
STORMWATER REPORT

For Proposed work at:
1320 South Street
Andover, MA 02743

Prepared By:
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55 Technology Drive, Suite 102
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Submitted to:
**Town of Andover
Planning Board**
36 Bartlet Street
Andover, MA 01810

July 27, 2022

1. Introduction

The proposed project is to construct a 12MW AC stand alone storage facility on a +/-9.88 acre parcel off of Moonlight Drive in Andover, Massachusetts. The proposed project area of disturbance is approximately 1.5 acres and consists of the lithium-ion battery storage system, gravel access road, necessary grading and tree clearing areas.

The project is subject to Massachusetts Department of Environmental Protection (MADEP) stormwater standards. The project has been designed to comply with these stormwater standards; calculations and supporting evidence has been presented in section 4 of this document. This document also presents existing conditions and proposed construction as well as hydrologic conditions pre- and post-development.

2. Existing Conditions

The proposed project is located to the east of Moonlight Drive in Andover, Massachusetts. Natural resources have been professionally delineated within and around the project site, resulting in the flagging of a wetland complex just north of the parcel, and one vernal pool located to the northwest. A few hundred feet north of the parcel also lies the Shawsheen River.

The area of hydrologic study is approximately 6.9 acres; however, the total project limit of disturbance area will be kept to an area of approximately 1.5 acres. The area of study is mostly wooded land cover with some grassed areas, brush within a utility easement and wetlands. The existing topography of the project area is sloping towards the northern wetland complex, which then drains to the Shawsheen River, which is all offsite. The elevations of the project site range from +/-102 feet in the southwest corner of the parcel to +/-67 feet in the northeast corner.

3. Proposed Construction

The proposed project will consist of the construction of the standalone storage equipment pads, and gravel access road. The project is located outside all wetland buffers, riverfront

buffers, vernal pool buffers and FEMA Zone AE areas. The layout of the proposed project can be found in the project plan set on sheet C-3.0 Layout and Materials Plan.

Energy Storage Facility Characteristics

Parcel Area:	9.88± acres
Batteries:	92 – 4 hour duration lithium ion batteries
Number of Inverters:	4 inverters
Height of Fence:	7-foot
Proposed Impervious area:	5,442 sf (concrete pads)
Proposed gravel roads/pad:	27,585 ± sf
Total area of disturbance:	1.5 acres
Fenced area:	0.52 acres

Where batteries or roads are installed, wooded areas will need to be cleared and the stumps removed. Due to the more significant impact this represents, no activity will be done in any buffer zones or protected areas.

4. Stormwater

The Massachusetts Department of Environmental Protection (MA DEP) issued stormwater standards in 2008. The following section describes how each of these standards will be achieved by incorporating Best Management Practices into the design.

Standard No. 1 – No new stormwater conveyances may discharge untreated directly to or cause erosion in wetlands or waters of the Commonwealth.

Stormwater from the facility will be directed to infiltration Best Management Practices (BMPs) and will not discharge directly to wetlands or waters of the Commonwealth. Two infiltration swales are proposed to capture runoff from the road and battery system areas and direct stormwater northwest and northeast of the project site. Check dams located along the length of these swales will slow the flow of water to prevent scouring or transportation of sediment off of the site. Additionally, runoff from the entire fenced portion of the project will be captured by an infiltration basin. An emergency overflow has been designed just in case and the overflow will discharge to the northwest at a rate designed to mimic existing discharge rates. These discharges are located a minimum of 100 feet away from the wetland boundary.

Standard No. 2 – Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.

The following section outlines the procedure for determining the peak rates for the existing condition as well as the methods for attenuating the peak flows in the proposed condition.

Methodology and Design Criteria

The drainage analysis was performed using the Soil Conservation Service (SCS) TR-55 and TR-20 methodologies and the computer program HydroCAD by HydroCAD Software Solutions, LLC.

Time of concentration (Tc) values were calculated using Average Velocities for Overland Flow, found in SCS TR-55 Urban Hydrology for Small Watersheds.

Curve numbers were developed for each of the different use categories and hydrologic soil group types within each sub-area. The curve numbers were based on the SCS TR-55 methodology and are included in the HydroCAD input and output found in the attachments of this report.

Rainfall depths are based on a 24-hour event using the “NOAA Atlas 14”. The following rainfall depths were used in the calculations:

Storm Event Rainfall Depth

1-Year	2.59 inches	25-Year	6.24 inches
2-Year	3.21 inches	100-Year	8.04 inches
10-Year	5.08 inches		

Soil Conditions

The NRCS soil maps for the proposed project area find soils with a low runoff potential, classified as Hydrologic Soil Group A. Approximately 0.5 acres of the site is classified as Hydrologic Soil Group D. The soils found within the area of analysis are:

- Water
- Freetown muck, 0 to 1 percent slopes
- Windsor loamy sand, 3 to 8 percent slopes

The NRCS soil report can be found in the attachments section of this report.

Existing Conditions

The area of analysis is approximately 6.9 acres. Under the existing condition stormwater runoff from the proposed project site flows to one main point of analyses. A pre-development watershed map can be found in the attachments.

Point of Analysis 1

Point of Analysis 1 (POA-1) discharges to the north and northwestern end of the site. Runoff travels overland across the proposed project site where it exits the parcel and travels towards POA-1 and the wetland system. The existing condition consists of one subcatchment area (1) which is approximately 6.9 acres and consists of mostly woods with some areas of grass, brush and roofs.

Each existing cover type was assigned a curve number. Those can be found broken down in the HydroCAD Report attached. The weighted drainage area characteristics for the existing conditions can be found in Table 1.

Table 1 - Existing Conditions Drainage Area Characteristics

Subcatchment	Area Acres (AC)	Curve Number*	Tc (mins**)
1	6.88	35	39.9

*Reference HydroCAD Data for Pre-Development Conditions, CN of each drainage area.

**Reference HydroCAD Data for Pre-Development Conditions, TC of each drainage area.

Proposed Conditions

The proposed conditions continue to consider the one Point of Analysis (POA-1) as described above. A post development watershed map can be found in the attachments.

Point of Analysis 1

The location of Point of Analysis 1 (POA-1) is unchanged from existing conditions; it is located at the north/northwestern end of the site. Post-development, the drainage area consists of batteries and a gravel access drive with existing woodlands and grassed wetland areas that will remain undisturbed. Under the proposed conditions, four subcatchment areas flow to POA-1 (Subcatchments 10, 11, 12 and 13).

Subcatchment 13 consists of a small area (0.07 acres) of the gravel access road which will flow towards an infiltration swale and then into an infiltration trench. This trench will be dug out and lined with fabric and then filled with crushed stone to allow for proper infiltration. This is modeled in HydroCAD as 14P. The water that does not infiltrate during large storm events will be discharged to the northwest of the site towards POA-1. The infiltration rate used to model this was gathered from the NRCS data base. The area where the BMP is proposed is rated 100 micrometers/hr. In inches/hr this translates to 14.2 in/hr. To be extremely conservative until soil testing is performed, the infiltration rate chosen for the model was 2.41 inches/hr per Horsley Witten recommendation. Soil testing is underway to get accurate infiltration rates as well as accurate depth to groundwater values.

Subcatchment 12 encompasses the entire gravel and concrete equipment pad. The pad was graded with a slight slope, allowing water to travel northwest into an infiltration basin. The basin has been designed to infiltrate the full 100-year storm discharging from the facility area. In an emergency event, any water that would need to be discharged from the basin will do so through a rip-rap lined emergency outlet at elevation 80'. The infiltration rate used to model this was gathered from the NRCS data base. The area where the BMP is proposed is rated 100 micrometers/hr. In inches/hr this translates to 14.2 in/hr. To be extremely conservative until soil testing is performed, the infiltration rate chosen for the model was 2.41 inches/hr per Horsley Witten recommendation. Soil testing is underway to get accurate infiltration rates as well as accurate depth to groundwater values.

Subcatchment 11 consists of water that flows from a high point near the landowner's house. The water will enter an infiltration swale designed to intercept the flow of water before it flows over the road. The flat slope of the swale, combined with stone check dams, will allow for sufficient retention time to allow for infiltration within the swale. The remaining water that doesn't get infiltrated will get taken east where it will discharge away from the system and towards the original POA-1. The infiltration rate used to model this was gathered from the NRCS data base. The area where the BMP is proposed is rated 100 micrometers/hr. In inches/hr this translates to 14.2 in/hr. To be extremely conservative until soil testing is performed, the infiltration rate chosen for the model was 2.41 inches/hr per Horsley Witten recommendation. Soil testing is underway to get accurate infiltration rates as well as accurate depth to groundwater values.

Subcatchment 10 consists of all remaining areas that will flow overland to POA-1.

Table 2 - Proposed Conditions Drainage Area Characteristics

Subcatchment	Area	Curve Number*	Tc (mins**)
--------------	------	---------------	-------------

	Acres (AC)		
10	4.32	37	35.2
11	1.68	44	16.0
12	0.74	83	6.0
13	0.14	79	6.0

*Reference HydroCAD Data for Post-Development Conditions, CN of each drainage area.

**Reference HydroCAD Data for Post-Development Conditions, TC of each drainage area.

Peak Discharge Runoff Rates

The peak flows were calculated for the 2-, 10-, and 100-year storm events under the existing and proposed conditions to compare with the existing runoff rates. These rates are shown in Table 3.

Table 3 Existing and Proposed Peak Rates of Runoff

Discharge Point	2-YR			10-YR			100-YR		
	Pre (cfs)	Post (cfs)	Δ (cfs)	Pre (cfs)	Post (cfs)	Δ (cfs)	Pre (cfs)	Post (cfs)	Δ (cfs)
POA-1	0.0	0.0	(0.0)	0.1	0.1	(0.0)	1.8	1.8	(0.0)

As shown, all the proposed peak rates of runoff will be lower than the existing rates.

Standard No. 3 – Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operations and maintenance. At a minimum, the annual recharge from pre-development site shall approximate the annual recharge from pre-development conditions based on soil type. This standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Infiltration BMPs have been used extensively in the stormwater design to ensure groundwater recharge rates will be minimally impacted. Annual recharge to groundwater will continue to occur. Any precipitation that falls on the project site will shed directly onto the ground not affecting annual groundwater recharge. The areas of impervious cover are

due to the battery equipment. Any water that lands in that area will be guided to an infiltration basin to allow for groundwater recharge.

Recharge Calculations:

The required recharge volume equals a depth of runoff corresponding to the soil type times the impervious areas covering that soil type at the post-development site. See Table 4 for the target depth of runoff to be infiltrated for each soil group.

Table 4 Target Recharge Depth Based on Hydrologic Soil Group

HSG	Soil Texture	Target Depth (inches)
A	Sand	0.60
B	Loam	0.35
C	Silty Loam	0.25
D	Clay	0.10

Recharge Volumes Required

Based on impervious surfaces (concrete pads = 5,442 sf), and the soil type where they are located (HSG A):

$$\text{Recharge Volume Required} = (\text{Area})(\text{Target Depth}) \left(\frac{\text{in}}{\text{ft}} \right) = \frac{5,442\text{sf}(0.60\text{in})}{12} = \mathbf{272.1 \text{ cubic feet}}$$

Recharge Volumes Provided

All discharges from the energy storage facility will be directed to the infiltration basin. This basin has been oversized to accommodate and infiltrate the entire 100-year Storm, a total of 18,557 cubic feet. This is significantly more than the 272 cubic feet required for the minimum Recharge volume, and so therefore Standard 3 is met.

Standard No. 4 – Stormwater Management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).

