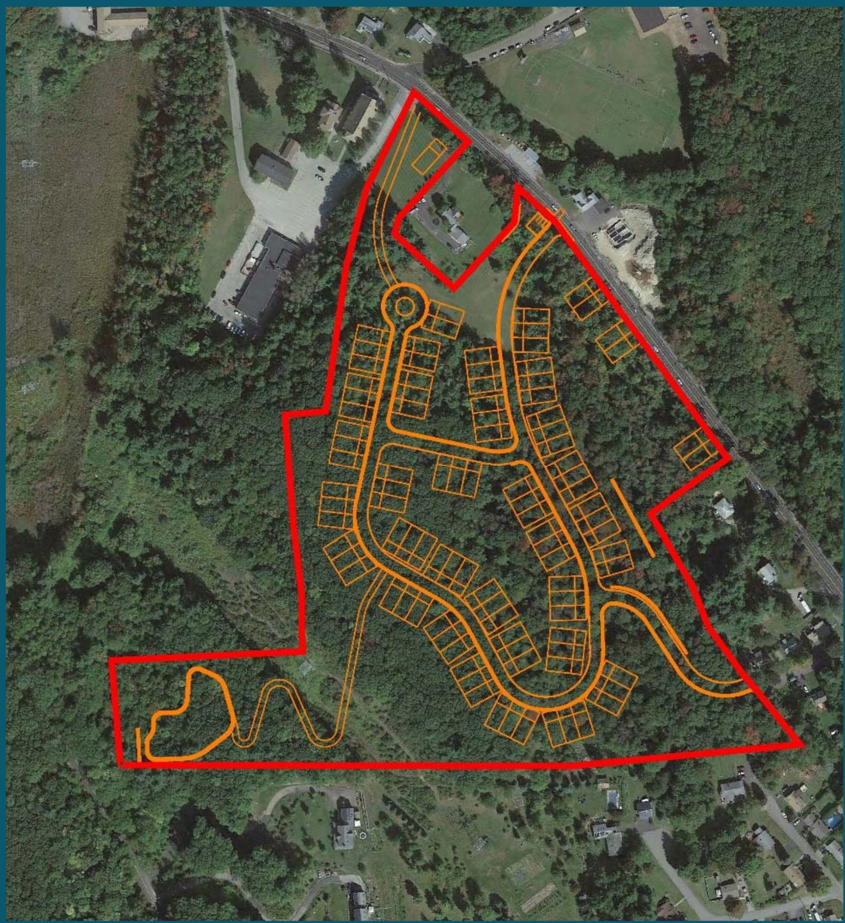
ALLEN & MAJOR
ASSOCIATES, INC.

DRAINAGE REPORT

Skyview Estates
Leicester, MA



APPLICANT:
MKEP 770 LLC
265 Sunrise Highway, Suite 1368
Rockville Center, NY 11570

PREPARED BY:
Allen & Major Associates, Inc.
100 Commerce Way, Suite 5
Woburn, Massachusetts 01801

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PREPARED BY:
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Woburn, Massachusetts 01801

REVISED:

ISSUED:
09-01-2022

A&M PROJECT NO.:
2889-01

TABLE OF CONTENTS

SECTION 1.0 -
DRAINAGE REPORT

Introduction

The purpose of this drainage report is to provide an overview of the proposed stormwater management system (SMS) for the Skyview Estates site plan located at 651 Main Street in Leicester. The report will show by means of narrative, calculations and exhibits that the proposed stormwater management system will meet or exceed the Massachusetts Department of Environmental Protection (MassDEP) stormwater standards, and the Town of Leicester Stormwater Management Regulations.

The proposed site improvements include the construction of a neighborhood style residential development. The development will consist of two family town homes situated along a curvilinear roadway network. The entire development will remain private under the control of an established home owner association.

The proposed SMS incorporates structural and non-structural Best Management Practices (BMPs) to provide stormwater peak flow mitigation, quality treatment, and conveyance. The SMS includes catch basins, drain manholes, proprietary separators, subsurface detention systems, and gabion wall systems.

