0.782	77	Woods, Good, HSG D
*	0.207	98	Pavement, HSG D
	0.232	80	>75% Grass cover, Good, HSG D
	1.221	81	Weighted Average
	1.014		83.05% Pervious Area
	0.207		16.95% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	20	0.0100	0.09		**Sheet Flow, A-->B** Grass: Short n= 0.150 P2= 3.08"
25.3	30	0.0050	0.02		**Sheet Flow, B-->C** Woods: Dense underbrush n= 0.800 P2= 3.08"
32.8	220	0.0020	0.11		**Shallow Concentrated Flow, C --> EW** Forest w/Heavy Litter Kv= 2.5 fps
61.7	270	Total			

Subcatchment 3:



Summary for Subcatchment 4:

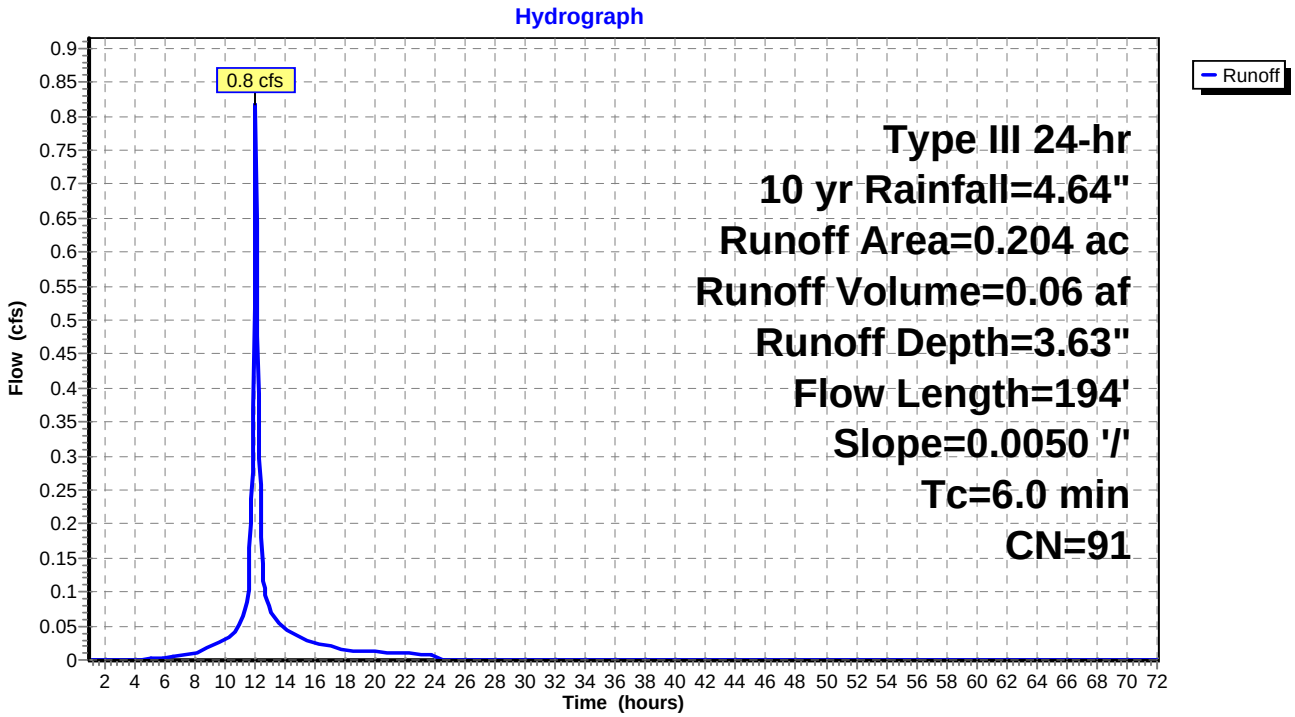
Runoff = 0.8 cfs @ 12.09 hrs, Volume= 0.06 af, Depth= 3.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

	Area (ac)	CN	Description
	0.076	80	>75% Grass cover, Good, HSG D
*	0.069	98	Building, HSG D
*	0.059	98	Pavement, HSG D
	0.204	91	Weighted Average
	0.076		37.25% Pervious Area
	0.128		62.75% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	21	0.0050	0.57		**Sheet Flow, A-->B** Smooth surfaces n= 0.011 P2= 3.08"
2.0	173	0.0050	1.46	2.55	**Trap/Vee/Rect Channel Flow, B-->C** Bot.W=2.00' D=0.50' Z= 3.0 '/' Top.W=5.00' n= 0.035 Earth, dense weeds
2.6	194	Total, Increased to minimum Tc = 6.0 min			

Subcatchment 4:



Summary for Subcatchment 5:

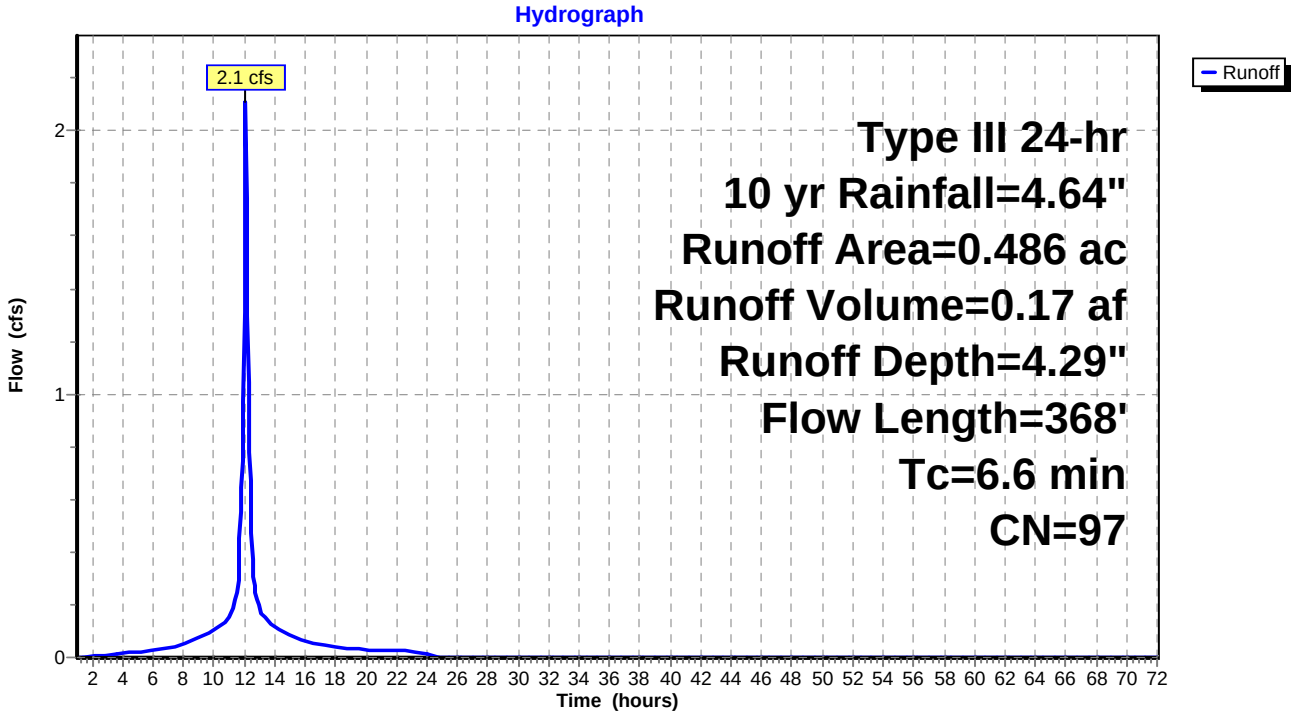
Runoff = 2.1 cfs @ 12.09 hrs, Volume= 0.17 af, Depth= 4.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

	Area (ac)	CN	Description
*	0.392	98	Pavement, HSG D
	0.025	80	>75% Grass cover, Good, HSG D
*	0.069	98	Building, HSG D
	0.486	97	Weighted Average
	0.025		5.14% Pervious Area
	0.461		94.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	40	0.0750	0.24		**Sheet Flow, A-->B** Grass: Short n= 0.150 P2= 3.08"
3.8	328	0.0050	1.44		**Shallow Concentrated Flow, B-->C** Paved Kv= 20.3 fps
6.6	368	Total			

Subcatchment 5:



Summary for Subcatchment 6:

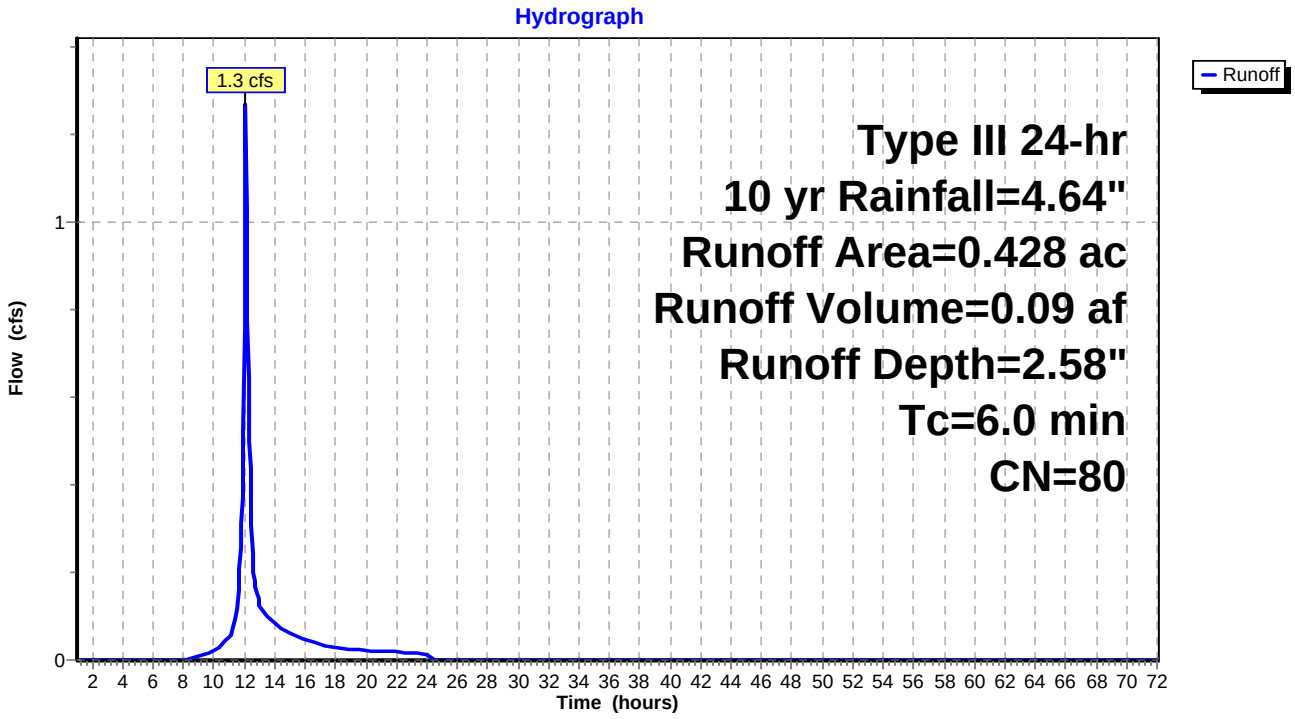
Runoff = 1.3 cfs @ 12.09 hrs, Volume= 0.09 af, Depth= 2.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