80% TSS shall be achieved on site via the use of the infiltration basin. All impervious areas constructed as part of the facility will have runoff transported to the infiltration basin, where the entire water quality volume will be infiltrated, thereby removing greater than 80% TSS. The required water quality volume has been calculated below:

Given:

- The site is in an area of rapid infiltration (rate greater than 2.4 inches/hour), therefore the Water Quality Depth = 1.0 Inch of runoff
- Total Impervious area = 5,442 square feet

$$\begin{aligned} \text{Required Water Quality Volume} &= (\text{Water Quality Depth})(\text{Total Impervious Area}) \\ &= (1.0 \text{ inch})(5,442 \text{ SF}) \left(\frac{1 \text{ ft}}{12 \text{ inches}} \right) = \mathbf{453.5 \text{ CF}} \end{aligned}$$

The infiltration basin has been designed to provide infiltration for 18,557 cubic feet, much greater than the Required Water Quality Volume. Additionally, the impervious surface proposed as part of this project is not for vehicular access. Therefore, there are no significant generators of TSS as part of the proposed project. Any access to the project will be via gravel drives and stormwater runoff will be allowed to directly recharge into the ground. Such areas will also be surrounded by grassed pervious surfaces, which will encourage further infiltration. Standard 4 has been met.

Standard No. 5 – For land uses with higher pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.

The proposed project is not classified as a “Land Use with Higher Pollutant Loads”. This standard does not apply to the project. Standard 5 has been met.

Standard No. 6 – Stormwater discharges with the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.

We have reviewed the Massachusetts Geographical Information System (GIS) and the site is not located within Zone II, Interim Wellhead Protection Areas, or Outstanding Resource Watersheds and therefore this standard has been met.

Standard No. 7 - A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

The project is not a redevelopment project.

Standard No. 8 - A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period pollution prevention plan) shall be developed and implemented.

A Stormwater Pollution Prevention Plan (SWPPP) will be implemented to control erosion and sedimentation associated with the construction/installation of the project. Erosion and sedimentation controls will be in place prior to construction-related land disturbance on the site. A NPDES (National Pollutant Discharge Elimination System) Notice of Intent (NOI) will be filed with the US EPA a minimum of 14 days prior to the commencement of construction.

Standard No. 9 - A long-term Operation and Maintenance Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

An Operations and Maintenance Plan (O & M) has been developed. The O & M Plan will be implemented to ensure that any site stormwater management systems function as designed. The owner of the system will be responsible for contracting with an energy storage facility operations and maintenance company to implement the attached O & M Plan. The Site Inspection Protocol and Long-Term Pollution Prevention Plans included as part of this submittal.

Standard No. 10 - All illicit discharges to the stormwater management system are prohibited.

An Illicit Discharge Compliance Statement confirming that no illicit discharges exist on site will be provided prior to the discharge of any stormwater to post-construction BMPs.



Energy Storage Facility
Stormwater Report
1320 South Street
Andover, MA

As demonstrated by the above sections and the attached supporting material, the proposed project at 1320 South Street in Andover, Massachusetts has been designed to meet the stormwater standards set forth by the Massachusetts Department of Environmental Protection and the Regulations for Stormwater Quality and Quantity Control in Andover, Massachusetts.

If any questions arise during review of the contents above and attachments, please do not hesitate to contact me.

Thank you,

Borrego Solar Systems

Carli Shroyer

Civil Engineer

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860-558-4869



Energy Storage Facility
Stormwater Report
1320 South Street
Andover, MA

Attachments:

Pre-Development Watershed Plan

Post-Development Watershed Plan

Pre-Development HydroCAD Analysis

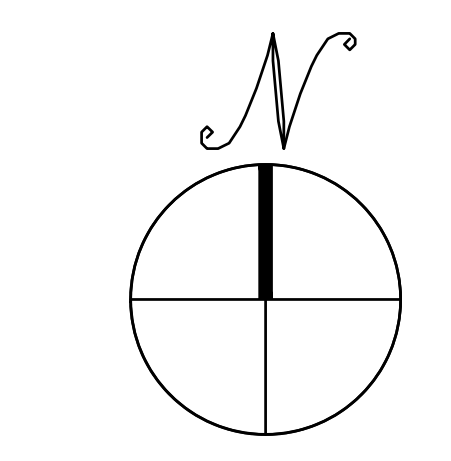
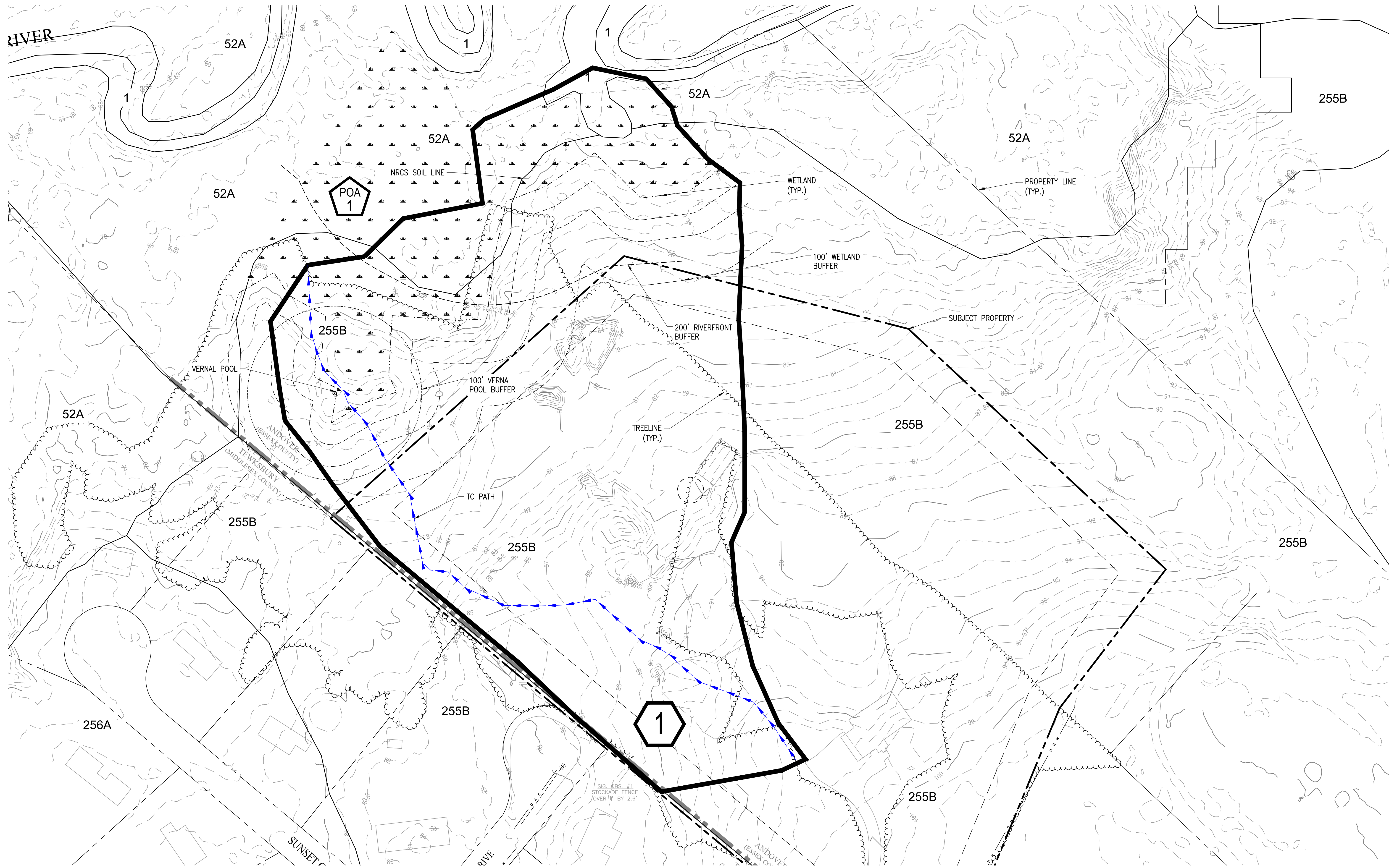
Post-Development HydroCAD Analysis

NRCS Hydrologic Soil Group Report

NRCS Depth to Water Table Report

NRCS Saturated Hydraulic Conductivity (ksat) Report

PRE-DEVELOPMENT WATERSHED PLAN



PRE-DEVELOPMENT WATERSHED PLAN

SCALE: 1" = 50.34'

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CONSTRUCTION ACCESS PLAN
 1320 S STREET
 ANDOVER, MA 01810

PROJECT NUMBER:
 120-0345

REV	DATE	DRAWN	CHECKED	RELEASE LEVEL	COMMENTS
1	4/12/22	CS	BS	SITE USE PERMIT SET	
2	6/14/22	CS	BS	RESPONSE TO PEER REVIEW	

SCALES STATED ON DRAWINGS ARE VALID ONLY WHEN PLOTTED ARCH D 24" X 36"

W-1.0
 PRE-DEVELOPMENT WATERSHED PLAN

POST-DEVELOPMENT WATERSHED PLAN

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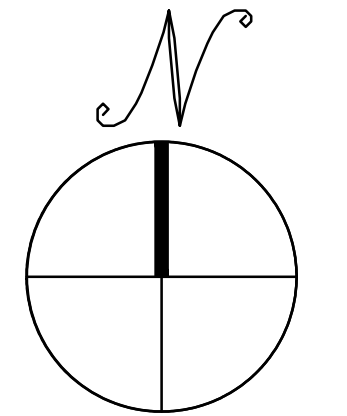
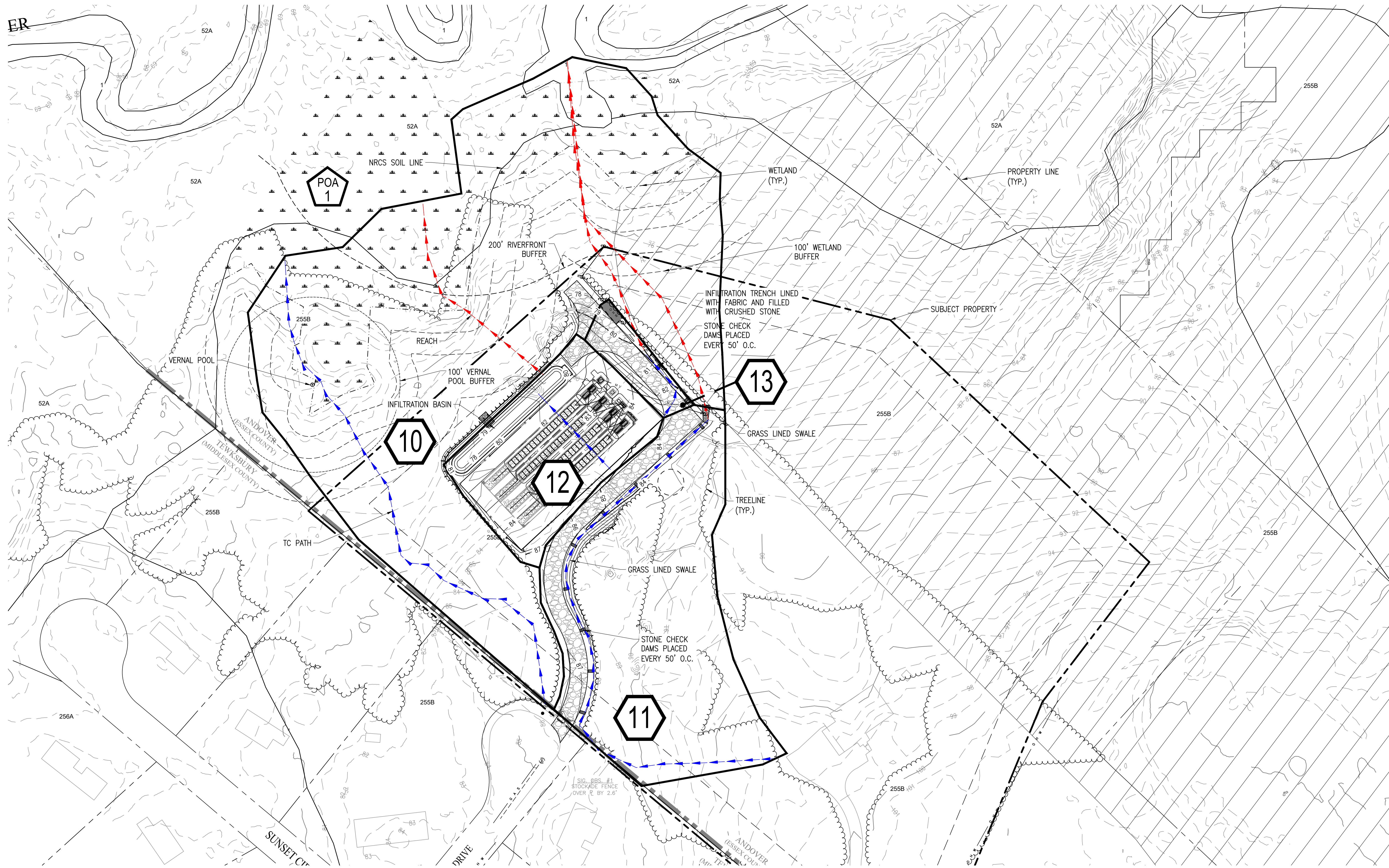
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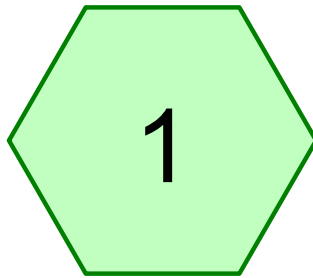
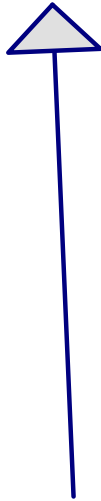
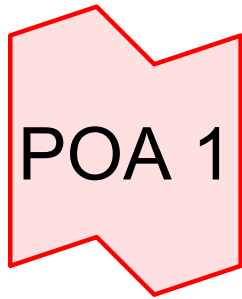
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POST DEVELOPMENT WATERSHED PLAN