Site Categorization for Stormwater Regulations

The proposed site improvements at 651 Main Street are considered a new development under the DEP Stormwater Management Standards due to the net increase in impervious area. A new development project is required to meet the all of Stormwater Management Standards listed within the MA DEP Stormwater Handbook.

Site Location and Access

The site is a single lot (21-B5.1) that is proposed to be subdivided into 5 lots. Each of the proposed lots which front Main Street contains the minimum 100 feet of frontage. The remaining lot will be further developed into a residential development. The parcel is located along Main Street (Route 9) approximately 0.2 miles south of Waite Pond.

The parcel is abutted by the Residential 1 zone to the southeast and Suburban-Agricultural zone to the southwest. St. Josephs Church and Leicester Early Learning Center abut the parcel to the west while residential homes abut the parcel to the east and south.

The site is accessed to the southeast by an existing curb cut for Colonial Drive as well as to the north by a proposed curb cut on Main Street. The proposed private roadway network will be connected by these curb cuts to provide adequate traffic flow and safe travel throughout the site.

Existing Site Conditions

The site currently includes unused land that is occupied by trees and various wetland pockets. There is an existing electrical tower and 250’ easement that is located through the southwest portion of the site. Various stone walls, concrete walls, and a concrete foundation were also found by an on the ground survey performed by A&M. The site topography ranges from elevation 815 in the southwest corner of the parcel to 948 in the southern-central portion of the site.

The surface drainage flows were analyzed at five Study Points. Study Point #1 summarizes off-site flows generated from the northeast portion of the parcel. This area flows to existing drainage infrastructure located within Main Street and discharges to the municipal drainage system. Study Point #2 summarizes off-site flows generated from southeast portion of the site. This area flows to an existing wetland/swale formed along an existing stone wall. Study Point #3 summarizes off-site flows generated from the southwest portion of the parcel. This area flows to an existing wetland that is enclosed by the parcel to the west and Henshaw Street to the east. Study Point #4 summarizes off-site flows generated from the northwest portion of the parcel. Study Point #5 summarizes off-site flows generated from the northern-central portion of the parcel.

Existing Soil Conditions

The on-site soils were identified using the USDA Natural Resources Conservation Services (NRCS) Soil Survey for Worcester County. The site contains a range of soil types including: Ridgebury, Whitman, Paxton, Woodbridge, Charlton, Canton, and Udorthents. The majority of the site is made up of Paxton fine sandy loam. A copy of the NRCS Custom Soil Resource Report is included in the appendix of this report.

Based upon the NRCS soil report the project site is classified as multiple types of fine sandy loam. The NRCS soil survey classified the onsite soil as the following:

Symbol	Soil Taxonomic Name	Hydrologic Soil Group
70B	Ridgebury, 3-8% slopes	D
71B	Ridgebury (stony), 3-8% slopes	D
73A	Whitman, 0-3% slopes	D
305B	Paxton, 3-8% slopes	C
305C	Paxton, 8-15% slopes	C
305D	Paxton, 15-25% slopes	C
312B	Woodbridge, 0-8% slopes	C/D
407C	Charlton, 8-15% slopes	A
420B	Canton, 3-8% slopes	B
651	Udorthents, smoothed	A

Paxton fine sandy loam has a Hydrologic Soil Group "C" designation which has been used throughout the design. An Infiltration rate for the Paxton fine sandy loam was used for the design being 4.06 micrometers per second, converted to 0.575 inches per hour.

FEMA Floodplain/Environmental Due Diligence

There are no portions of the site located within the FEMA Zone "AE" Special Flood Hazard Area Subject to Inundation by the 1% Annual Chance Flood (100-year floodplain). The official Flood Insurance Rate Map (FIRM) effective date July 4, 2011, map #25027C0782E, panel 782 of 1075. See section 3 of this report for a copy of the FEMA FIRM.