Area (ac)	CN	Description
0.427	80	>75% Grass cover, Good, HSG D
0.001	77	Woods, Good, HSG D
0.428	80	Weighted Average
0.428		100.00% Pervious Area

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

Subcatchment 6:



Summary for Subcatchment 7:

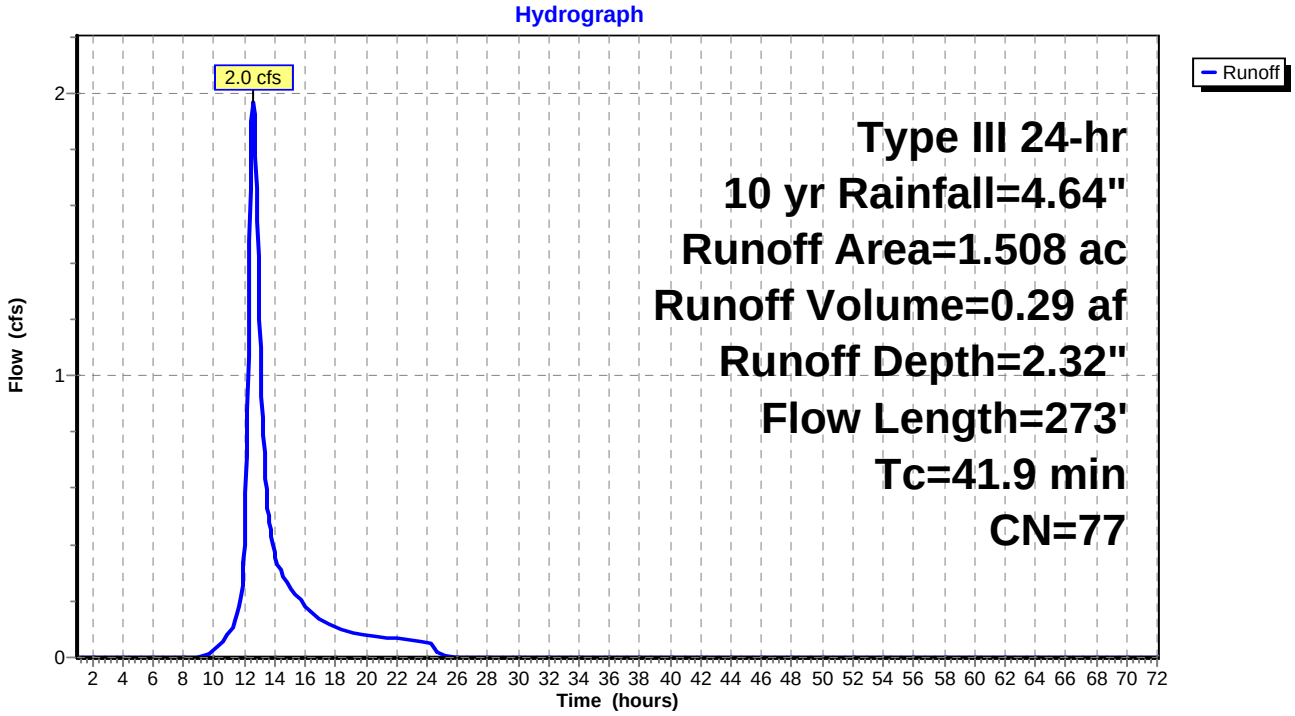
Runoff = 2.0 cfs @ 12.59 hrs, Volume= 0.29 af, Depth= 2.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.64"

Area (ac)	CN	Description
1.354	77	Woods, Good, HSG D
0.154	80	>75% Grass cover, Good, HSG D
1.508	77	Weighted Average
1.508		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.4	50	0.0026	0.03		**Sheet Flow, A-->B** Woods: Light underbrush n= 0.400 P2= 3.08"
1.0	35	0.0129	0.57		**Shallow Concentrated Flow, B-->C** Woodland Kv= 5.0 fps
12.5	188	0.0100	0.25		**Shallow Concentrated Flow, C-->D** Forest w/Heavy Litter Kv= 2.5 fps
41.9	273	Total			

Subcatchment 7:



Summary for Reach 1R: Wetlands

Inflow Area = 1.118 ac, 52.68% Impervious, Inflow Depth > 2.57" for 10 yr event
Inflow = 0.1 cfs @ 20.07 hrs, Volume= 0.24 af
Outflow = 0.1 cfs @ 20.45 hrs, Volume= 0.24 af, Atten= 0%, Lag= 23.0 min

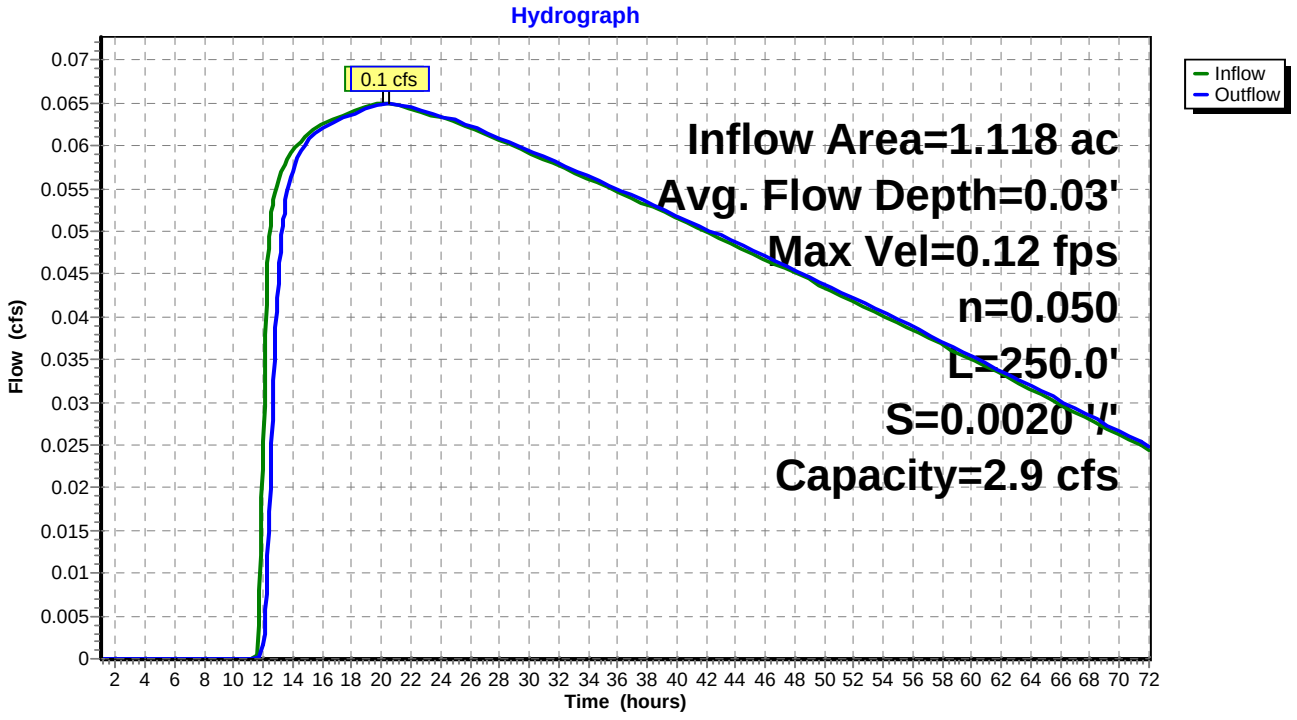
Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.12 fps, Min. Travel Time= 35.5 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 40.5 min

Peak Storage= 138 cf @ 20.45 hrs
Average Depth at Peak Storage= 0.03'
Bank-Full Depth= 0.25' Flow Area= 6.3 sf, Capacity= 2.9 cfs

20.00' x 0.25' deep channel, n= 0.050
Side Slope Z-value= 20.0 '/' Top Width= 30.00'
Length= 250.0' Slope= 0.0020 '/'
Inlet Invert= 199.80', Outlet Invert= 199.30'

‡

Reach 1R: Wetlands



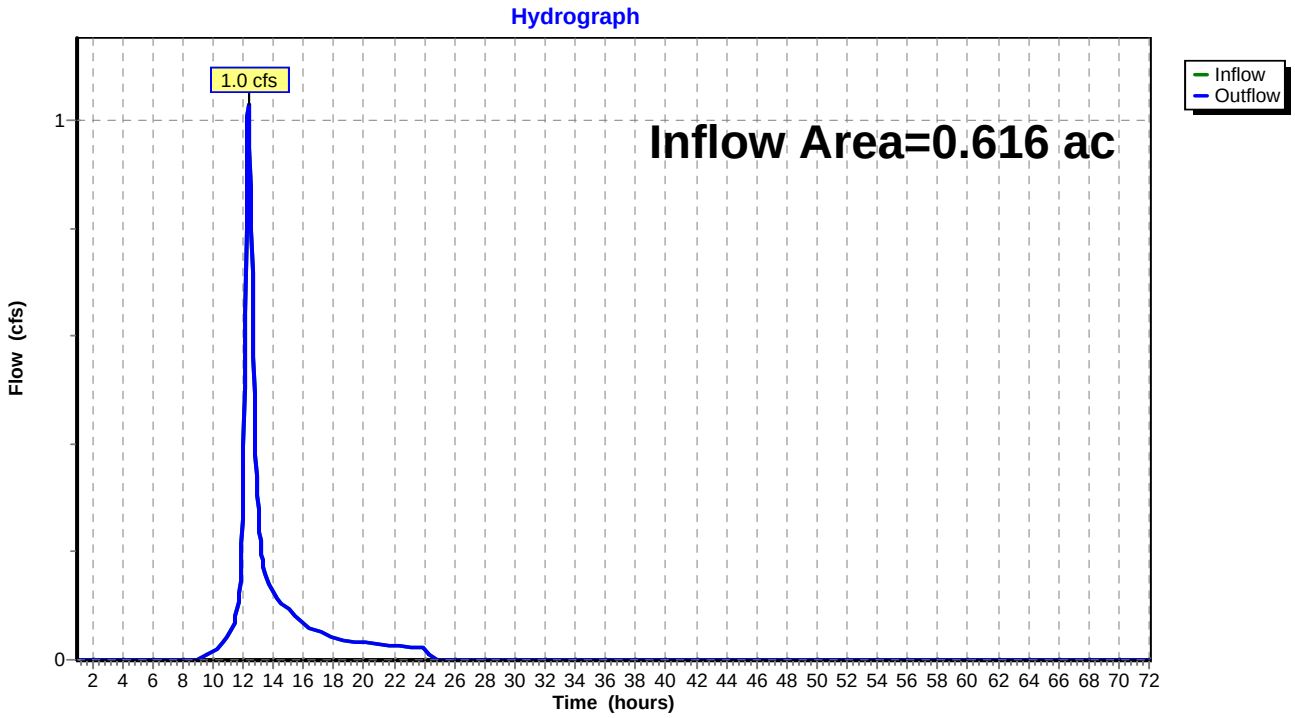
Summary for Reach POA1:

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

Inflow Area = 0.616 ac, 0.00% Impervious, Inflow Depth = 2.32" for 10 yr event
Inflow = 1.0 cfs @ 12.35 hrs, Volume= 0.12 af
Outflow = 1.0 cfs @ 12.35 hrs, Volume= 0.12 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA1:



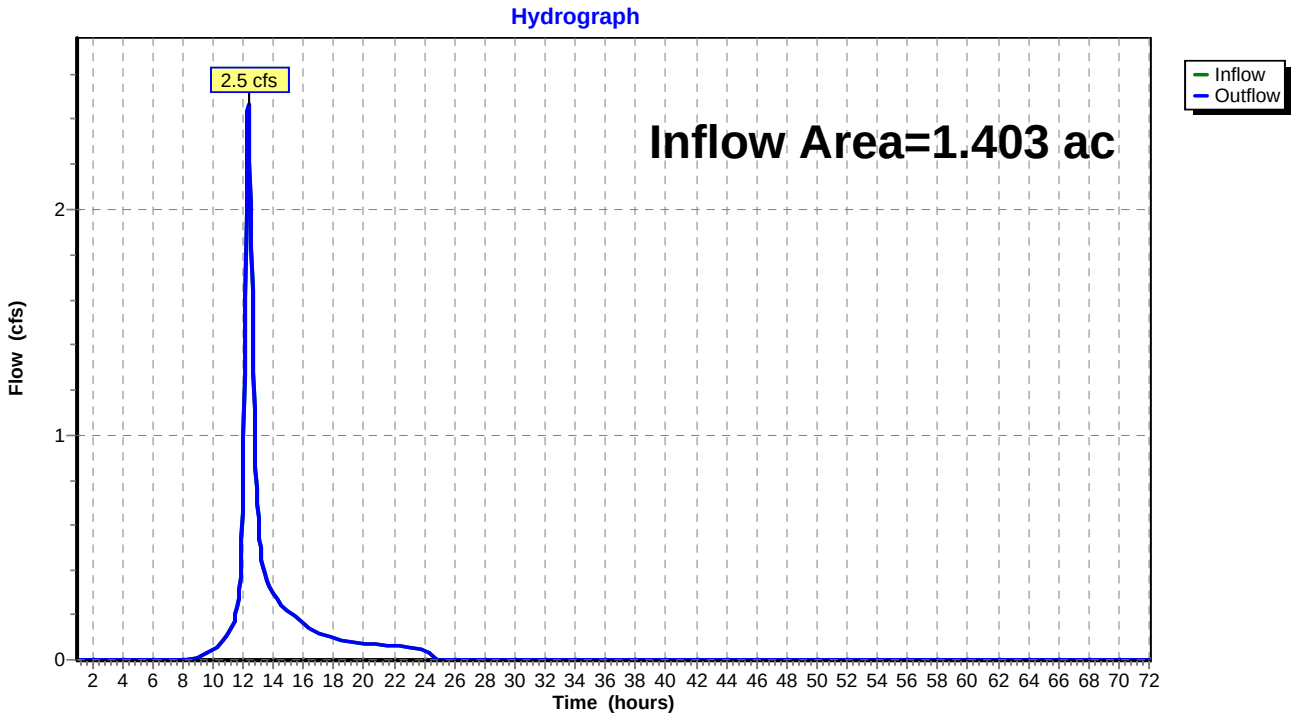
Summary for Reach POA2:

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

Inflow Area = 1.403 ac, 0.14% Impervious, Inflow Depth = 2.41" for 10 yr event
Inflow = 2.5 cfs @ 12.34 hrs, Volume= 0.28 af
Outflow = 2.5 cfs @ 12.34 hrs, Volume= 0.28 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA2:



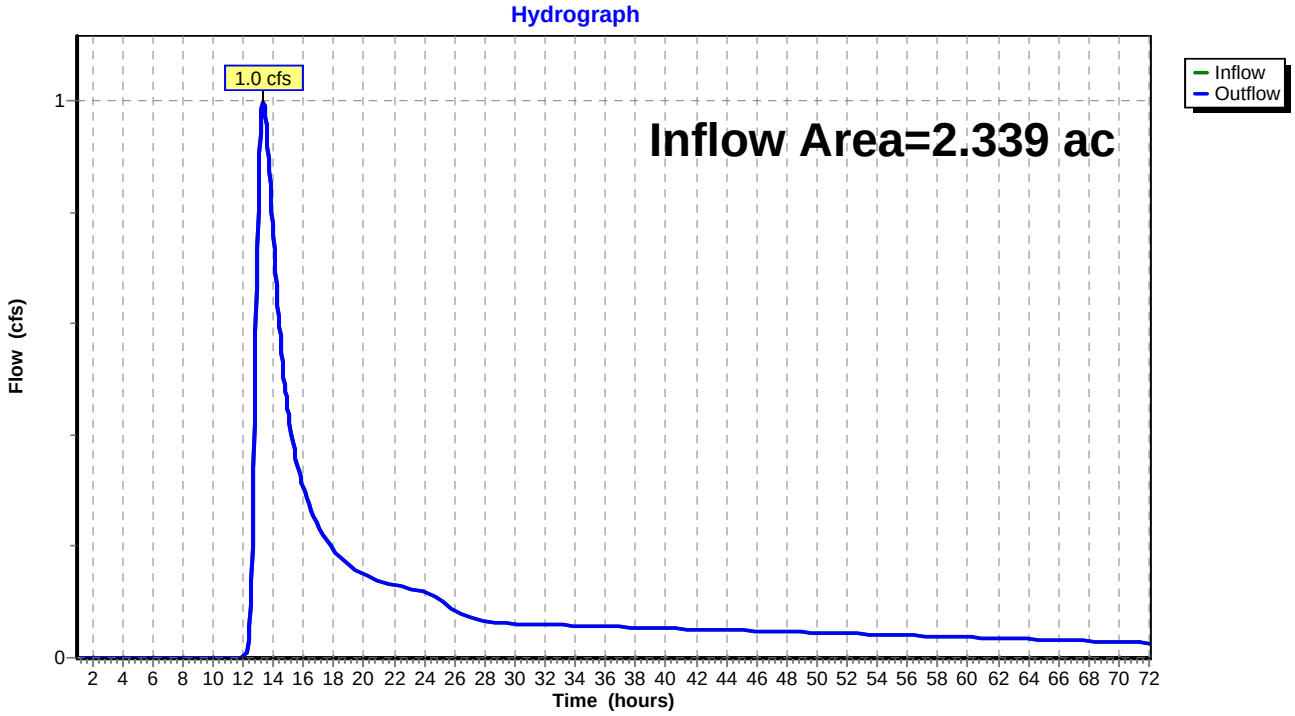
Summary for Reach POA3:

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

Inflow Area = 2.339 ac, 34.03% Impervious, Inflow Depth > 2.44" for 10 yr event
Inflow = 1.0 cfs @ 13.35 hrs, Volume= 0.47 af
Outflow = 1.0 cfs @ 13.35 hrs, Volume= 0.47 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA3:



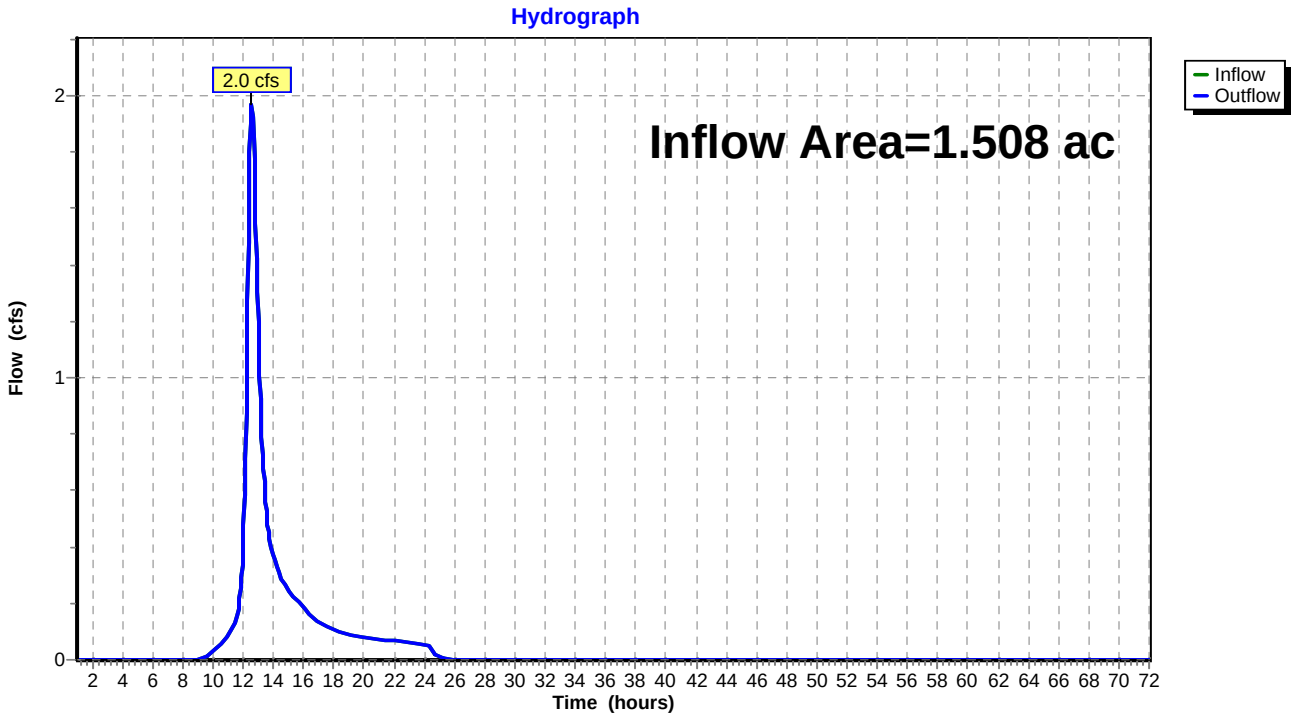
Summary for Reach POA4:

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

Inflow Area = 1.508 ac, 0.00% Impervious, Inflow Depth = 2.32" for 10 yr event
Inflow = 2.0 cfs @ 12.59 hrs, Volume= 0.29 af
Outflow = 2.0 cfs @ 12.59 hrs, Volume= 0.29 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Reach POA4:



Summary for Reach TS1: TS

Inflow Area = 0.690 ac, 85.36% Impervious, Inflow Depth = 4.09" for 10 yr event
Inflow = 2.9 cfs @ 12.09 hrs, Volume= 0.24 af
Outflow = 2.5 cfs @ 12.15 hrs, Volume= 0.24 af, Atten= 16%, Lag= 3.4 min