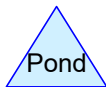
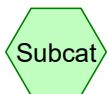
POST DEVELOPMENT WATERSHED PLAN

SCALE: 1" = 50'
0 50' 100'

PRE-DEVELOPMENT HYDROCAD ANALYSIS



Subcat 1



1320 South St MA_Pre_052022_D

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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.21	2
2	10-Year	Type III 24-hr		Default	24.00	1	5.08	2
3	100-Year	Type III 24-hr		Default	24.00	1	8.04	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.42	39	>75% Grass cover, Good, HSG A (1)
1.29	30	Brush, Good, HSG A (1)
0.58	73	Brush, Good, HSG D (1)
0.03	98	Roofs, HSG A (1)
4.52	30	Woods, Good, HSG A (1)
0.04	77	Woods, Good, HSG D (1)
6.87	35	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.25	HSG A	1
0.00	HSG B	
0.00	HSG C	
0.63	HSG D	1
0.00	Other	
6.87		TOTAL AREA

1320 South St MA_Pre_052022_D

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.42	0.00	0.00	0.00	0.00	0.42	>75% Grass cover, Good	1
1.29	0.00	0.00	0.58	0.00	1.87	Brush, Good	1
0.03	0.00	0.00	0.00	0.00	0.03	Roofs	1
4.52	0.00	0.00	0.04	0.00	4.56	Woods, Good	1
6.25	0.00	0.00	0.63	0.00	6.87	TOTAL AREA	

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1: Subcat 1

Runoff Area=6.87 ac 0.40% Impervious Runoff Depth=0.00"
Flow Length=847' Tc=39.9 min CN=35 Runoff=0.0 cfs 0.000 af

Link POA 1:

Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Total Runoff Area = 6.87 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
99.60% Pervious = 6.85 ac 0.40% Impervious = 0.03 ac

Summary for Subcatchment 1: Subcat 1

Runoff = 0.0 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"
 Routed to Link POA 1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Rainfall=3.21"

Area (ac)	CN	Description
0.42	39	>75% Grass cover, Good, HSG A
1.29	30	Brush, Good, HSG A
0.58	73	Brush, Good, HSG D
0.03	98	Roofs, HSG A
4.52	30	Woods, Good, HSG A
0.04	77	Woods, Good, HSG D
6.87	35	Weighted Average
6.85		99.60% Pervious Area
0.03		0.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.9	50	0.0032	0.03		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
0.6	53	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
13.4	744	0.0341	0.92		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
39.9	847	Total			

Summary for Link POA 1:

Inflow Area = 6.87 ac, 0.40% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.0 cfs @ 5.00 hrs, Volume= 0.000 af
 Primary = 0.0 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1: Subcat 1

Runoff Area=6.87 ac 0.40% Impervious Runoff Depth=0.09"
Flow Length=847' Tc=39.9 min CN=35 Runoff=0.1 cfs 0.054 af

Link POA 1:

Inflow=0.1 cfs 0.054 af
Primary=0.1 cfs 0.054 af

Total Runoff Area = 6.87 ac Runoff Volume = 0.054 af Average Runoff Depth = 0.09"
99.60% Pervious = 6.85 ac 0.40% Impervious = 0.03 ac

Summary for Subcatchment 1: Subcat 1

Runoff = 0.1 cfs @ 15.55 hrs, Volume= 0.054 af, Depth= 0.09"
 Routed to Link POA 1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.08"

Area (ac)	CN	Description
0.42	39	>75% Grass cover, Good, HSG A
1.29	30	Brush, Good, HSG A
0.58	73	Brush, Good, HSG D
0.03	98	Roofs, HSG A
4.52	30	Woods, Good, HSG A
0.04	77	Woods, Good, HSG D
6.87	35	Weighted Average
6.85		99.60% Pervious Area
0.03		0.40% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.9	50	0.0032	0.03		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
0.6	53	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
13.4	744	0.0341	0.92		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
39.9	847	Total			

Summary for Link POA 1:

Inflow Area = 6.87 ac, 0.40% Impervious, Inflow Depth = 0.09" for 10-Year event
 Inflow = 0.1 cfs @ 15.55 hrs, Volume= 0.054 af
 Primary = 0.1 cfs @ 15.55 hrs, Volume= 0.054 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

Time span=5.00-30.00 hrs, dt=0.05 hrs, 501 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1: Subcat 1

Runoff Area=6.87 ac 0.40% Impervious Runoff Depth=0.82"
Flow Length=847' Tc=39.9 min CN=35 Runoff=1.8 cfs 0.468 af

Link POA 1:

Inflow=1.8 cfs 0.468 af
Primary=1.8 cfs 0.468 af

Total Runoff Area = 6.87 ac Runoff Volume = 0.468 af Average Runoff Depth = 0.82"
99.60% Pervious = 6.85 ac 0.40% Impervious = 0.03 ac

Summary for Subcatchment 1: Subcat 1

Runoff = 1.8 cfs @ 12.77 hrs, Volume= 0.468 af, Depth= 0.82"
 Routed to Link POA 1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=8.04"

Area (ac)	CN	Description
0.42	39	>75% Grass cover, Good, HSG A
1.29	30	Brush, Good, HSG A
0.58	73	Brush, Good, HSG D
0.03	98	Roofs, HSG A
4.52	30	Woods, Good, HSG A
0.04	77	Woods, Good, HSG D
6.87	35	Weighted Average
6.85		99.60% Pervious Area
0.03		0.40% Impervious Area

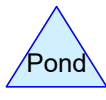
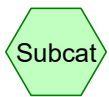
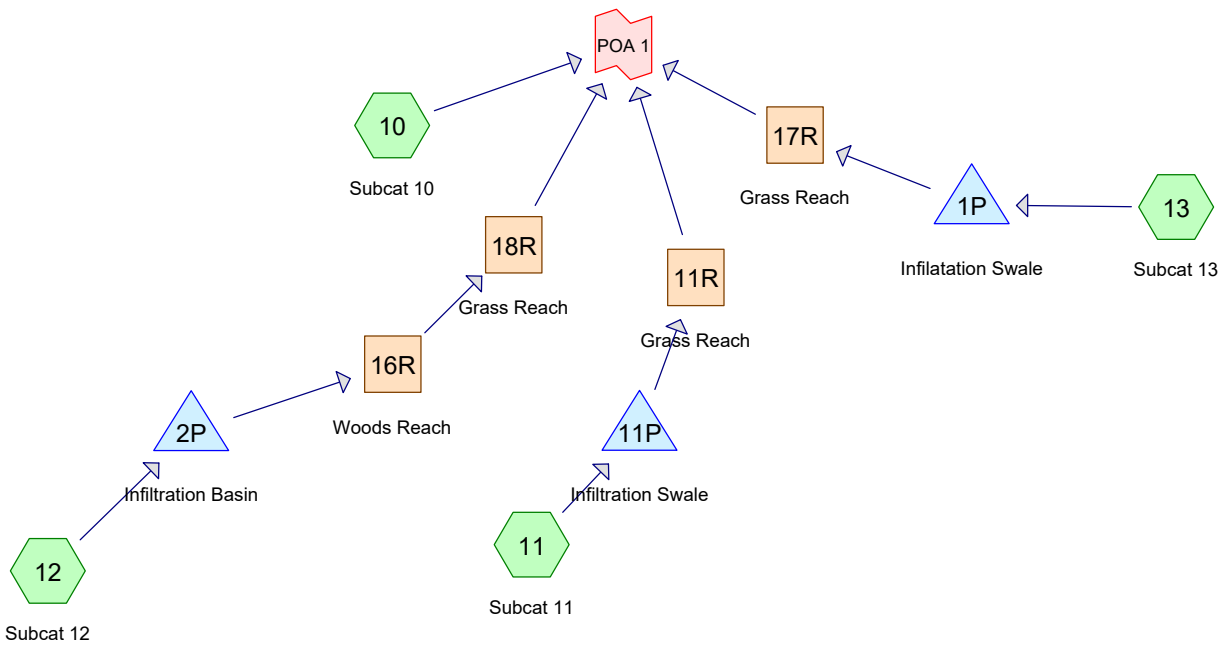
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.9	50	0.0032	0.03		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
0.6	53	0.0520	1.60		Shallow Concentrated Flow, Short Grass Pasture Kv= 7.0 fps
13.4	744	0.0341	0.92		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
39.9	847	Total			

Summary for Link POA 1:

Inflow Area = 6.87 ac, 0.40% Impervious, Inflow Depth = 0.82" for 100-Year event
 Inflow = 1.8 cfs @ 12.77 hrs, Volume= 0.468 af
 Primary = 1.8 cfs @ 12.77 hrs, Volume= 0.468 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.05 hrs

POST-DEVELOPMENT HYDROCAD ANALYSIS



Routing Diagram for 1320 South St MA_Post_052022_D
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Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	Type III 24-hr		Default	24.00	1	3.21	2
2	10-Year	Type III 24-hr		Default	24.00	1	5.08	2
3	100-Year	Type III 24-hr		Default	24.00	1	8.04	2

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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.44	39	>75% Grass cover, Good, HSG A (11)
1.44	30	Brush, Good, HSG A (10, 11, 12, 13)
0.58	73	Brush, Good, HSG D (10)
0.57	96	Gravel surface, HSG A (10, 11, 12, 13)
0.54	68	Pasture/grassland/range, Poor, HSG A (10, 11, 12, 13)
0.15	98	Paved parking, HSG A (12)
3.11	30	Woods, Good, HSG A (10, 11)
0.04	77	Woods, Good, HSG D (10)
6.89	44	TOTAL AREA