Environmentally Sensitive Zones

The Commonwealth of Massachusetts asserts control over numerous protected and regulated areas including: Areas of Critical Environmental Concern (ACEC); Outstanding Resource Waters (ORWs); Priority and Protected Habitat for rare and endangered species, and areas protected under the Wetlands Protection Act. The subject property is not located within any of these regulated areas.

Drainage Analysis Methodology

A peak rate of runoff will be determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.
2. HydroCAD © Stormwater Modeling System by HydroCAD Software Solutions LLC, version 10.1-5a. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/ stage/storage characteristics for the stormwater BMPs, to perform drainage routing and to combine the results of the runoff hydrographs. HydroCAD uses the TR-20 methodology of the SCS Unit Hydrograph procedure (SCS-UH).

Proposed Conditions – Peak Rate of Runoff

The stormwater runoff analysis of the existing and proposed conditions includes an estimate of the peak rate of runoff from various rainfall events. Peak runoff rates were developed using TR55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD computer program. Further, the analysis has been prepared in accordance with the MassDEP and the town requirements and standard engineering practices. The peak rate of runoff has been estimated for each watershed during the 2, 10, 25, and 100-year storm events.

The proposed stormwater management system for the site consists of deep sump catch basins, pipe detention systems, a detention basin, outlet control structures, and gabion walls (level spreaders). These systems have been designed in accordance with the MA DEP

Stormwater Management Policy to recharge groundwater and reduce rate of runoff from the parcel.

Detention system 1A and detention system 1B will overflow and discharges through an outlet control structure to an existing catch basin within Main Street (Study Point 1).

Detention system 2A overflows to gabion wall 2, which discharges into an existing wetland/swale at the eastern portion of the site that conveys stormwater to a proposed catch basin that is connected to the existing municipal system (SP-2) within Colonial Drive. Detention system 2B overflows through an outlet control structure that discharges to existing catch basin within the municipal system (SP-2).

Detention system 3 consisting of an extended dry detention basin overflows to gabion wall 2, which discharges to an existing wetland to the west of the site along Henshaw Street (SP-3). Stormwater runoff along the south-western border of the parcel will flow to the proposed Detention Basin which overflows to the existing wetland (SP- 3).

There are no proposed stormwater management systems used for on-site flows directed to Study Points 4 & 5. However, the rate of runoff to these points has been mitigated from the existing to proposed conditions.

The stormwater runoff model indicates that the proposed site development reduces the rate of runoff during all storm events at the identified points of analysis. The following tables provide a summary of the estimated peak rate, in Cubic Feet per Second (CFS) and total runoff volume, in cubic-feet (CF) at each of the five (5) Study Points for each of the design storm events. The HydroCAD worksheets are included in Section 4 and 5 of this report.

STUDY POINT #1 (Existing Catch Basin 1)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	3.95	10.15	15.72	28.02
Proposed Flow (CFS)	3.92	10.00	15.59	26.84
Change (CFS)	**-0.03**	**-0.15**	**-0.13**	**-1.18**
Existing Volume (AF)	0.439	1.014	1.537	2.714
Proposed Volume (AF)	0.610	1.341	1.968	3.322
Change (AF)	**0.171**	**0.327**	**0.431**	**0.608**

STUDY POINT #2 (Existing Catch Basin 2)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	2.81	8.34	13.67	25.99
Proposed Flow (CFS)	2.04	6.94	11.65	23.37
Change (CFS)	**-0.77**	**-1.40**	**-2.02**	**-2.62**
Existing Volume (AF)	0.738	1.682	2.534	4.447
Proposed Volume (AF)	0.972	2.119	3.081	5.138
Change (AF)	**0.234**	**0.437**	**0.547**	**0.691**

STUDY POINT #3 (Existing Wetland East)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	3.94	10.91	17.41	32.17
Proposed Flow (CFS)	3.62	10.42	13.62	26.15
Change (CFS)	**-0.32**	**-0.49**	**-3.79**	**-6.02**
Existing Volume (AF)	0.644	1.482	2.243	3.954
Proposed Volume (AF)	1.114	2.311	3.330	5.532
Change (AF)	**0.470**	**0.829**	**1.087**	**1.578**