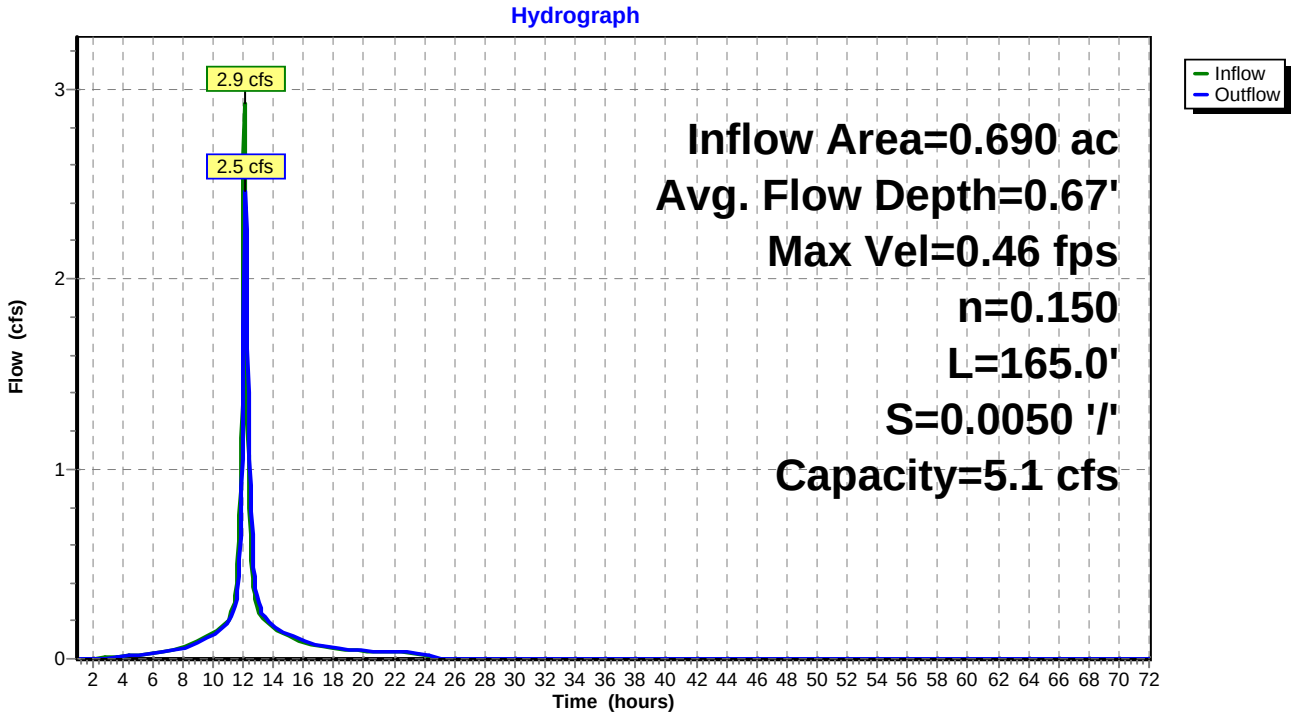
Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.46 fps, Min. Travel Time= 6.0 min
Avg. Velocity = 0.10 fps, Avg. Travel Time= 27.4 min

Peak Storage= 892 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.67'
Bank-Full Depth= 1.00' Flow Area= 9.0 sf, Capacity= 5.1 cfs

6.00' x 1.00' deep channel, n= 0.150 Sheet flow over Short Grass
Side Slope Z-value= 3.0 '/' Top Width= 12.00'
Length= 165.0' Slope= 0.0050 '/'
Inlet Invert= 203.20', Outlet Invert= 202.38'

‡

Reach TS1: TS



Summary for Pond DB:

Inflow Area = 1.118 ac, 52.68% Impervious, Inflow Depth = 3.52" for 10 yr event
Inflow = 3.6 cfs @ 12.12 hrs, Volume= 0.33 af
Outflow = 0.1 cfs @ 20.07 hrs, Volume= 0.24 af, Atten= 98%, Lag= 476.6 min
Primary = 0.1 cfs @ 20.07 hrs, Volume= 0.24 af
Secondary = 0.0 cfs @ 1.00 hrs, Volume= 0.00 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 202.02' @ 20.07 hrs Surf.Area= 6,921 sf Storage= 11,661 cf

Plug-Flow detention time= 1,560.2 min calculated for 0.24 af (73% of inflow)
Center-of-Mass det. time= 1,469.7 min (2,262.4 - 792.7)

Volume	Invert	Avail.Storage	Storage Description
#1	200.00'	27,710 cf	**DB (Conic)** Listed below (Recalc)

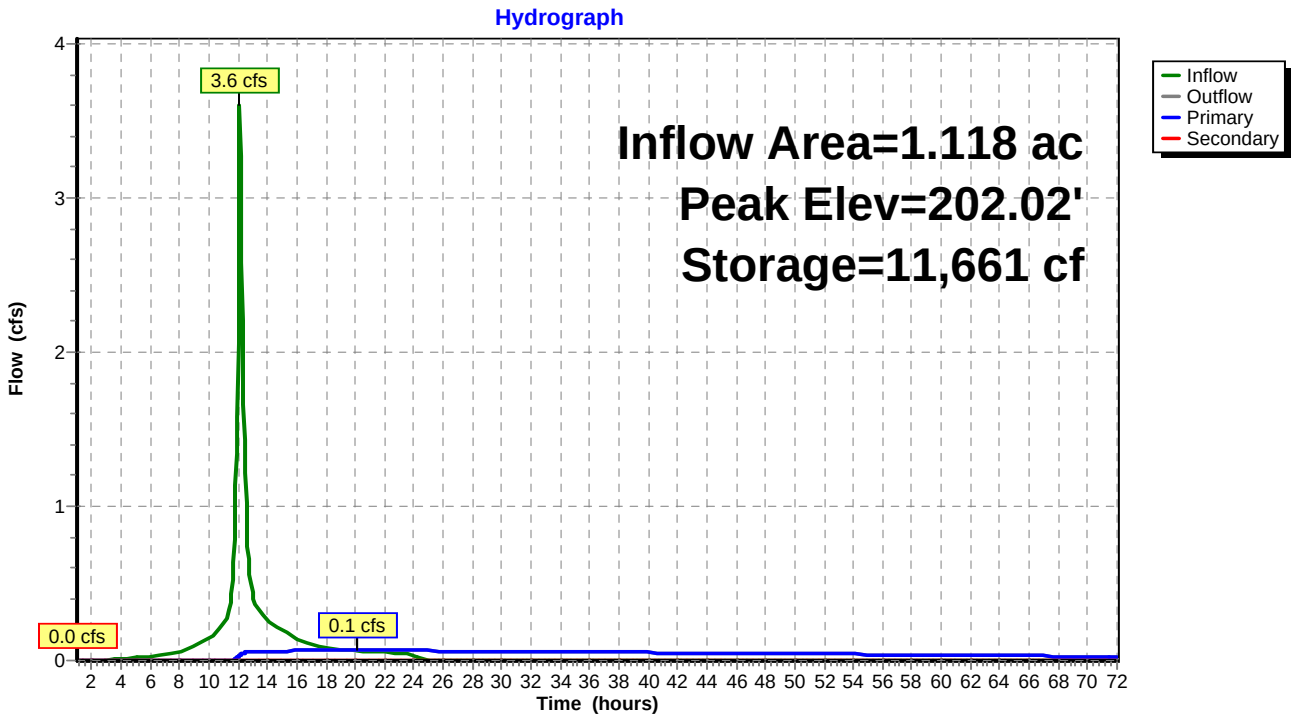
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
200.00	4,707	0	0	4,707
202.00	6,901	11,538	11,538	6,966
204.00	9,332	16,172	27,710	9,479

Device	Routing	Invert	Outlet Devices
#1	Primary	200.00'	**15.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 200.00' / 199.80' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	200.50'	**1.0" Vert. Orifice/Grate X 2.00** C= 0.600
#3	Device 1	202.00'	**2.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Device 1	202.50'	**1.0" Vert. Orifice/Grate X 3.00** C= 0.600
#5	Device 1	203.00'	**15.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Device 1	203.50'	**36.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#7	Secondary	203.75'	**10.0' long x 5.5' 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) 2.35 2.51 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.69 2.73 2.77 2.86

Primary OutFlow Max=0.1 cfs @ 20.07 hrs HW=202.02' TW=199.83' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.1 cfs of 5.5 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.1 cfs @ 5.85 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.0 cfs @ 0.45 fps)
  ├─**4=Orifice/Grate** (Controls 0.0 cfs)
  ├─**5=Orifice/Grate** (Controls 0.0 cfs)
  └─**6=Orifice/Grate** (Controls 0.0 cfs)

Secondary OutFlow Max=0.0 cfs @ 1.00 hrs HW=200.00' TW=199.80' (Dynamic Tailwater)
└─**7=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Pond DB:


Hydrograph
Inflow Area=1.118 ac
Peak Elev=202.02'
Storage=11,661 cf
3.6 cfs
0.1 cfs
0.0 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0 1 2 3 4
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72

Summary for Pond EW: Wetland

[62] Hint: Exceeded Reach 1R OUTLET depth by 0.50' @ 13.35 hrs

Inflow Area = 2.339 ac, 34.03% Impervious, Inflow Depth > 2.61" for 10 yr event
Inflow = 1.5 cfs @ 12.84 hrs, Volume= 0.51 af
Outflow = 1.0 cfs @ 13.35 hrs, Volume= 0.47 af, Atten= 34%, Lag= 30.7 min
Primary = 1.0 cfs @ 13.35 hrs, Volume= 0.47 af

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 199.82' @ 13.35 hrs Surf.Area= 5,157 sf Storage= 3,962 cf

Plug-Flow detention time= 279.6 min calculated for 0.47 af (93% of inflow)
Center-of-Mass det. time= 110.7 min (1,643.4 - 1,532.7)

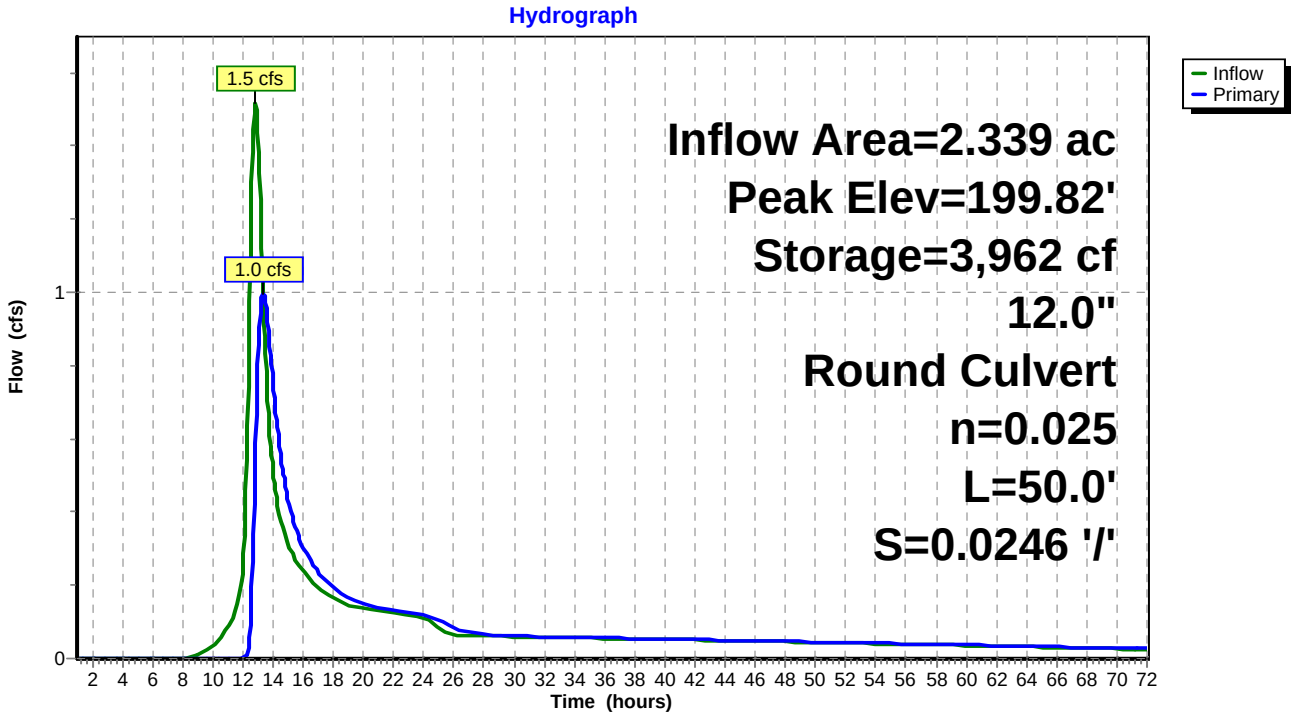
Volume	Invert	Avail.Storage	Storage Description
#1	199.00'	7,650 cf	**wetland pond (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
199.00	4,500	0	0
200.00	5,300	4,900	4,900
200.50	5,700	2,750	7,650

Device	Routing	Invert	Outlet Devices
#1	Primary	199.23'	**12.0" Round Culvert** L= 50.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 199.23' / 198.00' S= 0.0246 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 0.79 sf

Primary OutFlow Max=1.0 cfs @ 13.35 hrs HW=199.82' TW=0.00' (Dynamic Tailwater)
1=Culvert (Inlet Controls 1.0 cfs @ 2.07 fps)

Pond EW: Wetland



APPENDIX A-8:

INSPECTION AND MAINTENANCE MANUAL WITH LONG TERM AGREEMENTS

STORMWATER MANAGEMENT SYSTEMS INSPECTION & MAINTENANCE MANUAL

PREPARED FOR:
ANDERSON WELDING, LLC
COLONIAL WAY
BARRINGTON, NH
STRAFFORD COUNTY

MARCH 2020

PREPARED BY:

NORWAY PLAINS ASSOCIATES, INC.