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Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
6.26	HSG A	10, 11, 12, 13
0.00	HSG B	
0.00	HSG C	
0.63	HSG D	10
0.00	Other	
6.89		TOTAL AREA

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Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.44	0.00	0.00	0.00	0.00	0.44	>75% Grass cover, Good	11
1.44	0.00	0.00	0.58	0.00	2.03	Brush, Good	10, 11, 12, 13
0.57	0.00	0.00	0.00	0.00	0.57	Gravel surface	10, 11, 12, 13
0.54	0.00	0.00	0.00	0.00	0.54	Pasture/grassland/range, Poor	10, 11, 12, 13
0.15	0.00	0.00	0.00	0.00	0.15	Paved parking	12
3.11	0.00	0.00	0.04	0.00	3.15	Woods, Good	10, 11
6.26	0.00	0.00	0.63	0.00	6.89	TOTAL AREA	

Time span=1.00-30.00 hrs, dt=0.05 hrs, 581 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment10: Subcat 10 Runoff Area=4.32 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=644' Tc=35.2 min CN=37 Runoff=0.0 cfs 0.000 af

Subcatchment11: Subcat 11 Runoff Area=1.68 ac 0.00% Impervious Runoff Depth=0.03"
Flow Length=673' Tc=16.0 min CN=44 Runoff=0.0 cfs 0.005 af

Subcatchment12: Subcat 12 Runoff Area=0.74 ac 20.82% Impervious Runoff Depth=1.62"
Flow Length=120' Tc=6.0 min CN=83 Runoff=1.4 cfs 0.100 af

Subcatchment13: Subcat 13 Runoff Area=0.14 ac 0.00% Impervious Runoff Depth=1.41"
Flow Length=189' Tc=6.0 min CN=80 Runoff=0.2 cfs 0.017 af

Reach 11R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.080 L=398.0' S=0.0366 '/' Capacity=53.9 cfs Outflow=0.0 cfs 0.000 af

Reach 16R: Woods Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.100 L=140.0' S=0.0599 '/' Capacity=55.2 cfs Outflow=0.0 cfs 0.000 af

Reach 17R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.080 L=289.0' S=0.0417 '/' Capacity=57.6 cfs Outflow=0.0 cfs 0.000 af

Reach 18R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.030 L=112.0' S=0.0060 '/' Capacity=58.1 cfs Outflow=0.0 cfs 0.000 af

Pond 1P: Infiltration Swale Peak Elev=79.51' Storage=274 cf Inflow=0.2 cfs 0.017 af
Discarded=0.0 cfs 0.017 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.017 af

Pond 2P: Infiltration Basin Peak Elev=78.80' Storage=1,654 cf Inflow=1.4 cfs 0.100 af
Discarded=0.2 cfs 0.100 af Primary=0.0 cfs 0.000 af Outflow=0.2 cfs 0.100 af

Pond 11P: Infiltration Swale Peak Elev=83.01' Storage=4 cf Inflow=0.0 cfs 0.005 af
Discarded=0.0 cfs 0.005 af Primary=0.0 cfs 0.000 af Outflow=0.0 cfs 0.005 af

Link POA 1: Inflow=0.0 cfs 0.000 af
Primary=0.0 cfs 0.000 af

Total Runoff Area = 6.89 ac Runoff Volume = 0.121 af Average Runoff Depth = 0.21"
97.75% Pervious = 6.73 ac 2.25% Impervious = 0.15 ac

Summary for Subcatchment 10: Subcat 10

Runoff = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"
 Routed to Link POA 1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Rainfall=3.21"

Area (ac)	CN	Description
1.36	30	Brush, Good, HSG A
0.58	73	Brush, Good, HSG D
0.03	96	Gravel surface, HSG A
0.04	68	Pasture/grassland/range, Poor, HSG A
2.27	30	Woods, Good, HSG A
0.04	77	Woods, Good, HSG D
4.32	37	Weighted Average
4.32		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	50	0.0040	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
11.5	594	0.0298	0.86		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
35.2	644	Total			

Summary for Subcatchment 11: Subcat 11

Runoff = 0.0 cfs @ 15.83 hrs, Volume= 0.005 af, Depth= 0.03"
 Routed to Pond 11P : Infiltration Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 2-Year Rainfall=3.21"

Area (ac)	CN	Description
0.44	39	>75% Grass cover, Good, HSG A
0.05	30	Brush, Good, HSG A
0.20	96	Gravel surface, HSG A
0.15	68	Pasture/grassland/range, Poor, HSG A
0.84	30	Woods, Good, HSG A
1.68	44	Weighted Average
1.68		100.00% Pervious Area

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Type III 24-hr 2-Year Rainfall=3.21"

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	50	0.0280	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
3.1	198	0.0453	1.06		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.0	425	0.0100	3.53	17.63	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=1.00' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
16.0	673	Total			

Summary for Subcatchment 12: Subcat 12

Runoff = 1.4 cfs @ 12.09 hrs, Volume= 0.100 af, Depth= 1.62"
Routed to Pond 2P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.21"

Area (ac)	CN	Description
0.02	30	Brush, Good, HSG A
0.26	96	Gravel surface, HSG A
0.31	68	Pasture/grassland/range, Poor, HSG A
0.15	98	Paved parking, HSG A
0.74	83	Weighted Average
0.59		79.18% Pervious Area
0.15		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0314	1.42		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.15"
0.2	70	0.0791	5.71		Shallow Concentrated Flow, Paved Kv= 20.3 fps
5.2					Direct Entry, 6.0 Direct Entry Tc Path
6.0	120	Total			

Summary for Subcatchment 13: Subcat 13

Runoff = 0.2 cfs @ 12.10 hrs, Volume= 0.017 af, Depth= 1.41"
Routed to Pond 1P : Infiltration Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.21"

Area (ac)	CN	Description
0.02	30	Brush, Good, HSG A
0.08	96	Gravel surface, HSG A
0.04	68	Pasture/grassland/range, Poor, HSG A
0.14	80	Weighted Average
0.14		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	37	0.1012	2.14		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.15"
0.5	152	0.0221	4.92	19.68	Trap/Vee/Rect Channel Flow, Bot.W=1.00' D=1.00' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
5.2					Direct Entry, 6.0 Direct Entry Tc Path
6.0	189	Total			

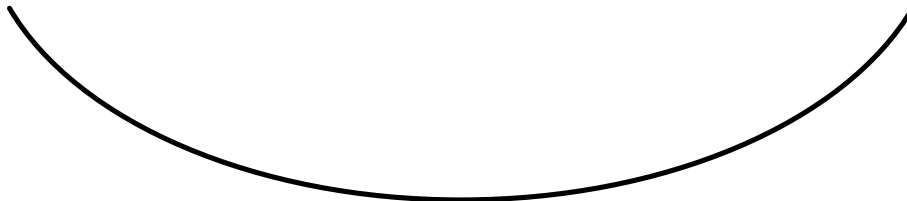
Summary for Reach 11R: Grass Reach

Inflow Area = 1.68 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 53.9 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.080 Earth, long dense weeds
 Length= 398.0' Slope= 0.0366 '/'
 Inlet Invert= 82.52', Outlet Invert= 67.96'



Summary for Reach 16R: Woods Reach

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Reach 18R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 55.2 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.100 Heavy timber, flow below branches
Length= 140.0' Slope= 0.0599 '/'
Inlet Invert= 77.43', Outlet Invert= 69.05'



Summary for Reach 17R: Grass Reach

Inflow Area = 0.14 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 57.6 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.080 Earth, long dense weeds
Length= 289.0' Slope= 0.0417 '/'
Inlet Invert= 80.02', Outlet Invert= 67.96'



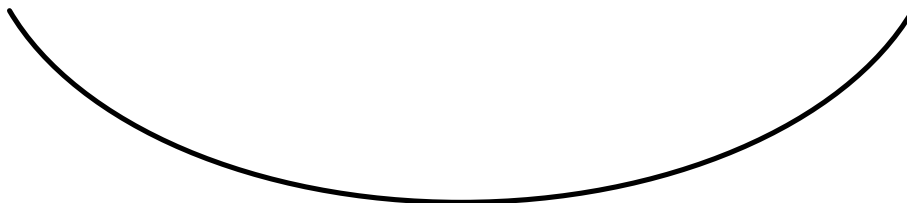
Summary for Reach 18R: Grass Reach

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 58.1 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.030 Short grass
 Length= 112.0' Slope= 0.0060 '/'
 Inlet Invert= 69.05', Outlet Invert= 68.38'



Summary for Pond 1P: Infiltration Swale

Inflow Area = 0.14 ac, 0.00% Impervious, Inflow Depth = 1.41" for 2-Year event
 Inflow = 0.2 cfs @ 12.10 hrs, Volume= 0.017 af
 Outflow = 0.0 cfs @ 13.01 hrs, Volume= 0.017 af, Atten= 89%, Lag= 54.7 min
 Discarded = 0.0 cfs @ 13.01 hrs, Volume= 0.017 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 17R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 79.51' @ 13.01 hrs Surf.Area= 300 sf Storage= 274 cf

Plug-Flow detention time= 102.4 min calculated for 0.017 af (100% of inflow)
 Center-of-Mass det. time= 102.3 min (944.9 - 842.6)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	1,943 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
78.00	300	0.0	0	0
79.00	300	40.0	120	120
80.00	300	100.0	300	420
81.00	335	100.0	318	738
82.00	538	100.0	437	1,174
83.00	1,000	100.0	769	1,943

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 75.00'
#2	Primary	80.50'	7.0' long x 5.0' breadth Broad-Crested Rectangular Weir

Head (feet)	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
	2.50	3.00	3.50	4.00	4.50	5.00	5.50			
Coef. (English)	2.34	2.50	2.70	2.68	2.68	2.66	2.65	2.65	2.65	
	2.65	2.67	2.66	2.68	2.70	2.74	2.79	2.88		

Discarded OutFlow Max=0.0 cfs @ 13.01 hrs HW=79.51' (Free Discharge)

↑1=Exfiltration (Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=78.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 1.62" for 2-Year event
 Inflow = 1.4 cfs @ 12.09 hrs, Volume= 0.100 af
 Outflow = 0.2 cfs @ 12.85 hrs, Volume= 0.100 af, Atten= 88%, Lag= 45.6 min
 Discarded = 0.2 cfs @ 12.85 hrs, Volume= 0.100 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 16R : Woods Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 78.80' @ 12.85 hrs Surf.Area= 2,474 sf Storage= 1,654 cf

Plug-Flow detention time= 96.7 min calculated for 0.100 af (100% of inflow)
 Center-of-Mass det. time= 96.6 min (929.3 - 832.8)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	15,148 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
78.00	1,661	0	0
79.00	2,677	2,169	2,169
80.00	3,750	3,214	5,383
81.00	4,878	4,314	9,697
81.50	5,464	2,586	12,282
82.00	6,000	2,866	15,148

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 75.00'
#2	Primary	81.00'	10.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.2 cfs @ 12.85 hrs HW=78.80' (Free Discharge)

↑1=Exfiltration (Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=78.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Pond 11P: Infiltration Swale

Inflow Area = 1.68 ac, 0.00% Impervious, Inflow Depth = 0.03" for 2-Year event
 Inflow = 0.0 cfs @ 15.83 hrs, Volume= 0.005 af
 Outflow = 0.0 cfs @ 16.02 hrs, Volume= 0.005 af, Atten= 1%, Lag= 11.6 min
 Discarded = 0.0 cfs @ 16.02 hrs, Volume= 0.005 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 11R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 83.01' @ 16.02 hrs Surf.Area= 542 sf Storage= 4 cf