STUDY POINT #4 (Existing Wetland West)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	1.57	3.91	5.98	10.55
Proposed Flow (CFS)	0.75	1.62	2.36	3.93
Change (CFS)	**-0.82**	**-2.29**	**-3.62**	**-6.62**
Existing Volume (AF)	0.144	0.329	0.495	0.869
Proposed Volume (AF)	0.056	0.012	0.171	0.287
Change (AF)	**-0.088**	**-0.317**	**-0.324**	**-0.582**

STUDY POINT #5 (Off-Site)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	0.46	1.12	1.70	2.98
Proposed Flow (CFS)	0.17	0.39	0.58	0.98
Change (CFS)	**-0.29**	**-0.73**	**-1.12**	**-2.00**
Existing Volume (AF)	0.050	0.112	0.168	0.292
Proposed Volume (AF)	0.013	0.028	0.042	0.072
Change (AF)	**-0.037**	**-0.084**	**-0.126**	**-0.220**

TOTAL				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	7.22	19.61	31.09	56.99
Proposed Flow (CFS)	6.13	17.33	27.82	51.19
Change (CFS)	**-1.09**	**-2.28**	**-3.27**	**-5.80**
Existing Volume (AF)	1.227	2.808	4.239	7.453
Proposed Volume (AF)	1.595	3.488	5.091	8.532
Change (AF)	**0.368**	**0.680**	**0.852**	**1.079**

MASSDEP Stormwater Performance Standards

The MA DEP Stormwater Management Policy was developed to improve water quality by implementing performance standards for stormwater management. The intent is to implement the stormwater management standards through the review of Notice of Intent filings by the issuing authority (Conservation Commission or DEP). The following section outlines how the proposed Stormwater Management System meets the standards set forth by the Policy.

BMP's implemented in the design include:

- Deep Sump Catch Basins
- Proprietary Separators (CDS units)
- Detention Systems (Precast Concrete Chambers & Basin)
- Level Spreaders (Gabion Wall)
- Outlet Control Structures

Stormwater Best Management Practices (BMP's) have been incorporated into the design of the project to mitigate the anticipated pollutant loading. An Operations and Maintenance Plan has been developed for the project, which addresses the long-term maintenance requirements of the proposed system.

Temporary erosion and sedimentation controls will be incorporated into the construction phase of the project. These temporary controls may include straw bale and/or silt fence barriers, inlet sediment traps, slope stabilization, and stabilized construction entrances.

The Massachusetts Department of Environmental Protection has established ten (10) Stormwater Management Standards. A project that meets or exceeds the standards is presumed to satisfy the regulatory requirements regarding stormwater management. The Standards are enumerated below as well as descriptions and supporting calculations as to how the Project will comply with the Standards:

1. *No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.*

   The proposed development will not introduce any new outfalls with direct discharge to a wetland area or waters of the Commonwealth of Massachusetts. The rate of discharges to existing wetlands will not be increased in comparison to the existing conditions (See Proposed Conditions Tables).

2. *Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.*

   The proposed development has been designed so that the post-development peak discharge rates do not exceed the predevelopment peak discharge rates. A summary of the existing and proposed discharge rates is included within this document (See Proposed Conditions Tables).

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 operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.*

   The existing annual recharge for the site has been approximated in the proposed condition. There are proposed dry wells that are designed to meet this requirement. The proposed Recharge Volume is based on the Static Method per the MA DEP Stormwater Management Standards, Volume 3, Chapter 1.

   See the appendix located at section 6 of this report for stormwater recharge calculations.

4. *Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This standard is met when:*
   - *Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;*

- *Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and*
- *Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.*

Standard #4 is met when structural stormwater best management practices are sized to capture and treat the required water quality volume and pretreatment is provided in accordance with the Massachusetts Stormwater Handbook. Standard #4 also requires that suitable source control measures are identified in the Long-term Pollution Prevention Plan. The water quality volume for the proposed development is captured and treated using street sweeping, deep sump catch basins, and proprietary separators (CDS units).