Scott A. Lawler, P.E.
N.H. Reg. #10026

2 CONTINENTAL BOULEVARD, P.O. BOX 249, ROCHESTER, NEW HAMPSHIRE 03866-0249 (603) 335-3948

TABLE OF CONTENTS

APPENDICES

1.0 INTRODUCTION:

The purpose of this Manual is to:

1) Make the Property Owner/Facility Operator explicitly aware of the maintenance responsibility that goes along with the design site that is located on the southern end of Colonial Way.
2) Set forth instruction on maintenance protocols for all stormwater management practices on the property.
3) Provide maintenance and inspection guidelines to be followed by this property owner, their successors and assigns and the agents thereof.

1.1 SUMMARY OF STORMWATER MANAGEMENT PRACTICES ON-SITE:

There are two (2) primary stormwater management practices employed on the site that will require routine inspection and maintenance to insure proper functioning of stormwater controls into the future.

1) DETENTION BASIN (1)
2) TREATMENT SWALE (1)

1.2 RESPONSIBLE PARTIES:

Property Owner
Wanda Lee & Richard A. Walker, Jr.
24 Greenhill Road
Barrington, NH 03825

Developer
Anderson Welding LLC
Jesse Anderson
269 1st New Hampshire Turnpike Unit #6
Northwood, NH 03261
(603)828-5876
jesse@andersonweldingllc.com

1.3 TRANSFER OF RESPONSIBILITY:

In the event that the property is sold or transferred to another party, Jesse Anderson or a representative of Anderson Welding LLC, shall notify the Town of Barrington of the transfer of ownership and responsibility for the stormwater management practices discussed in this manual. The mailing address for the Town of Barrington is:

Town of Barrington
PO Box 660
Barrington, NH 03825

1.4 LONGTERM AGREEMENT

I the undersigned have read this inspection and maintenance manual. With the signature below, I acknowledge that it is the responsibility of Anderson Welding LLC to maintain or have maintained by qualified professionals all of the stormwater management practices outlined in this manual for perpetuity and that all successors and assigns of Anderson Welding LLC will be responsible for inspection and maintenance of the stormwater management practices as well. I also acknowledge that it is responsibility of Anderson Welding LLC to document any transfer of ownership and responsibility with the Town of Barrington.

Anderson Welding LLC, Representative Date

2.0 INSPECTION & MAINTENANCE (CONSTRUCTION):

During Construction it is important to maintain the site where construction is ongoing in a manner that minimizes tracking of silt, sediment and construction materials onto the gravel surface areas as well as the bottoms of the DETENTION BASIN.

2.1 INSPECTION (CONSTRUCTION):

1) The Site Construction Contractor Shall perform a daily inspection of the entire site to ensure that construction activities are not impacting:

    a. Areas not currently under construction

    b. Areas under construction but sensitive to sediment and silt deposition
        - Gravel and crushed gravel courses

2) The Site superintendent or his designee shall walk the perimeter of the site taking note of any sedimentation /siltation that may be occurring.

3) All silt fences shall be inspected weekly and after each rain event.

4) The Stabilized Construction Exit shall be inspected daily to ensure any mud, sediment and or silt is not tracked off site and is limited on site.

2.2 MAINTENANCE (CONSTRUCTION):

1) The Site Construction Contractor shall be responsible for all erosion and sediment control devices during construction. Refer to the Plan Set "*Proposed Welding and Fabrication Facility*" for all best management practices (BMP's) locations, details on proper installation and, construction sequencing.

2) In an effort to limit travel on the DETENTION BASIN the area should be constructed early in the construction sequence and stabilized as soon as possible.

3) Orange Construction Fence and Silt Fence must be installed around the perimeters of the Detention Basin to discourage travel, storage or other construction related activity in these areas.

4) If silt, sand or sediment becomes noticeably deposited on areas of travel not within the work zone these areas shall be swept or cleaned as appropriate.

3.0 INSPECTION & MAINTENANCE (OPERATION):

To insure the prolonged operational life of all of the stormwater management practices employed on the site it is imperative that a logical and thorough inspection and maintenance plan be implemented. The following sections outline the Inspection & Maintenance Schedule and methods to be employed on site after the completion of construction during the operational life of individual stormwater management practices employed.

3.1 GENERAL SITE:

The site shall undergo general inspection as follows (see Appendix A-1 for Stormwater Management Practices, Inspection & Maintenance Checklist):

1) **Litter and Trash pick-up and removal:**
   a. **Inspection Frequency:**
      - Weekly

   b. **Minimum Inspection Requirements:**
      - Inspect the site within the limits of the lawn areas for blown or loose litter.

   c. **Maintenance/Cleanout Threshold:**
      - Clean as required;
      - Clean when visually apparent litter or trash spillage occurs.

3.2 PAVED ROADWAY & DRIVEWAY AREAS:

The access driveway and parking areas shall undergo inspection as follows (see Appendix A-1 for Stormwater Management Practices, Inspection & Maintenance Checklist)

1) **Paved roadway & driveway surface inspection**

The surface of the areas shall be inspected for erosion twice per year (spring and fall) and shall be re-graded as necessary to promote the sheet flow of stormwater runoff and to prevent the concentration (channelization) of runoff. After plowing it is necessary to inspect roadways and driveways for need of de-icing agent, refer to Appendix 3 for de-icing log.

2) **De-icing Agents:**

   The use of sand as a de-icing agent is allowed **BUT**, should be monitored and applied in minimum amounts necessary. Use the log in Appendix 3 to document the use of de-icing agents.

   a. **Inspection/Maintenance Frequency:**
      - After every plowing, the site manager shall inspect the parking area to determine the need for salt/sand application.

   b. **Minimum Inspection/Maintenance Requirements:**
      - Sand shall be applied only as necessary. This will vary depending on sun exposure. The use of sand shall be minimized.
      - Salt shall be applied only as necessary. This will vary depending on sun exposure. The use of salt shall be minimized.

   c. **Maintenance Threshold:**
      - After plowing of appreciable snow

3.3 DETENTION BASIN:

The Detention Basin shall undergo inspection as follows (see Appendix A-1 for Stormwater Management Practices, Inspection & Maintenance Checklist).

1) **Detention Basin:**

a. **Inspection/Maintenance Frequency:**

- Inspect pretreatment measures (i.e. roadside ditches, culverts, etc.) Bi-annually. Once in the spring prior to May 15 and once in the fall prior to October 15.
- Inspect detention basin and outlet structure bi-annually. Once in the spring prior to May 15 and once in the fall prior to October 15.Inspect detention basin outlet structure after any rainfall event of 2.5-inches in a 24-hour period or greater.
- Conduct periodic mowing of the detention basin slopes and embankments (minimum twice a year) to eliminate woody growth from the embankments and bottom. Mowing the detention basin embankments when mowing the rest of the site is recommended.

B. **MINIMUM INSPECTION/MAINTENANCE REQUIREMENTS:**

- Remove and dispose of accumulated sediment based on inspection. Repair area of removal as necessary to restore detention capacity.
- Perform maintenance and rehabilitation based on inspections.
- Remove debris (if any) from detention basin inlet based on inspection.

3.4 TREATMENT SWALES AND DRAINAGE DITCHES:

The Treatment Swale and Drainage Ditches shall undergo inspection as follows (see Appendix A-1 for Stormwater Management Practices).

1) **Treatment Swales and Drainage Ditches:**

a. **Inspection/Maintenance Frequency:**

- Inspect the swale and ditches bi-annually; once in the spring prior to May 15 and once in the fall prior to October 15.
- Inspect the swale and ditches after any rainfall event of 2.5-inches in a 24-hour period or greater.
- Conduct periodic mowing of the swale and ditches (bottom and embankments) at least twice a year to eliminate woody growth from the embankments and bottom. Mowing the swale and ditches when mowing the rest of the site is recommended, no shorter than 4 inches.

b. **Minimum Inspection/Maintenance Requirements:**

- Remove and dispose of accumulated sediment based on inspection. Repair area of removal as necessary. Restore grass cover as necessary.
- Perform maintenance and rehabilitation based on inspections.

3.5 SEDIMENT & WASTE MATERIAL DISPOSAL:

All material removed from the STORMWATER MANAGEMENT PRACTICES on site shall be disposed of in accordance with local, state and federal regulations offsite.

3.6 CONTROL OF INVASIVE PLANTS

During maintenance activities, check for the presence of invasive plants and remove in a safe manner as described in Appendix A-2. They should be controlled as described by Douglas Cygan with New Hampshire Department of Agriculture, Markets & Food, 603-271-3488, doug.cygan@agr.nh.gov

4.0 RECORD KEEPING; LONG TERM INSPECTION & MAINTENANCE:

Inspection and maintenance logs for stormwater practices employed by new development and re-development with substantial stormwater management infrastructure shall be kept and provided to the Town of Barrington upon request.

4.1 REPORTING REQUIREMENTS:

Inspection and maintenance logs for stormwater practices employed by new development and re-development with substantial stormwater management infrastructure shall be kept and provided to the Barrington Land Use Department:

Barrington Land Use Department
PO Box 660
Barrington, NH 03825
Phone: 603-664-5798

Inspection and maintenance logs for stormwater practices employed by new development and re-development with substantial stormwater management infrastructure shall be made availabe to the City upon request.