Plug-Flow detention time= 11.5 min calculated for 0.005 af (100% of inflow)
 Center-of-Mass det. time= 11.5 min (1,154.3 - 1,142.8)

Volume	Invert	Avail.Storage	Storage Description
#1	83.00'	9,176 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
83.00	536	0	0
84.00	1,277	907	907
85.00	2,115	1,696	2,603
86.00	3,016	2,566	5,168
87.00	5,000	4,008	9,176

Device	Routing	Invert	Outlet Devices
#1	Discarded	83.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 80.00'
#2	Primary	86.00'	5.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.0 cfs @ 16.02 hrs HW=83.01' (Free Discharge)

↑1=Exfiltration (Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=83.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Link POA 1:

Inflow Area = 6.89 ac, 2.25% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs

Time span=1.00-30.00 hrs, dt=0.05 hrs, 581 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment10: Subcat 10 Runoff Area=4.32 ac 0.00% Impervious Runoff Depth=0.15"
Flow Length=644' Tc=35.2 min CN=37 Runoff=0.1 cfs 0.054 af

Subcatchment11: Subcat 11 Runoff Area=1.68 ac 0.00% Impervious Runoff Depth=0.42"
Flow Length=673' Tc=16.0 min CN=44 Runoff=0.3 cfs 0.059 af

Subcatchment12: Subcat 12 Runoff Area=0.74 ac 20.82% Impervious Runoff Depth=3.25"
Flow Length=120' Tc=6.0 min CN=83 Runoff=2.8 cfs 0.201 af

Subcatchment13: Subcat 13 Runoff Area=0.14 ac 0.00% Impervious Runoff Depth=2.96"
Flow Length=189' Tc=6.0 min CN=80 Runoff=0.5 cfs 0.035 af

Reach 11R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.080 L=398.0' S=0.0366 '/' Capacity=53.9 cfs Outflow=0.0 cfs 0.000 af

Reach 16R: Woods Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.100 L=140.0' S=0.0599 '/' Capacity=55.2 cfs Outflow=0.0 cfs 0.000 af

Reach 17R: Grass Reach Avg. Flow Depth=0.09' Max Vel=0.59 fps Inflow=0.1 cfs 0.003 af
n=0.080 L=289.0' S=0.0417 '/' Capacity=57.6 cfs Outflow=0.1 cfs 0.003 af

Reach 18R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.030 L=112.0' S=0.0060 '/' Capacity=58.1 cfs Outflow=0.0 cfs 0.000 af

Pond 1P: Infiltration Swale Peak Elev=80.54' Storage=587 cf Inflow=0.5 cfs 0.035 af
Discarded=0.0 cfs 0.032 af Primary=0.1 cfs 0.003 af Outflow=0.2 cfs 0.035 af

Pond 2P: Infiltration Basin Peak Elev=79.57' Storage=3,867 cf Inflow=2.8 cfs 0.201 af
Discarded=0.3 cfs 0.201 af Primary=0.0 cfs 0.000 af Outflow=0.3 cfs 0.201 af

Pond 11P: Infiltration Swale Peak Elev=83.78' Storage=639 cf Inflow=0.3 cfs 0.059 af
Discarded=0.1 cfs 0.059 af Primary=0.0 cfs 0.000 af Outflow=0.1 cfs 0.059 af

Link POA 1: Inflow=0.1 cfs 0.057 af
Primary=0.1 cfs 0.057 af

Total Runoff Area = 6.89 ac Runoff Volume = 0.349 af Average Runoff Depth = 0.61"
97.75% Pervious = 6.73 ac 2.25% Impervious = 0.15 ac

Summary for Subcatchment 10: Subcat 10

Runoff = 0.1 cfs @ 14.89 hrs, Volume= 0.054 af, Depth= 0.15"
 Routed to Link POA 1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.08"

Area (ac)	CN	Description
1.36	30	Brush, Good, HSG A
0.58	73	Brush, Good, HSG D
0.03	96	Gravel surface, HSG A
0.04	68	Pasture/grassland/range, Poor, HSG A
2.27	30	Woods, Good, HSG A
0.04	77	Woods, Good, HSG D
4.32	37	Weighted Average
4.32		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	50	0.0040	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
11.5	594	0.0298	0.86		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
35.2	644	Total			

Summary for Subcatchment 11: Subcat 11

Runoff = 0.3 cfs @ 12.48 hrs, Volume= 0.059 af, Depth= 0.42"
 Routed to Pond 11P : Infiltration Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 10-Year Rainfall=5.08"

Area (ac)	CN	Description
0.44	39	>75% Grass cover, Good, HSG A
0.05	30	Brush, Good, HSG A
0.20	96	Gravel surface, HSG A
0.15	68	Pasture/grassland/range, Poor, HSG A
0.84	30	Woods, Good, HSG A
1.68	44	Weighted Average
1.68		100.00% Pervious Area

1320 South St MA_Post_052022_D

Type III 24-hr 10-Year Rainfall=5.08"

Prepared by New Leaf Energy Inc

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Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	50	0.0280	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
3.1	198	0.0453	1.06		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.0	425	0.0100	3.53	17.63	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=1.00' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
16.0	673	Total			

Summary for Subcatchment 12: Subcat 12

Runoff = 2.8 cfs @ 12.09 hrs, Volume= 0.201 af, Depth= 3.25"
Routed to Pond 2P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.08"

Area (ac)	CN	Description
0.02	30	Brush, Good, HSG A
0.26	96	Gravel surface, HSG A
0.31	68	Pasture/grassland/range, Poor, HSG A
0.15	98	Paved parking, HSG A
0.74	83	Weighted Average
0.59		79.18% Pervious Area
0.15		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0314	1.42		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.15"
0.2	70	0.0791	5.71		Shallow Concentrated Flow, Paved Kv= 20.3 fps
5.2					Direct Entry, 6.0 Direct Entry Tc Path
6.0	120	Total			

Summary for Subcatchment 13: Subcat 13

Runoff = 0.5 cfs @ 12.09 hrs, Volume= 0.035 af, Depth= 2.96"
Routed to Pond 1P : Infiltration Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=5.08"

Area (ac)	CN	Description
0.02	30	Brush, Good, HSG A
0.08	96	Gravel surface, HSG A
0.04	68	Pasture/grassland/range, Poor, HSG A
0.14	80	Weighted Average
0.14		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	37	0.1012	2.14		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.15"
0.5	152	0.0221	4.92	19.68	Trap/Vee/Rect Channel Flow, Bot.W=1.00' D=1.00' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
5.2					Direct Entry, 6.0 Direct Entry Tc Path
6.0	189	Total			

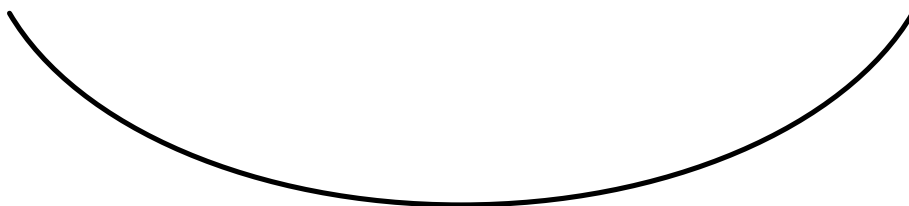
Summary for Reach 11R: Grass Reach

Inflow Area = 1.68 ac, 0.00% Impervious, Inflow Depth = 0.00" for 10-Year event
 Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 53.9 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.080 Earth, long dense weeds
 Length= 398.0' Slope= 0.0366 '/'
 Inlet Invert= 82.52', Outlet Invert= 67.96'



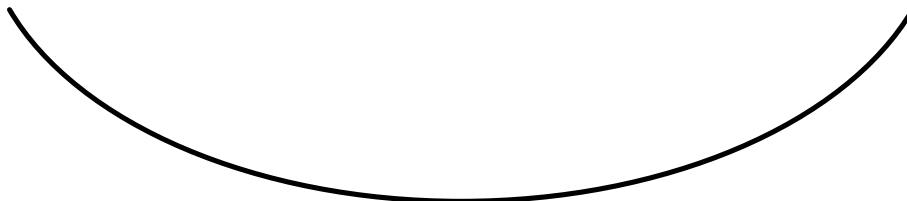
Summary for Reach 16R: Woods Reach

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 0.00" for 10-Year event
 Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Reach 18R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 55.2 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.100 Heavy timber, flow below branches
Length= 140.0' Slope= 0.0599 '/'
Inlet Invert= 77.43', Outlet Invert= 69.05'



Summary for Reach 17R: Grass Reach

Inflow Area = 0.14 ac, 0.00% Impervious, Inflow Depth = 0.29" for 10-Year event
Inflow = 0.1 cfs @ 12.42 hrs, Volume= 0.003 af
Outflow = 0.1 cfs @ 12.55 hrs, Volume= 0.003 af, Atten= 45%, Lag= 7.5 min
Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.59 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 0.29 fps, Avg. Travel Time= 16.4 min

Peak Storage= 38 cf @ 12.55 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 2.14'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 57.6 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.080 Earth, long dense weeds
Length= 289.0' Slope= 0.0417 '/'
Inlet Invert= 80.02', Outlet Invert= 67.96'



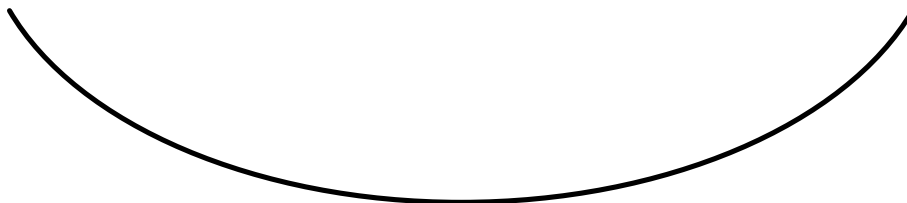
Summary for Reach 18R: Grass Reach

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 0.00" for 10-Year event
Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 58.1 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.030 Short grass
 Length= 112.0' Slope= 0.0060 '/'
 Inlet Invert= 69.05', Outlet Invert= 68.38'



Summary for Pond 1P: Infiltration Swale

Inflow Area = 0.14 ac, 0.00% Impervious, Inflow Depth = 2.96" for 10-Year event
 Inflow = 0.5 cfs @ 12.09 hrs, Volume= 0.035 af
 Outflow = 0.2 cfs @ 12.42 hrs, Volume= 0.035 af, Atten= 64%, Lag= 19.8 min
 Discarded = 0.0 cfs @ 12.42 hrs, Volume= 0.032 af
 Primary = 0.1 cfs @ 12.42 hrs, Volume= 0.003 af
 Routed to Reach 17R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 80.54' @ 12.42 hrs Surf.Area= 319 sf Storage= 587 cf

Plug-Flow detention time= 181.0 min calculated for 0.035 af (100% of inflow)
 Center-of-Mass det. time= 179.5 min (1,000.6 - 821.1)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	1,943 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
78.00	300	0.0	0	0
79.00	300	40.0	120	120
80.00	300	100.0	300	420
81.00	335	100.0	318	738
82.00	538	100.0	437	1,174
83.00	1,000	100.0	769	1,943

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 75.00'
#2	Primary	80.50'	7.0' long x 5.0' breadth Broad-Crested Rectangular Weir

Head (feet)	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
	2.50	3.00	3.50	4.00	4.50	5.00	5.50			
Coef. (English)	2.34	2.50	2.70	2.68	2.68	2.66	2.65	2.65	2.65	
	2.65	2.67	2.66	2.68	2.70	2.74	2.79	2.88		

Discarded OutFlow Max=0.0 cfs @ 12.42 hrs HW=80.53' (Free Discharge)