The implemented BMPs have been designed to treat the contributing water quality volume. These water quality calculations can be seen within the appendix of this report.

The proposed stormwater management system has been designed to remove 80% of the average annual post-construction load for each treatment train. The TSS removal calculations can be seen within the appendix of this report.

5. *For land uses with higher potential 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. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.*

The site is considered a source of higher potential pollutant loads because it has a proposed roadway, driveways, and vehicle travel daily. Pretreatment and Source reduction is provided to the maximum extent practicable. The drainage system will be designed to treat 1″ water quality volume utilizing BMPs listed in Table LUHPPL, within the Massachusetts Stormwater Handbook, Volume 1: Overview of the

Massachusetts Stormwater Standards, Chapter 1, Page 14. This requirement only applies to stormwater discharges that come into contract with the actual area or activity on the site that may generate the higher potential pollutant load.

6. *Stormwater discharges within 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. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.*

   The project site does not discharge stormwater within a Zone II or Interim Wellhead Protection Area or near a critical area. Critical Areas are Outstanding Resource Waters as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02, bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

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 proposed project is not considered a re-development project under the Stormwater Management Handbook guidelines as there is an increase in the amount of impervious area.

8. *A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.*

   A plan to control construction-related impacts, including erosion, sedimentation and other pollutant sources during construction has been developed. A detailed Erosion and Sedimentation Control Plan is included in the Permit Drawings. The proponent will prepare and submit a Stormwater Pollution Prevention Plan (SWPPP) prior to commencement of construction activities that will result in the disturbance of one acre of land or more.

9. *A long-term operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.*

   A Long-Term Operation & Maintenance (O&M) Plan has been developed for the proposed stormwater management system and is included within this document. See Section 2.0 of this report.

10. *All illicit discharges to the stormwater management system are prohibited.*

    There are no expected illicit discharges to the stormwater management system. The applicant will submit the Illicit Discharge Compliance Statement prior to the discharge of stormwater runoff to the post-construction stormwater best management practices and prior to the issuance of a Certificate of Compliance.

See the next page for the MassDEP Stormwater Checklist.

MASSDEP Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

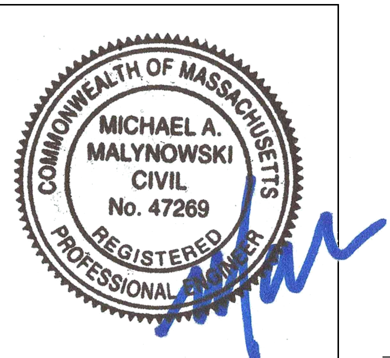
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☒ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): ____________________

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

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

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

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

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☒ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☒ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

SECTION 2.0 -
OPERATION & MAINTENANCE PLAN

Introduction

In accordance with the standards set forth by the Stormwater Management Policy issued by the Massachusetts Department of Environmental Protection (MassDEP), Allen & Major Associates, Inc. has prepared the following Operations & Maintenance (O&M) Plan for the existing development at 651 Main Street, Leicester, MA.

The plan is broken down into three major sections. The first section describes construction-related erosion and sedimentation controls (Demolition & Construction Maintenance Plan). The second section describes the long-term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long-Term Maintenance Plan – Facilities Description).

Notification Procedures for Change of Responsibility for O&M

The Stormwater Management System (SMS) for this project is owned by MKEP 770 LLC (owner). The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance Plan.

The owner shall submit an annual summary report and the completed Operation & Maintenance Schedule & Checklist to the Conservation Commission (via email or print copy), highlighting inspection and maintenance activities including performances of BMPs. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Commission that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Commission of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel or creation of lease areas, the owner(s) shall establish an association on other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS. The legal instrument creating such responsibility shall be recorded with the Registry of Deeds and promptly following its recording, a copy thereof shall be furnished to the Commission.