APPENDIX A-1:

STORMWATER MANAGEMENT SYSTEM: INSPECTION & MAINTENANCE CHECKLIST

STORMWATER MANAGEMENT SYSTEM: INSPECTION AND MAINTENANCE LOG

Stormwater Management System:
Inspection and Maintenance Checklist

BMP/System Component	Minimum Inspection Frequency	Minimum Inspection Requirements	Maintenance/Cleanout Threshold
General Site:			
Litter and Trash pick-up	Weekly	• Inspect the site within the limits of the lawn areas for blown or loose litter.	• Clean as required • Clean when visually apparent litter or trash spillage has occurred
Control of Invasive Species	Monthly	• Inspect the site where plantings have occurred for any species listed in appendix A-2.	• Disposed of the invasive species in accordance with A-2.
Pavement Parking Areas/Standard Pavement Driveways:			
Parking Lot Sweeping	• At least 1 time per year, preferably 2 times/year (Early Spring prior to May 15 and Fall prior Oct. 15)	• Mandatory sweeping performed by a qualified professional* • Typical street sweeping equipment is acceptable for sweeping the paved areas.	N/A
Paved Surface Inspection	Twice per year – spring and fall	Check all gravel surfaces for erosion	Re-grade as needed to promote sheet flow and prevent channelization of runoff on the gravel surface
De-icing Agent Application	• After every plowing, the site manager shall inspect the parking area to determine the need for sand application.	• Sand shall be applied only as necessary. This will vary depending on sun exposure. The use of sand shall be minimized. • Salt shall be applied only as necessary. This will vary depending on sun exposure. The use of salt shall be minimized.	• After plowing of appreciable snowfall
Open Drainage System:			
Treatment Swales:	• 2 times a year (Early Spring prior to May 15, Fall prior to October 15) same time as the pavement sweeping • Inspect treatment swale after any rainfall event of 2.5-inches in a 24-hour period or greater. • Conduct periodic mowing of the swale slopes and embankments	• Check for sediment accumulation; • Check for floatable contaminants (i.e. oils etc.) • Check for floatable trash (i.e. cigarette butts, paper etc.) • Treatment swale to be cleaned out and the side slopes and	• Remove and dispose of accumulated sediment based on inspection. • Remove debris from the outlet protection prior to the swale at least twice annually.

BMP/System Component	Minimum Inspection Frequency	Minimum Inspection Requirements	Maintenance/Cleanout Threshold
	(minimum twice a year) to eliminate woody growth from the embankments and bottom.	bottoms to be restored to a stabilized condition using equipment appropriate for the job.	
Detention Basins:	• 2 times a year (Early Spring prior to May 15, Fall prior to October 15) same time as the pavement sweeping • Inspect treatment swale after any rainfall event of 2.5-inches in a 24-hour period or greater. • Conduct periodic mowing of the detention basin bottom, slopes and embankments (minimum twice a year) to eliminate woody growth from the embankments and bottom.	• Check for sediment accumulation; • Check for floatable contaminants (i.e. oils etc.) • Check for floatable trash (i.e. cigarette butts, paper etc.) • Detention basin and outlet structure to be cleaned out and the side slopes and bottoms to be restored to a stabilized condition using equipment appropriate for the job.	• Remove and dispose of accumulated sediment based on inspection. • Remove debris from the outlet structure of the detention basin and sediment basin (i.e. stone check dam) at least once annually.

Stormwater Management System Inspection & Maintenance Log

Date Inspected	Inspector	Cleaning/Repair Needed (List Items/Comments)	Date of Cleaning repair	Performed By

APPENDIX A-2:

CONTROL OF INVASIVE PLANTS

CONTROL OF INVASIVE PLANTS

During maintenance activities, check for the presence of invasive plants and remove in a safe manner as described on the following pages. They should be controlled as described on the following pages.

Background:

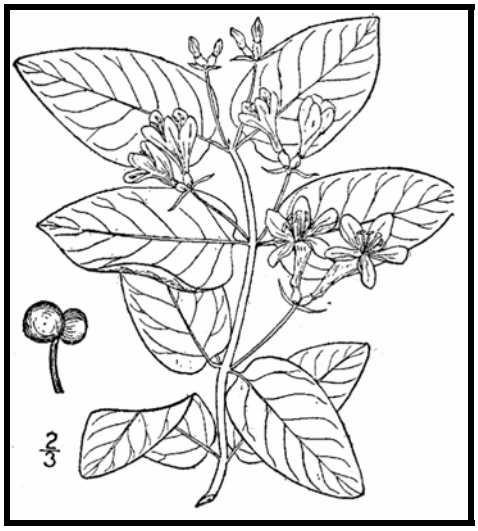
Invasive plants are introduced, alien, or non-native plants, which have been moved by people from their native habitat to a new area. Some exotic plants are imported for human use such as landscaping, erosion control, or food crops. They also can arrive as "hitchhikers" among shipments of other plants, seeds, packing materials, or fresh produce. Some exotic plants become invasive and cause harm by:

- becoming weedy and overgrown;
- killing established shade trees;
- obstructing pipes and drainage systems;
- forming dense beds in water;
- lowering water levels in lakes, streams, and wetlands;
- destroying natural communities;
- promoting erosion on stream banks and hillsides; and
- resisting control except by hazardous chemical.

UNIVERSITY of NEW HAMPSHIRE COOPERATIVE EXTENSION

Methods for Disposing Non-Native Invasive Plants

Prepared by the Invasives Species Outreach Group, volunteers interested in helping people control invasive plants. Assistance provided by the Piscataquog Land Conservancy and the NH Invasives Species Committee. Edited by Karen Bennett, Extension Forestry Professor and Specialist.



Tatarian honeysuckle
Lonicera tatarica
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 3: 282.

Non-native invasive plants crowd out natives in natural and managed landscapes. They cost taxpayers billions of dollars each year from lost agricultural and forest crops, decreased biodiversity, impacts to natural resources and the environment, and the cost to control and eradicate them.

Invasive plants grow well even in less than desirable conditions such as sandy soils along roadsides, shaded wooded areas, and in wetlands. In ideal conditions, they grow and spread even faster. There are many ways to remove these non-native invasives, but once removed, care is needed to dispose the removed plant material so the plants don't grow where disposed.

Knowing how a particular plant reproduces indicates its method of spread and helps determine the appropriate disposal method. Most are spread by seed and are dispersed by wind, water, animals, or people. Some reproduce by vegetative means from pieces of stems or roots forming new plants. Others spread through both seed and vegetative means.

Because movement and disposal of viable plant parts is restricted (see NH Regulations), viable invasive parts can't be brought to most transfer stations in the state. Check with your transfer station to see if there is an approved, designated area for invasives disposal. This fact sheet gives recommendations for rendering plant parts non-viable.

Control of invasives is beyond the scope of this fact sheet. For information about control visit www.nhinvasives.org or contact your UNH Cooperative Extension office.

New Hampshire Regulations

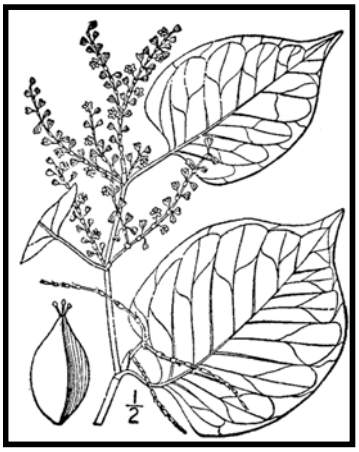
Prohibited invasive species shall only be disposed of in a manner that renders them nonliving and nonviable. (Agr. 3802.04)

No person shall collect, transport, import, export, move, buy, sell, distribute, propagate or transplant any living and viable portion of any plant species, which includes all of their cultivars and varieties, listed in Table 3800.1 of the New Hampshire prohibited invasive species list. (Agr 3802.01)

How and When to Dispose of Invasives?

To prevent seed from spreading remove invasive plants before seeds are set (produced). Some plants continue to grow, flower and set seed even after pulling or cutting. Seeds can remain viable in the ground for many years. If the plant has flowers or seeds, place the flowers and seeds in a heavy plastic bag "head first" at the weeding site and transport to the disposal site. The following are general descriptions of disposal methods. See the chart for recommendations by species.

Burning: Large woody branches and trunks can be used as firewood or burned in piles. For outside burning, a written fire permit from the local forest fire warden is required unless the ground is covered in snow. Brush larger than 5 inches in diameter can't be burned. Invasive plants with easily airborne seeds like black swallow-wort with mature seed pods (indicated by their brown color) shouldn't be burned as the seeds may disperse by the hot air created by the fire.



Japanese knotweed
Polygonum cuspidatum
USDA-NRCS PLANTS Database / Britton, N.L., and A. Brown. 1913. *An illustrated flora of the northern United States, Canada and the British Possessions*. Vol. 1: 676.

Bagging (solarization): Use this technique with softer-tissue plants. Use heavy black or clear plastic bags (contractor grade), making sure that no parts of the plants poke through. Allow the bags to sit in the sun for several weeks and on dark pavement for the best effect.

Tarping and Drying: Pile material on a sheet of plastic and cover with a tarp, fastening the tarp to the ground and monitoring it for escapes. Let the material dry for several weeks, or until it is clearly nonviable.

Chipping: Use this method for woody plants that don't reproduce vegetatively.

Burying: This is risky, but can be done with watchful diligence. Lay thick plastic in a deep pit before placing the cut up plant material in the hole. Place the material away from the edge of the plastic before covering it with more heavy plastic. Eliminate as much air as possible and toss in soil to weight down the material in the pit. Note that the top of the buried material should be at least three feet underground. Japanese knotweed should be at least 5 feet underground!

Drowning: Fill a large barrel with water and place soft-tissue plants in the water. Check after a few weeks and look for rotted plant material (roots, stems, leaves, flowers). Well-rotted plant material may be composted. A word of caution- seeds may still be viable after using this method. Do this before seeds are set. This method isn't used often. Be prepared for an awful stink!

Composting: Invasive plants can take root in compost. Don't compost any invasives unless you know there is no viable (living) plant material left. Use one of the above techniques (bagging, tarping, drying, chipping, or drowning) to render the plants nonviable before composting. Closely examine the plant before composting and avoid composting seeds.

Be diligent looking for seedlings for *years* in areas where removal and disposal took place.

Suggested Disposal Methods for Non-Native Invasive Plants

This table provides information concerning the disposal of removed invasive plant material. If the infestation is treated with herbicide and left in place, these guidelines don't apply. Don't bring invasives to a local transfer station, unless there is a designated area for their disposal, or they have been rendered non-viable. This listing includes wetland and upland plants from the New Hampshire Prohibited Invasive Species List. The disposal of aquatic plants isn't addressed.