↑1=Exfiltration (Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.42 hrs HW=80.53' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Weir Controls 0.1 cfs @ 0.43 fps)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 3.25" for 10-Year event
 Inflow = 2.8 cfs @ 12.09 hrs, Volume= 0.201 af
 Outflow = 0.3 cfs @ 13.05 hrs, Volume= 0.201 af, Atten= 91%, Lag= 57.8 min
 Discarded = 0.3 cfs @ 13.05 hrs, Volume= 0.201 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 16R : Woods Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 79.57' @ 13.05 hrs Surf.Area= 3,288 sf Storage= 3,867 cf

Plug-Flow detention time= 170.2 min calculated for 0.201 af (100% of inflow)
 Center-of-Mass det. time= 170.0 min (982.8 - 812.8)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	15,148 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
78.00	1,661	0	0
79.00	2,677	2,169	2,169
80.00	3,750	3,214	5,383
81.00	4,878	4,314	9,697
81.50	5,464	2,586	12,282
82.00	6,000	2,866	15,148

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 75.00'
#2	Primary	81.00'	10.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.3 cfs @ 13.05 hrs HW=79.57' (Free Discharge)

↑1=Exfiltration (Controls 0.3 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=78.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Pond 11P: Infiltration Swale

Inflow Area = 1.68 ac, 0.00% Impervious, Inflow Depth = 0.42" for 10-Year event
 Inflow = 0.3 cfs @ 12.48 hrs, Volume= 0.059 af
 Outflow = 0.1 cfs @ 15.33 hrs, Volume= 0.059 af, Atten= 73%, Lag= 171.1 min
 Discarded = 0.1 cfs @ 15.33 hrs, Volume= 0.059 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 11R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 83.78' @ 15.33 hrs Surf.Area= 1,111 sf Storage= 639 cf

Plug-Flow detention time= 109.0 min calculated for 0.059 af (100% of inflow)
 Center-of-Mass det. time= 108.8 min (1,069.3 - 960.5)

Volume	Invert	Avail.Storage	Storage Description
#1	83.00'	9,176 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
83.00	536	0	0
84.00	1,277	907	907
85.00	2,115	1,696	2,603
86.00	3,016	2,566	5,168
87.00	5,000	4,008	9,176

Device	Routing	Invert	Outlet Devices
#1	Discarded	83.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 80.00'
#2	Primary	86.00'	5.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.1 cfs @ 15.33 hrs HW=83.78' (Free Discharge)

↑1=Exfiltration (Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=83.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Link POA 1:

Inflow Area = 6.89 ac, 2.25% Impervious, Inflow Depth = 0.10" for 10-Year event
Inflow = 0.1 cfs @ 14.19 hrs, Volume= 0.057 af
Primary = 0.1 cfs @ 14.19 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs

Time span=1.00-30.00 hrs, dt=0.05 hrs, 581 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment10: Subcat 10 Runoff Area=4.32 ac 0.00% Impervious Runoff Depth=0.99"
Flow Length=644' Tc=35.2 min CN=37 Runoff=1.7 cfs 0.357 af

Subcatchment11: Subcat 11 Runoff Area=1.68 ac 0.00% Impervious Runoff Depth=1.66"
Flow Length=673' Tc=16.0 min CN=44 Runoff=1.9 cfs 0.232 af

Subcatchment12: Subcat 12 Runoff Area=0.74 ac 20.82% Impervious Runoff Depth=6.02"
Flow Length=120' Tc=6.0 min CN=83 Runoff=5.0 cfs 0.372 af

Subcatchment13: Subcat 13 Runoff Area=0.14 ac 0.00% Impervious Runoff Depth=5.66"
Flow Length=189' Tc=6.0 min CN=80 Runoff=0.9 cfs 0.067 af

Reach 11R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.080 L=398.0' S=0.0366 '/' Capacity=53.9 cfs Outflow=0.0 cfs 0.000 af

Reach 16R: Woods Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.100 L=140.0' S=0.0599 '/' Capacity=55.2 cfs Outflow=0.0 cfs 0.000 af

Reach 17R: Grass Reach Avg. Flow Depth=0.26' Max Vel=1.15 fps Inflow=0.9 cfs 0.027 af
n=0.080 L=289.0' S=0.0417 '/' Capacity=57.6 cfs Outflow=0.7 cfs 0.027 af

Reach 18R: Grass Reach Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.0 cfs 0.000 af
n=0.030 L=112.0' S=0.0060 '/' Capacity=58.1 cfs Outflow=0.0 cfs 0.000 af

Pond 1P: Infiltration Swale Peak Elev=80.64' Storage=619 cf Inflow=0.9 cfs 0.067 af
Discarded=0.0 cfs 0.040 af Primary=0.9 cfs 0.027 af Outflow=0.9 cfs 0.068 af

Pond 2P: Infiltration Basin Peak Elev=80.63' Storage=7,989 cf Inflow=5.0 cfs 0.372 af
Discarded=0.4 cfs 0.372 af Primary=0.0 cfs 0.000 af Outflow=0.4 cfs 0.372 af

Pond 11P: Infiltration Swale Peak Elev=85.73' Storage=4,400 cf Inflow=1.9 cfs 0.232 af
Discarded=0.2 cfs 0.228 af Primary=0.0 cfs 0.000 af Outflow=0.2 cfs 0.228 af

Link POA 1: Inflow=1.8 cfs 0.384 af
Primary=1.8 cfs 0.384 af

Total Runoff Area = 6.89 ac Runoff Volume = 1.029 af Average Runoff Depth = 1.79"
97.75% Pervious = 6.73 ac 2.25% Impervious = 0.15 ac

Summary for Subcatchment 10: Subcat 10

Runoff = 1.7 cfs @ 12.66 hrs, Volume= 0.357 af, Depth= 0.99"
 Routed to Link POA 1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=8.04"

Area (ac)	CN	Description
1.36	30	Brush, Good, HSG A
0.58	73	Brush, Good, HSG D
0.03	96	Gravel surface, HSG A
0.04	68	Pasture/grassland/range, Poor, HSG A
2.27	30	Woods, Good, HSG A
0.04	77	Woods, Good, HSG D
4.32	37	Weighted Average
4.32		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.7	50	0.0040	0.04		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
11.5	594	0.0298	0.86		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
35.2	644	Total			

Summary for Subcatchment 11: Subcat 11

Runoff = 1.9 cfs @ 12.27 hrs, Volume= 0.232 af, Depth= 1.66"
 Routed to Pond 11P : Infiltration Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Type III 24-hr 100-Year Rainfall=8.04"

Area (ac)	CN	Description
0.44	39	>75% Grass cover, Good, HSG A
0.05	30	Brush, Good, HSG A
0.20	96	Gravel surface, HSG A
0.15	68	Pasture/grassland/range, Poor, HSG A
0.84	30	Woods, Good, HSG A
1.68	44	Weighted Average
1.68		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.9	50	0.0280	0.08		Sheet Flow, Woods: Light underbrush n= 0.400 P2= 3.15"
3.1	198	0.0453	1.06		Shallow Concentrated Flow, Woodland Kv= 5.0 fps
2.0	425	0.0100	3.53	17.63	Trap/Vee/Rect Channel Flow, Bot.W=2.00' D=1.00' Z= 3.0 '/' Top.W=8.00' n= 0.030 Earth, grassed & winding
16.0	673	Total			

Summary for Subcatchment 12: Subcat 12

Runoff = 5.0 cfs @ 12.09 hrs, Volume= 0.372 af, Depth= 6.02"
Routed to Pond 2P : Infiltration Basin

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.04"

Area (ac)	CN	Description
0.02	30	Brush, Good, HSG A
0.26	96	Gravel surface, HSG A
0.31	68	Pasture/grassland/range, Poor, HSG A
0.15	98	Paved parking, HSG A
0.74	83	Weighted Average
0.59		79.18% Pervious Area
0.15		20.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	50	0.0314	1.42		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.15"
0.2	70	0.0791	5.71		Shallow Concentrated Flow, Paved Kv= 20.3 fps
5.2					Direct Entry, 6.0 Direct Entry Tc Path
6.0	120	Total			

Summary for Subcatchment 13: Subcat 13

Runoff = 0.9 cfs @ 12.09 hrs, Volume= 0.067 af, Depth= 5.66"
Routed to Pond 1P : Infiltration Swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.04"

Area (ac)	CN	Description
0.02	30	Brush, Good, HSG A
0.08	96	Gravel surface, HSG A
0.04	68	Pasture/grassland/range, Poor, HSG A
0.14	80	Weighted Average
0.14		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	37	0.1012	2.14		Sheet Flow, Smooth surfaces n= 0.011 P2= 3.15"
0.5	152	0.0221	4.92	19.68	Trap/Vee/Rect Channel Flow, Bot.W=1.00' D=1.00' Z= 3.0 '/' Top.W=7.00' n= 0.030 Earth, grassed & winding
5.2					Direct Entry, 6.0 Direct Entry Tc Path
6.0	189	Total			

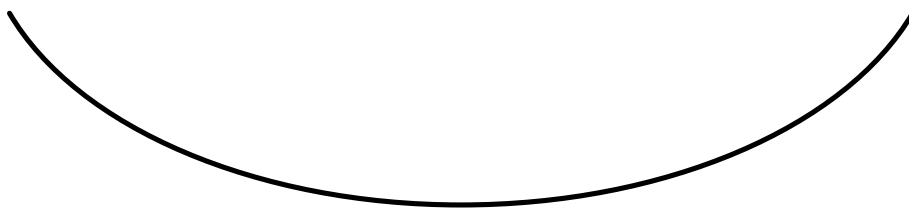
Summary for Reach 11R: Grass Reach

Inflow Area = 1.68 ac, 0.00% Impervious, Inflow Depth = 0.00" for 100-Year event
 Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 53.9 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.080 Earth, long dense weeds
 Length= 398.0' Slope= 0.0366 '/'
 Inlet Invert= 82.52', Outlet Invert= 67.96'



Summary for Reach 16R: Woods Reach

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 0.00" for 100-Year event
 Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Routed to Reach 18R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 55.2 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.100 Heavy timber, flow below branches
Length= 140.0' Slope= 0.0599 '/'
Inlet Invert= 77.43', Outlet Invert= 69.05'



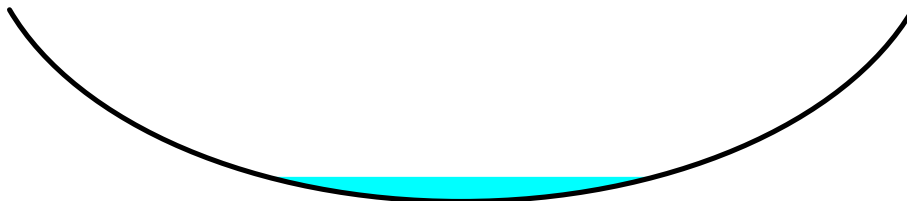
Summary for Reach 17R: Grass Reach

Inflow Area = 0.14 ac, 0.00% Impervious, Inflow Depth = 2.29" for 100-Year event
Inflow = 0.9 cfs @ 12.10 hrs, Volume= 0.027 af
Outflow = 0.7 cfs @ 12.17 hrs, Volume= 0.027 af, Atten= 18%, Lag= 3.9 min
Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.15 fps, Min. Travel Time= 4.2 min
Avg. Velocity = 0.41 fps, Avg. Travel Time= 11.8 min

Peak Storage= 176 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.26' , Surface Width= 3.58'
Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 57.6 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.080 Earth, long dense weeds
Length= 289.0' Slope= 0.0417 '/'
Inlet Invert= 80.02', Outlet Invert= 67.96'