<table>
<tr><th>Woody Plants</th><th>Method of Reproducing</th><th>Methods of Disposal</th></tr>
<tr><td rowspan="2">Norway maple
(Acer platanoides)
European barberry
(Berberis vulgaris)
Japanese barberry
(Berberis thunbergii)
autumn olive
(Elaeagnus umbellata)
burning bush
(Euonymus alatus)
Morrow's honeysuckle
(Lonicera morrowii)
Tatarian honeysuckle
(Lonicera tatarica)
showy bush honeysuckle
(Lonicera x bella)
common buckthorn
(Rhamnus cathartica)
glossy buckthorn
(Frangula alnus)</td><td rowspan="2">Fruit and Seeds
  </td><td>Prior to fruit/seed ripening
Seedlings and small plants
▪ Pull or cut and leave on site with roots exposed. No special care needed.
Larger plants
▪ Use as firewood.
▪ Make a brush pile.
▪ Chip.
▪ Burn.</td></tr>
<tr><td>After fruit/seed is ripe
Don't remove from site.
▪ Burn.
▪ Make a covered brush pile.
▪ Chip once all fruit has dropped from branches.
▪ Leave resulting chips on site and monitor.</td></tr>
<tr><td rowspan="2">oriental bittersweet
(Celastrus orbiculatus)
multiflora rose
(Rosa multiflora)</td><td rowspan="2">Fruits, Seeds, Plant Fragments
  </td><td>Prior to fruit/seed ripening
Seedlings and small plants
▪ Pull or cut and leave on site with roots exposed. No special care needed.
Larger plants
▪ Make a brush pile.
▪ Burn.</td></tr>
<tr><td>After fruit/seed is ripe
Don't remove from site.
▪ Burn.
▪ Make a covered brush pile.
▪ Chip – only after material has fully dried (1 year) and all fruit has dropped from branches. Leave resulting chips on site and monitor.</td></tr>
</table>

Non-Woody Plants	Method of Reproducing	Methods of Disposal
garlic mustard *(Alliaria petiolata)* spotted knapweed *(Centaurea maculosa)* ▪ Sap of related knapweed can cause skin irritation and tumors. Wear gloves when handling. black swallow-wort *(Cynanchum nigrum)* ▪ May cause skin rash. Wear gloves and long sleeves when handling. pale swallow-wort *(Cynanchum rossicum)* giant hogweed *(Heracleum mantegazzianum)* ▪ Can cause major skin rash. Wear gloves and long sleeves when handling. dame's rocket *(Hesperis matronalis)* perennial pepperweed *(Lepidium latifolium)* purple loosestrife *(Lythrum salicaria)* Japanese stilt grass *(Microstegium vimineum)* mile-a-minute weed *(Polygonum perfoliatum)*	**Fruits and Seeds** 	**Prior to flowering** Depends on scale of infestation Small infestation ▪ Pull or cut plant and leave on site with roots exposed. Large infestation ▪ Pull or cut plant and pile. (You can pile onto or cover with plastic sheeting). ▪ Monitor. Remove any re-sprouting material. **During and following flowering** Do nothing until the following year or remove flowering heads and bag and let rot. Small infestation ▪ Pull or cut plant and leave on site with roots exposed. Large infestation ▪ Pull or cut plant and pile remaining material. (You can pile onto plastic or cover with plastic sheeting). ▪ Monitor. Remove any re-sprouting material.
common reed (*Phragmites australis*) Japanese knotweed *(Polygonum cuspidatum)* Bohemian knotweed *(Polygonum x bohemicum)*	**Fruits, Seeds, Plant Fragments** Primary means of spread in these species is by plant parts. Although all care should be given to preventing the dispersal of seed during control activities, the presence of seed doesn't materially influence disposal activities.	**Small infestation** ▪ Bag all plant material and let rot. ▪ Never pile and use resulting material as compost. ▪ Burn. **Large infestation** ▪ Remove material to unsuitable habitat (dry, hot and sunny or dry and shaded location) and scatter or pile. ▪ Monitor and remove any sprouting material. ▪ Pile, let dry, and burn.

January 2010

APPENDIX A-3:

DE-ICING LOG

Deicing Log

Date Applied	Type of Deicing Material	Amount Applied

APPENDIX A-9:

RIPRAP APRON SIZING

Project Name: Anderson Welding Project Location.: Tax Map 220 Lot 29
Project No.: 19216 Date: 22-May By: HBL Chk'd By: SAL

Design Storm: 10 Year

Apron Location: DB Outlet

DOWNSTREAM CHANNEL (OR SPREADER) HYDRAULICS:

Q (required) =	**0.10**	**cfs**	←	**From HydroCAD**
Channel Bottom Width =	**1**	**ft.**		
Slope (along channel) =	**0.01**	**ft/ft**		
Left Side Slope =	**3**	**h:v ang. =**	18.43	deg.
Right Side Slope =	**3**	**h:v ang. =**	18.43	deg.
Depth of Flow =	**0.15**	**ft.**	←	**Iterative User Input**
Manning's 'n' =	**0.0630**			
Area =	0.22	sq.ft.		
Wetted Perimeter =	1.95	ft.		
Hydraulic Radius =	0.11	ft.		
Top Width =	1.90	ft.		
Velocity =	0.55	ft/sec		
Q (determined) =	**0.12**	**cfs**	**FLOW DEPTH ACHIEVED**	

La AND W CALCULATIONS:

Culvert Diameter (Do) =	**15**	**Inches**	←	**From HydroCAD**
Tail Water Depth (TW) =	**0.15**	**ft.**		
Length of Apron (La) =	9	ft.		
Width of Apron @ Do (Wo) =	4	ft.		
Width of Apron @ D.S. End (W) =	13	ft.		
Width of Apron if Channel (W) =	1	ft.		

*If outleting to flat area use Tailwater (TW) = 0.2 x Do 0.25

Tailwater TW to be hand calc'd if not outleting to flat area w/ invert out at grade

ROCK RIP-RAP SIZE:

d50 = (0.02 x Q^(4/3))/(TW x Do) **d50 =** **0.00** **ft. or** **0.1** **Inches**

*Use a minimum of 3 Inch d50 if Rip Rap to be installed **USE:** **3** **Inches***

ROCK RIP-RAP GRADATION:

(Taken from Table 7-24 of NHDES Erosion Control Handbook)

% of Weight Smaller Than the Given Size	Size of Stone (inches)		
100	5	to	6
85	4	to	5
50	3	to	5
15	1	to	2

Minimum Rock RipRap Blanket Thickness = 9 **in. use** **9** in.

Minimum 6 inch sand/gravel bedding or geotextile fabric required under all rock riprap

FORMULAE USED:

(Reference NHDES Erosion Control Handbook, Pages 7-114, 7-115)

Note: This spreadsheet was generated using the print-out "Pipe Outlet Protection Apron Design and d50 Riprap Sizing" prepared by Ed Minick of the Rockingham County Conservation District as a guide.

Manning's Uniform Channel Flow:	Q = 1.486*(A x r^(2/3) x s^(1/2)) / n
Length of Apron (La) TW < Do/2:	La = (1.8 x Q/(Do^(1.5)) + 7Do
Length of Apron (La) TW > Do/2:	La = (3.0 x Q/(Do^(1.5)) + 7Do
Width of Apron @ D.S. End TW < Do/2:	W = 3Do + La
Width of Apron @ D.S. End TW >= Do/2:	W = 3Do + 0.4La
Width of D.S. End if Channel:	W = Channel Bottom Width
Width of Apron at Culvert:	Wo = 3 xDo

APPENDIX A-10:

ADDITIONAL REFERENCES USED IN ANALYSIS AND DESIGN

APPENDIX A-10.1:

EXTREME PRECIPITATION TABLES FROM NORTHEAST REGIONAL CLIMATE CENTER

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	New Hampshire
Location	
Longitude	70.989 degrees West
Latitude	43.242 degrees North
Elevation	0 feet
Date/Time	Thu, 12 Mar 2020 10:17:36 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.49	0.65	0.81	1.02	**1yr**	0.70	0.98	1.19	1.53	1.97	2.56	2.82	**1yr**	2.26	2.71	3.13	3.85	4.41	**1yr**
2yr	0.32	0.49	0.61	0.80	1.01	1.28	**2yr**	0.87	1.16	1.49	1.89	2.41	3.08	3.44	**2yr**	2.73	3.30	3.80	4.53	5.16	**2yr**
5yr	0.37	0.57	0.72	0.96	1.23	1.57	**5yr**	1.06	1.44	1.84	2.36	3.03	3.89	4.39	**5yr**	3.44	4.22	4.85	5.70	6.45	**5yr**
10yr	0.40	0.63	0.80	1.09	1.42	1.84	**10yr**	1.22	1.69	2.17	2.80	3.60	4.64	5.29	**10yr**	4.10	5.09	5.83	6.79	7.64	**10yr**
25yr	0.47	0.74	0.94	1.30	1.73	2.27	**25yr**	1.49	2.08	2.69	3.49	4.53	5.85	6.77	**25yr**	5.18	6.51	7.43	8.57	9.56	**25yr**
50yr	0.52	0.83	1.07	1.49	2.01	2.67	**50yr**	1.74	2.45	3.18	4.15	5.40	6.99	8.16	**50yr**	6.18	7.85	8.94	10.21	11.34	**50yr**
100yr	0.58	0.94	1.22	1.72	2.34	3.13	**100yr**	2.02	2.88	3.75	4.92	6.42	8.35	9.85	**100yr**	7.39	9.47	10.76	12.18	13.45	**100yr**
200yr	0.65	1.06	1.37	1.97	2.72	3.69	**200yr**	2.35	3.39	4.43	5.85	7.66	9.97	11.88	**200yr**	8.82	11.43	12.95	14.53	15.96	**200yr**
500yr	0.76	1.26	1.64	2.38	3.34	4.57	**500yr**	2.88	4.21	5.51	7.33	9.65	12.62	15.24	**500yr**	11.17	14.65	16.56	18.37	20.02	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.36	0.44	0.60	0.73	0.90	**1yr**	0.63	0.88	0.91	1.25	1.50	1.96	2.48	**1yr**	1.73	2.38	2.93	3.28	3.96	**1yr**
2yr	0.31	0.48	0.59	0.81	0.99	1.18	**2yr**	0.86	1.15	1.35	1.81	2.33	2.99	3.34	**2yr**	2.65	3.21	3.69	4.41	5.03	**2yr**
5yr	0.35	0.54	0.67	0.91	1.16	1.40	**5yr**	1.00	1.37	1.61	2.13	2.76	3.61	4.05	**5yr**	3.19	3.90	4.52	5.34	6.04	**5yr**
10yr	0.38	0.59	0.73	1.02	1.32	1.60	**10yr**	1.14	1.56	1.81	2.42	3.11	4.13	4.70	**10yr**	3.66	4.52	5.25	6.16	6.91	**10yr**
25yr	0.44	0.67	0.83	1.19	1.56	1.91	**25yr**	1.35	1.87	2.12	2.83	3.62	4.93	5.68	**25yr**	4.37	5.47	6.40	7.42	8.19	**25yr**
50yr	0.49	0.74	0.92	1.33	1.78	2.19	**50yr**	1.54	2.14	2.37	3.19	4.04	5.64	6.56	**50yr**	4.99	6.31	7.44	8.55	9.44	**50yr**
100yr	0.55	0.82	1.03	1.49	2.04	2.52	**100yr**	1.76	2.46	2.67	3.59	4.50	6.43	7.57	**100yr**	5.69	7.28	8.67	9.85	10.77	**100yr**
200yr	0.61	0.91	1.16	1.68	2.34	2.89	**200yr**	2.02	2.82	3.00	4.03	5.01	7.33	8.74	**200yr**	6.49	8.40	10.10	11.35	12.31	**200yr**
500yr	0.71	1.06	1.36	1.98	2.82	3.49	**500yr**	2.43	3.42	3.51	4.71	5.79	8.66	10.55	**500yr**	7.67	10.15	12.36	13.70	14.63	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.53	0.71	0.87	1.07	**1yr**	0.75	1.05	1.23	1.72	2.17	2.77	3.02	**1yr**	2.45	2.90	3.35	4.14	4.74	**1yr**
2yr	0.33	0.50	0.62	0.84	1.03	1.24	**2yr**	0.89	1.21	1.46	1.94	2.50	3.19	3.55	**2yr**	2.82	3.41	3.92	4.67	5.32	**2yr**
5yr	0.39	0.60	0.75	1.02	1.30	1.57	**5yr**	1.12	1.53	1.83	2.47	3.16	4.17	4.71	**5yr**	3.69	4.53	5.18	6.07	6.84	**5yr**
10yr	0.45	0.70	0.86	1.21	1.56	1.90	**10yr**	1.35	1.85	2.21	3.01	3.81	5.14	5.86	**10yr**	4.55	5.63	6.43	7.41	8.29	**10yr**
25yr	0.55	0.84	1.05	1.50	1.97	2.44	**25yr**	1.70	2.38	2.84	3.91	4.89	6.80	7.82	**25yr**	6.02	7.52	8.52	9.80	10.75	**25yr**
50yr	0.64	0.97	1.21	1.74	2.35	2.93	**50yr**	2.03	2.87	3.44	4.75	5.93	8.40	9.74	**50yr**	7.44	9.37	10.56	12.02	13.18	**50yr**
100yr	0.75	1.13	1.41	2.04	2.80	3.53	**100yr**	2.42	3.45	4.17	5.80	7.20	10.39	12.14	**100yr**	9.19	11.68	13.08	14.77	16.09	**100yr**
200yr	0.87	1.31	1.65	2.39	3.34	4.26	**200yr**	2.88	4.17	5.06	7.09	8.73	12.89	15.16	**200yr**	11.40	14.58	16.21	18.14	19.66	**200yr**
500yr	1.06	1.58	2.03	2.95	4.20	5.45	**500yr**	3.62	5.33	6.53	9.24	11.28	17.17	20.32	**500yr**	15.20	19.54	21.52	23.85	25.67	**500yr**