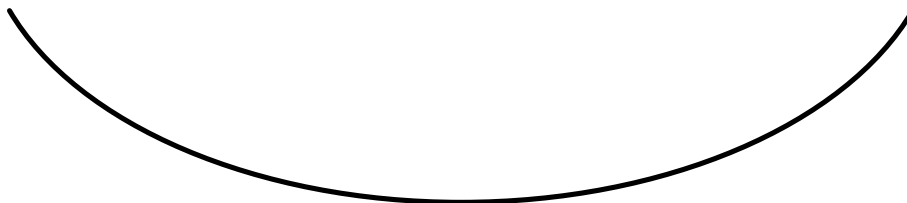
Summary for Reach 18R: Grass Reach

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 0.00" for 100-Year event
Inflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
Outflow = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Link POA 1 :

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
 Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 1.00 hrs
 Average Depth at Peak Storage= 0.00'
 Bank-Full Depth= 2.00' Flow Area= 13.3 sf, Capacity= 58.1 cfs

10.00' x 2.00' deep Parabolic Channel, n= 0.030 Short grass
 Length= 112.0' Slope= 0.0060 '/'
 Inlet Invert= 69.05', Outlet Invert= 68.38'



Summary for Pond 1P: Infiltration Swale

Inflow Area = 0.14 ac, 0.00% Impervious, Inflow Depth = 5.66" for 100-Year event
 Inflow = 0.9 cfs @ 12.09 hrs, Volume= 0.067 af
 Outflow = 0.9 cfs @ 12.10 hrs, Volume= 0.068 af, Atten= 2%, Lag= 0.7 min
 Discarded = 0.0 cfs @ 12.10 hrs, Volume= 0.040 af
 Primary = 0.9 cfs @ 12.10 hrs, Volume= 0.027 af
 Routed to Reach 17R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs / 2
 Peak Elev= 80.64' @ 12.10 hrs Surf.Area= 322 sf Storage= 619 cf

Plug-Flow detention time= 121.8 min calculated for 0.067 af (100% of inflow)
 Center-of-Mass det. time= 125.6 min (928.3 - 802.7)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	1,943 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
78.00	300	0.0	0	0
79.00	300	40.0	120	120
80.00	300	100.0	300	420
81.00	335	100.0	318	738
82.00	538	100.0	437	1,174
83.00	1,000	100.0	769	1,943

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 75.00'
#2	Primary	80.50'	7.0' long x 5.0' breadth Broad-Crested Rectangular Weir

Head (feet)	0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00
	2.50	3.00	3.50	4.00	4.50	5.00	5.50			
Coef. (English)	2.34	2.50	2.70	2.68	2.68	2.66	2.65	2.65	2.65	
	2.65	2.67	2.66	2.68	2.70	2.74	2.79	2.88		

Discarded OutFlow Max=0.0 cfs @ 12.10 hrs HW=80.64' (Free Discharge)

↑1=Exfiltration (Controls 0.0 cfs)

Primary OutFlow Max=0.8 cfs @ 12.10 hrs HW=80.64' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Weir Controls 0.8 cfs @ 0.87 fps)

Summary for Pond 2P: Infiltration Basin

Inflow Area = 0.74 ac, 20.82% Impervious, Inflow Depth = 6.02" for 100-Year event
 Inflow = 5.0 cfs @ 12.09 hrs, Volume= 0.372 af
 Outflow = 0.4 cfs @ 13.29 hrs, Volume= 0.372 af, Atten= 92%, Lag= 72.2 min
 Discarded = 0.4 cfs @ 13.29 hrs, Volume= 0.372 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 16R : Woods Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 80.63' @ 13.29 hrs Surf.Area= 4,466 sf Storage= 7,989 cf

Plug-Flow detention time= 248.9 min calculated for 0.372 af (100% of inflow)
 Center-of-Mass det. time= 248.9 min (1,044.4 - 795.5)

Volume	Invert	Avail.Storage	Storage Description
#1	78.00'	15,148 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
78.00	1,661	0	0
79.00	2,677	2,169	2,169
80.00	3,750	3,214	5,383
81.00	4,878	4,314	9,697
81.50	5,464	2,586	12,282
82.00	6,000	2,866	15,148

Device	Routing	Invert	Outlet Devices
#1	Discarded	78.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 75.00'
#2	Primary	81.00'	10.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.4 cfs @ 13.29 hrs HW=80.63' (Free Discharge)

↑1=Exfiltration (Controls 0.4 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=78.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

Summary for Pond 11P: Infiltration Swale

Inflow Area = 1.68 ac, 0.00% Impervious, Inflow Depth = 1.66" for 100-Year event
 Inflow = 1.9 cfs @ 12.27 hrs, Volume= 0.232 af
 Outflow = 0.2 cfs @ 15.28 hrs, Volume= 0.228 af, Atten= 88%, Lag= 180.8 min
 Discarded = 0.2 cfs @ 15.28 hrs, Volume= 0.228 af
 Primary = 0.0 cfs @ 1.00 hrs, Volume= 0.000 af
 Routed to Reach 11R : Grass Reach

Routing by Stor-Ind method, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 85.73' @ 15.28 hrs Surf.Area= 2,777 sf Storage= 4,400 cf

Plug-Flow detention time= 269.6 min calculated for 0.228 af (98% of inflow)
 Center-of-Mass det. time= 261.7 min (1,160.5 - 898.8)

Volume	Invert	Avail.Storage	Storage Description
#1	83.00'	9,176 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
83.00	536	0	0
84.00	1,277	907	907
85.00	2,115	1,696	2,603
86.00	3,016	2,566	5,168
87.00	5,000	4,008	9,176

Device	Routing	Invert	Outlet Devices
#1	Discarded	83.00'	2.410 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 80.00'
#2	Primary	86.00'	5.0' long x 5.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.2 cfs @ 15.28 hrs HW=85.73' (Free Discharge)

↑1=Exfiltration (Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 1.00 hrs HW=83.00' (Free Discharge)

↑2=Broad-Crested Rectangular Weir(Controls 0.0 cfs)

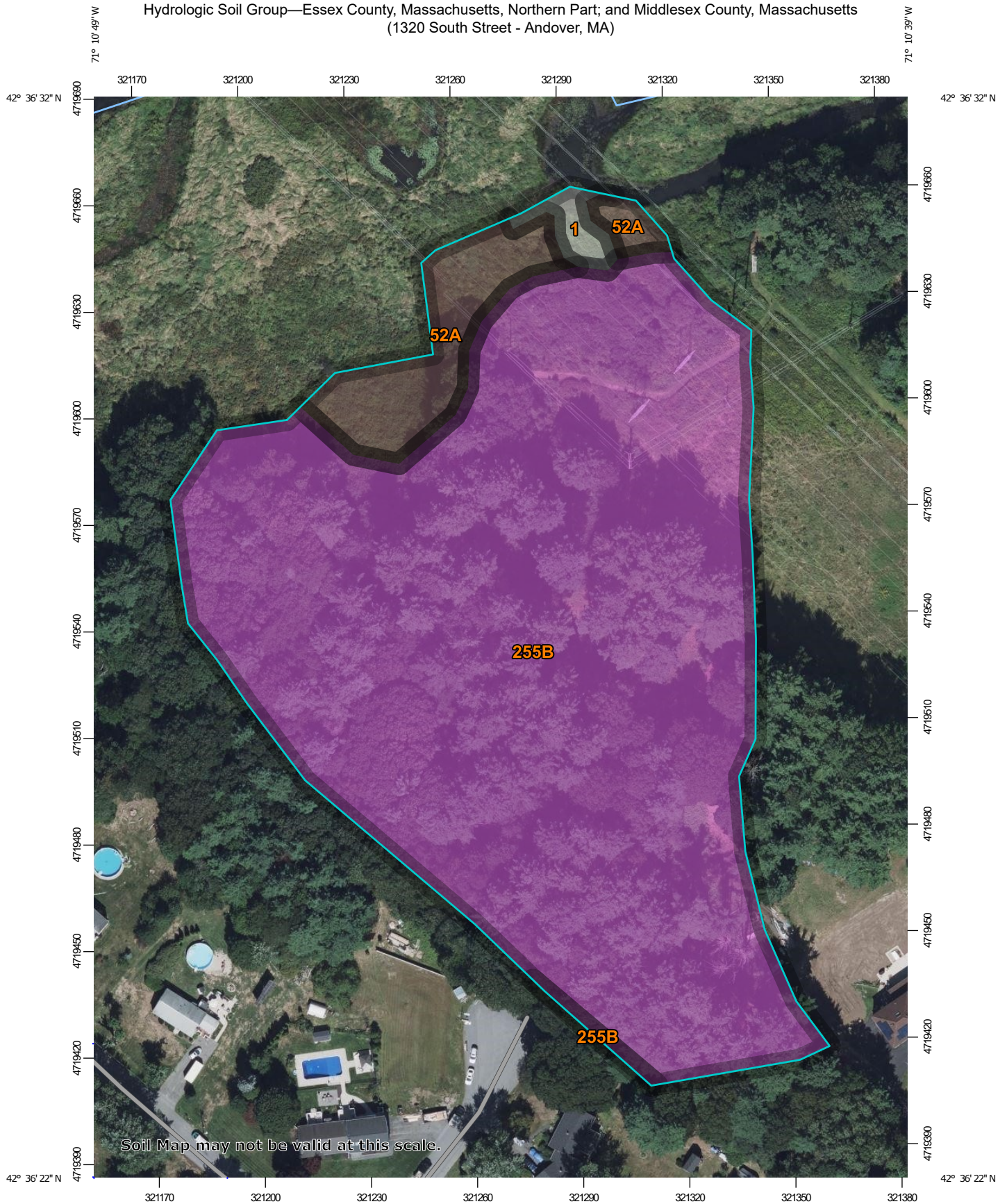
Summary for Link POA 1:

Inflow Area = 6.89 ac, 2.25% Impervious, Inflow Depth = 0.67" for 100-Year event
Inflow = 1.8 cfs @ 12.63 hrs, Volume= 0.384 af
Primary = 1.8 cfs @ 12.63 hrs, Volume= 0.384 af, Atten= 0%, Lag= 0.0 min

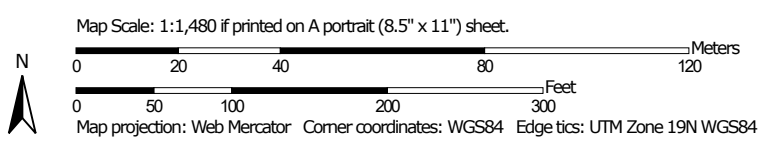
Primary outflow = Inflow, Time Span= 1.00-30.00 hrs, dt= 0.05 hrs

NRCS HYDROLOGIC SOIL GROUP REPORT

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part; and Middlesex County, Massachusetts
(1320 South Street - Andover, MA)




Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points



 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available


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 scales ranging from 1:15,800 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
 Survey Area Data: Version 17, Sep 2, 2021

Soil Survey Area: Middlesex County, Massachusetts
 Survey Area Data: Version 21, Sep 2, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 13, 2020—Sep 15, 2020

MAP LEGEND

MAP INFORMATION

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		0.1	1.2%
52A	Freetown muck, 0 to 1 percent slopes	B/D	0.5	7.6%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	6.3	91.1%
Subtotals for Soil Survey Area			6.9	99.9%
Totals for Area of Interest			6.9	100.0%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
255B	Windsor loamy sand, 3 to 8 percent slopes	A	0.0	0.1%
Subtotals for Soil Survey Area			0.0	0.1%
Totals for Area of Interest			6.9	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

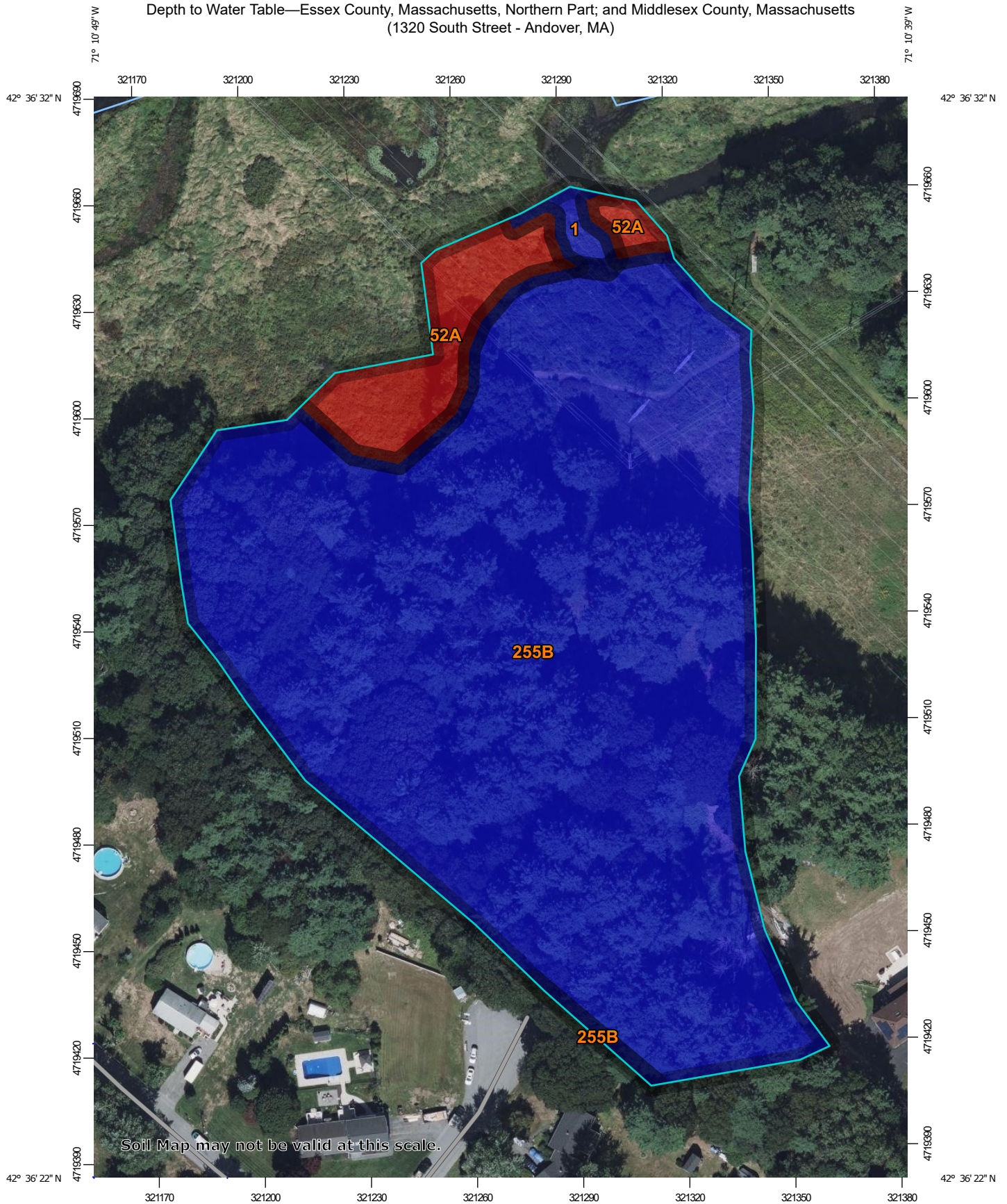
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

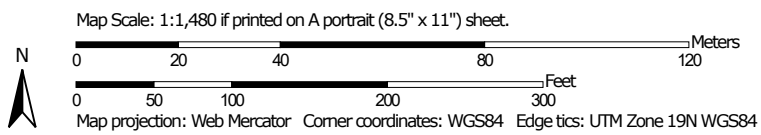
Tie-break Rule: Higher

NRCS DEPTH TO WATER TABLE REPORT






























Depth to Water Table—Essex County, Massachusetts, Northern Part; and Middlesex County, Massachusetts
(1320 South Street - Andover, MA)



Soil Map may not be valid at this scale.



MAP LEGEND

Area of Interest (AOI)	 Not rated or not available
 Area of Interest (AOI)	Water Features
Soils	 Streams and Canals
Soil Rating Polygons	Transportation
 0 - 25	 Rails
 25 - 50	 Interstate Highways
 50 - 100	 US Routes
 100 - 150	 Major Roads
 150 - 200	 Local Roads
 > 200	Background
 Not rated or not available	 Aerial Photography
Soil Rating Lines	
 0 - 25	
 25 - 50	
 50 - 100	
 100 - 150	
 150 - 200	
 > 200	
 Not rated or not available	
Soil Rating Points	
 0 - 25	
 25 - 50	
 50 - 100	
 100 - 150	
 150 - 200	
 > 200	

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:15,800 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 13, 2020—Sep 15, 2020

MAP LEGEND

MAP INFORMATION

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.

Depth to Water Table

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
1	Water	>200	0.1	1.2%
52A	Freetown muck, 0 to 1 percent slopes	0	0.5	7.6%
255B	Windsor loamy sand, 3 to 8 percent slopes	>200	6.3	91.1%
Subtotals for Soil Survey Area			6.9	99.9%
Totals for Area of Interest			6.9	100.0%

Map unit symbol	Map unit name	Rating (centimeters)	Acres in AOI	Percent of AOI
255B	Windsor loamy sand, 3 to 8 percent slopes	>200	0.0	0.1%
Subtotals for Soil Survey Area			0.0	0.1%
Totals for Area of Interest			6.9	100.0%

Description

"Water table" refers to a saturated zone in the soil. It occurs during specified months. Estimates of the upper limit are based mainly on observations of the water table at selected sites and on evidence of a saturated zone, namely grayish colors (redoximorphic features) in the soil. A saturated zone that lasts for less than a month is not considered a water table.

This attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Rating Options

Units of Measure: centimeters

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

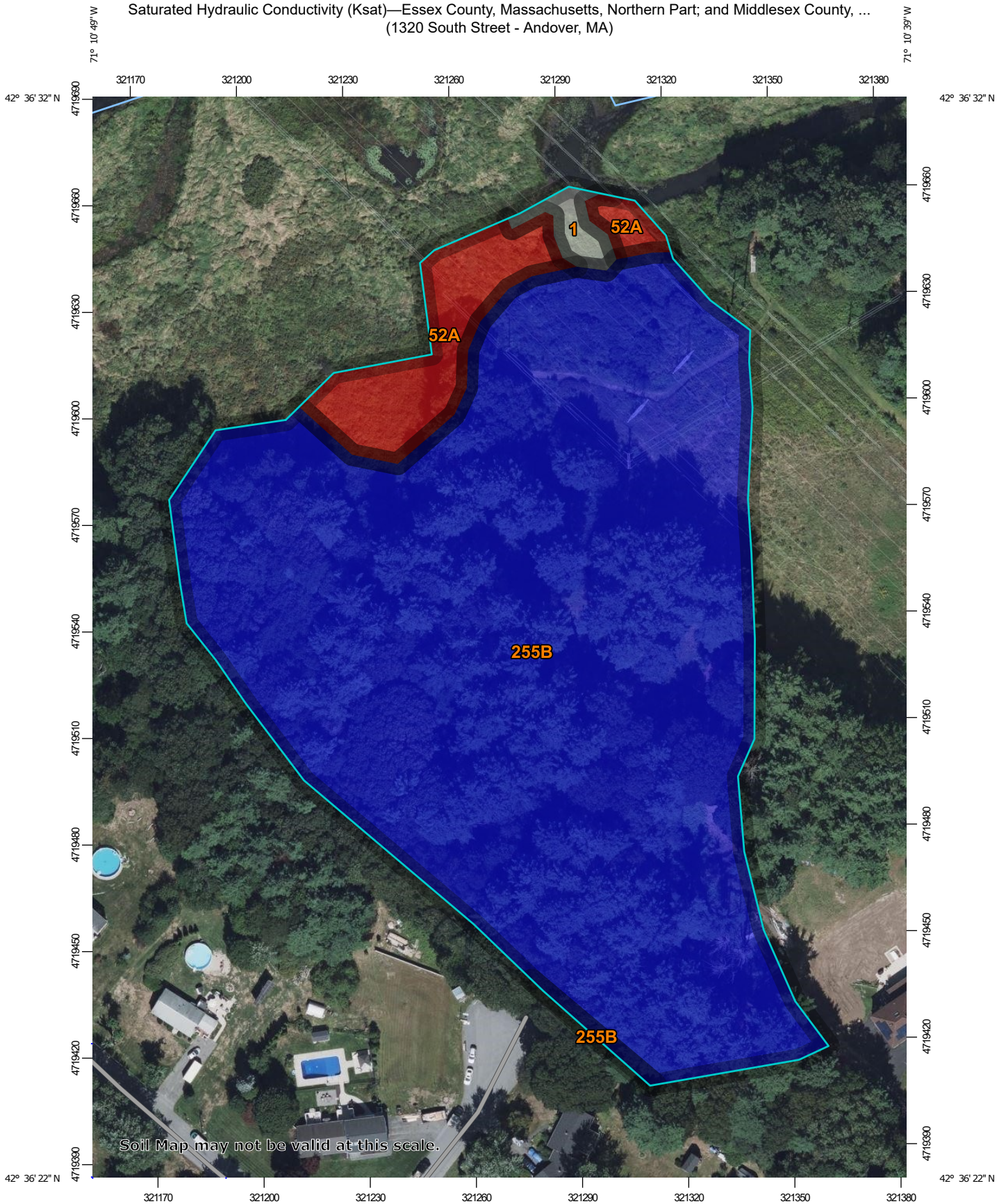
Interpret Nulls as Zero: No

Beginning Month: January

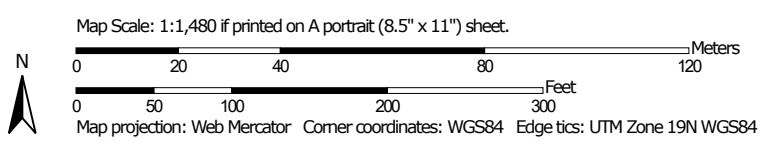
Ending Month: December

**NRCS SATURATED HYDRAULIC CONDUCTIVITY (KSAT)
REPORT**

Saturated Hydraulic Conductivity (Ksat)—Essex County, Massachusetts, Northern Part; and Middlesex County, ...
(1320 South Street - Andover, MA)




Soil Map may not be valid at this scale.






MAP LEGEND

Area of Interest (AOI)




 Area of Interest (AOI)

Soils




Soil Rating Polygons

-  <= 10.0000
-  > 10.0000 and <= 100.0000
-  Not rated or not available

Soil Rating Lines

-  <= 10.0000
-  > 10.0000 and <= 100.0000
-  Not rated or not available






Soil Rating Points

-  <= 10.0000
-  > 10.0000 and <= 100.0000
-  Not rated or not available


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 scales ranging from 1:15,800 to 1:25,000.

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

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

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

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

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 17, Sep 2, 2021

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 21, Sep 2, 2021

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Aug 13, 2020—Sep 15, 2020

MAP LEGEND

MAP INFORMATION

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.

Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
1	Water		0.1	1.2%
52A	Freetown muck, 0 to 1 percent slopes	10.0000	0.5	7.6%
255B	Windsor loamy sand, 3 to 8 percent slopes	100.0000	6.3	91.1%
Subtotals for Soil Survey Area			6.9	99.9%
Totals for Area of Interest			6.9	100.0%

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
255B	Windsor loamy sand, 3 to 8 percent slopes	100.0000	0.0	0.1%
Subtotals for Soil Survey Area			0.0	0.1%
Totals for Area of Interest			6.9	100.0%

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)