Powered by ACIS Northeast Regional Climate Center

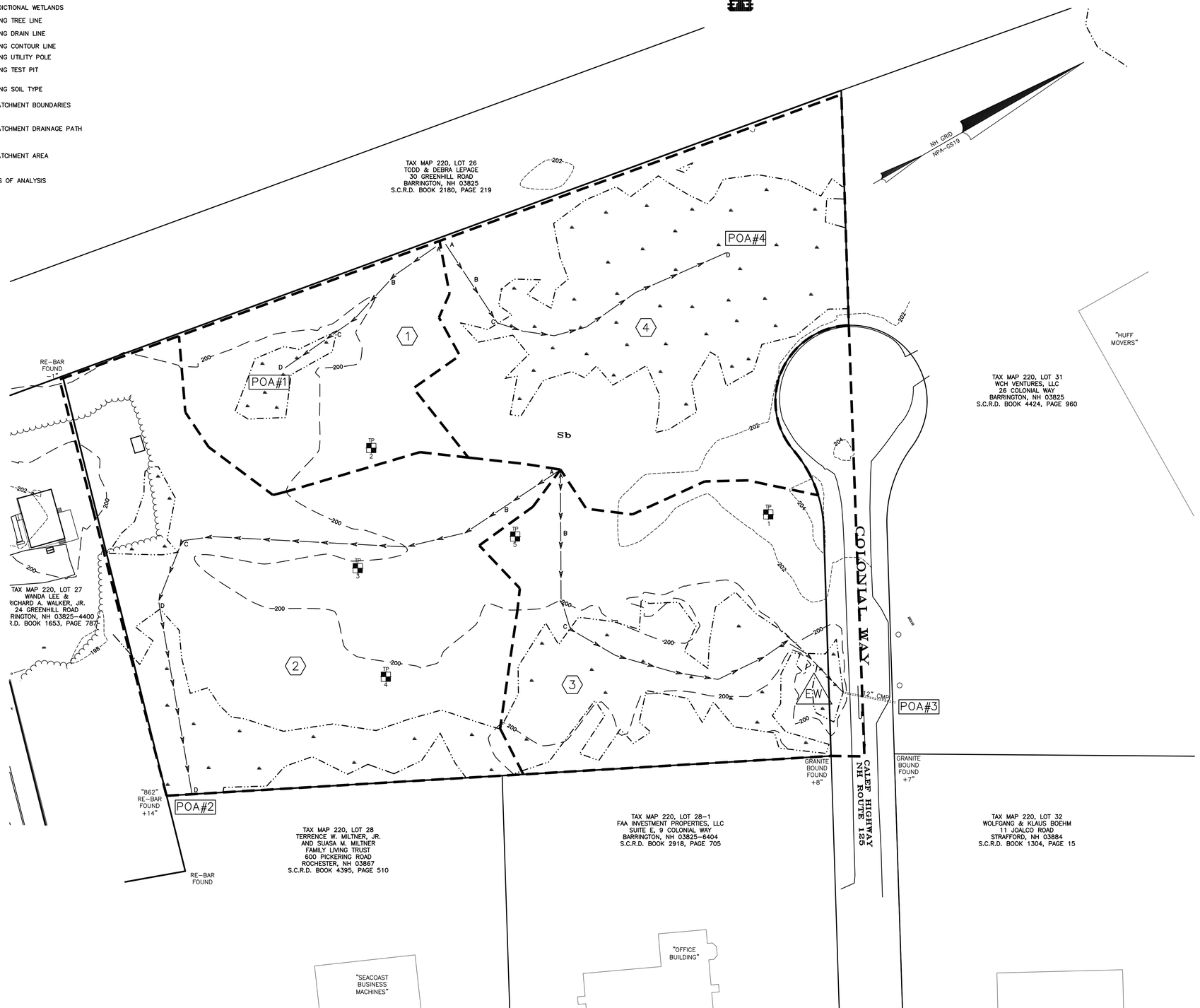
PLANS:

D-2 & D-3

STATE OF NEW HAMPSHIRE
SCOTT A. LAWLER No.10026
LICENSED PROFESSIONAL ENGINEER

LEGEND

- PROPERTY LINE
- JURISDICTIONAL WETLANDS
- EXISTING TREE LINE
- EXISTING DRAIN LINE
- 232 EXISTING CONTOUR LINE
- EXISTING UTILITY POLE
- TP #8 EXISTING TEST PIT
- 29B EXISTING SOIL TYPE
- SUBCATCHMENT BOUNDARIES
- A → B SUBCATCHMENT DRAINAGE PATH
- 7 SUBCATCHMENT AREA
- POA#1 POINTS OF ANALYSIS



PRE-DEVELOPMENT DRAINAGE ANALYSIS PLAN
TAX MAP 220, LOT 29
COLONIAL WAY
BARRINGTON, NH

PREPARED FOR:

ANDERSON PROPERTIES, LLC

MARCH 2020

GRAPHIC SCALE

40 0 20 40 80 160

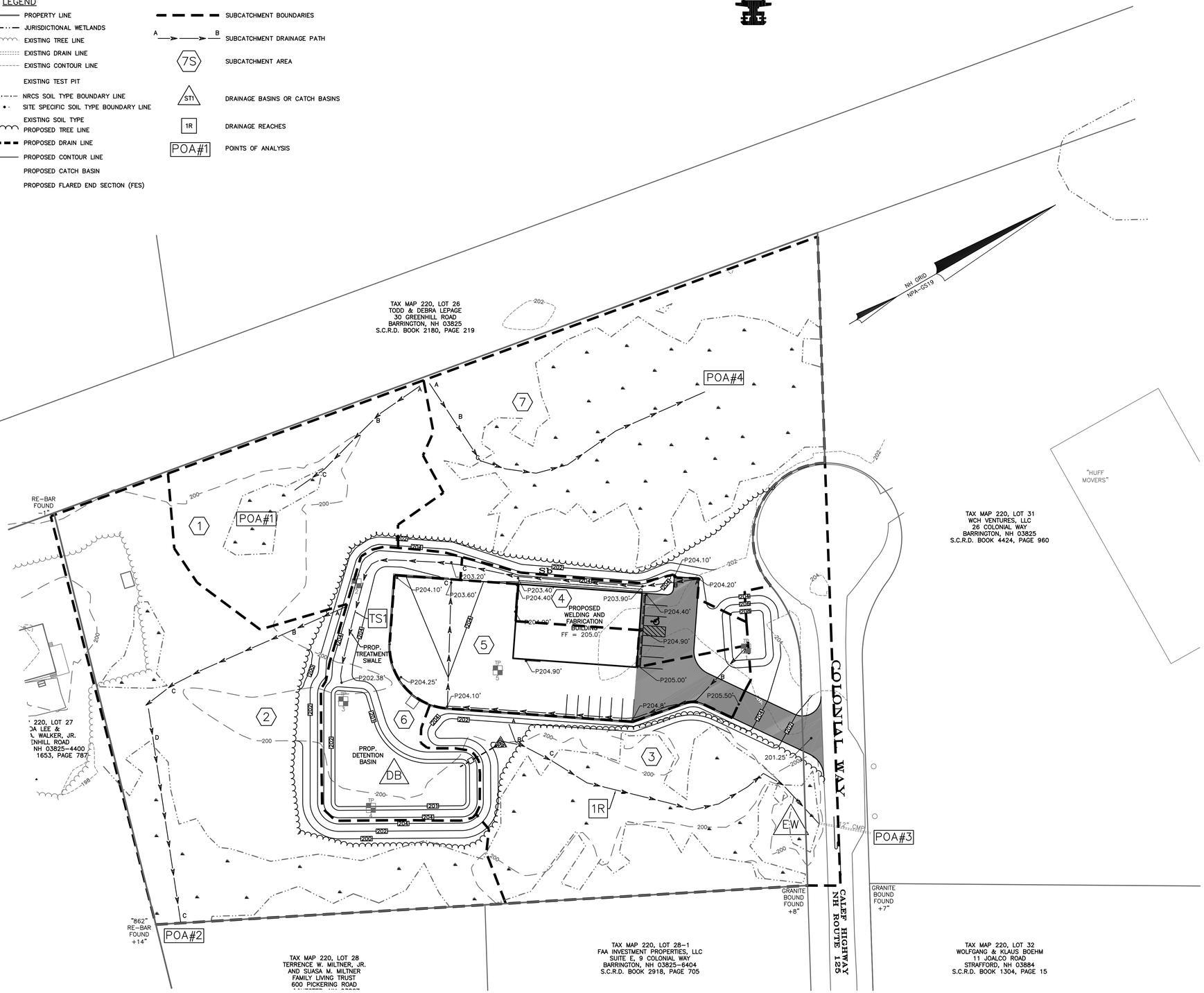
(IN FEET)
1 INCH = 40 FT.

FILE NO. 104
PLAN NO. C-2780
DWG. NO. 15225/SP-1
F.B. NO.

STATE OF NEW HAMPSHIRE
SCOTT A. LAWLER No.10026 LICENSED PROFESSIONAL ENGINEER

LEGEND

- PROPERTY LINE
- JURISDICTIONAL WETLANDS
- EXISTING TREE LINE
- EXISTING DRAIN LINE
- 232 EXISTING CONTOUR LINE
- TP #8 EXISTING TEST PIT
- NRCS SOIL TYPE BOUNDARY LINE
- SITE SPECIFIC SOIL TYPE BOUNDARY LINE
- 29B EXISTING SOIL TYPE
- PROPOSED TREE LINE
- PROPOSED DRAIN LINE
- 232 PROPOSED CONTOUR LINE
- PROPOSED CATCH BASIN
- PROPOSED FLARED END SECTION (FES)
- SUBCATCHMENT BOUNDARIES
- A → B SUBCATCHMENT DRAINAGE PATH
- 7S SUBCATCHMENT AREA
- ST1 DRAINAGE BASINS OR CATCH BASINS
- 1R DRAINAGE REACHES
- POA#1 POINTS OF ANALYSIS



POST-DEVELOPMENT DRAINAGE ANALYSIS PLAN
TAX MAP 220, LOT 29
COLONIAL WAY
BARRINGTON, NH

PREPARED FOR:

ANDERSON PROPERTIES, LLC

MARCH 2020

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 INCH = 40 FT.

FILE NO. 104
PLAN NO. C-2780
DWG. NO. 15225/SP-1
F.B. NO.

D-3