Contact Information

Stormwater Management System Owner:	MKEP 770 LLC 265 Sunrise Highway, Suite 1368 Leicester, MA Phone: (646) 483-2517

Emergency Contact Information:

MKEP 770 LLC (Owner/Operator)	Phone: (646) 483-2517
Allen & Major Associates, Inc. (Site Civil Engineer)	Phone: (781) 935-6889
Leicester Development & Inspectional Services	Phone: (508) 892-7007
Leicester Fire Department (non-emergency line)	Phone: (508) 892-7022
MassDEP Emergency Response	Phone: (888) 304-1133
Clean Harbors Inc (24-Hour Line)	Phone: (800) 645-8265

Demolition & Construction Maintenance Plan

1. Call Digsafe: 1-888-344-7233
2. Contact the Town of Leicester at least three (3) days prior to start of demolition and/or construction activities.
3. Install Erosion Control measures as shown on the Plans prepared by A&M. The Town shall review the installation of straw bales and silt fencing prior to the start of any site demolition work. Install Construction fencing if determined to be necessary at the commencement of construction.
4. Install construction entrances, straw bales, and silt fence at the locations shown on the Erosion Control Plan prepared by A&M.
5. Site access shall be achieved only from the designated construction entrances.
6. Cut and clear trees in construction areas only (within the limit of work; see plans).
7. Stockpiles of materials subject to erosion shall be stabilized with erosion control matting or temporary seeding whenever practicable, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased.
8. Install silt sacks and straw bales around each drain inlet prior to any demolition and or construction activities.

9. All erosion control measures shall be inspected weekly and after every rainfall event. Records of these inspections shall be kept on-site for review.
10. All erosion control measures shall be maintained, repaired, or replaced as required or at the direction of the owner's engineer or the Town.
11. Sediment accumulation up-gradient of the straw bales, silt fence, and stone check dams greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.
12. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.
13. Install stone check dams on-site during construction as needed. Refer to the erosion control details. Temporary sediment basins combined with stone check damns shall be installed on-site during construction to control and collect runoff from upland areas of this site during demolition and construction activities.
14. The contractor shall comply with the Sedimentation and Erosion Control Notes as shown on the Site Development Plans and Specifications.
15. The stabilized construction entrances shall be inspected weekly and records of inspections kept. The entrances shall be maintained by adding additional clean, angular, durable stone to remove the soil from the construction vehicle's tires when exiting the site. If soil is still leaving the site via the construction vehicle tires, adjacent roadways shall be kept clean by street sweeping.
16. Dust pollution shall be controlled using on-site water trucks and/or an approved soil stabilization product.
17. During demolition and construction activities, Status Reports on compliance with this O&M Document shall be submitted weekly. The report shall document any deficiencies and corrective actions taken by the applicant.

Long-Term Pollution Prevention Plan

Standard #4 from the MassDEP Stormwater Management Handbook requires that a Long-Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance Plan of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures of the LTPPP.

- Housekeeping
  The existing development has been designed to maintain a high level of water quality treatment for all stormwater discharge to the wetland areas. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

- Storing of Materials & Water Products
  The trash and waste program for the site includes exterior dumpsters. There is a trash contractor used to pick up the waste material in the dumpsters. The stormwater drainage system has water quality inlets designed to capture trash and debris.

- Vehicle Washing
  Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The existing development does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site.

- Spill Prevention & Response
  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the buildings and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

  1. Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
  2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
  3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
  4. All spills shall be cleaned up immediately after discovery.
  5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at (888) 304-1333.

6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- Maintenance of Lawns, Gardens, and Other Landscaped Areas
  It should be recognized that this is a general guideline towards achieving high quality and well-groomed landscaped areas. The grounds staff/landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trees shall be planted over the drain lines or recharge area, and that only shallow rooted plants and shrubs will be allowed.

  - Fertilizer
    Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measure available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

    Only slow-release organic fertilizers should be used in the planting and mulch areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of the planting and mulch areas will be performed within manufacturers labeling instructions and shall not exceed an NPK ration of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Fertilizers approved for the use under this O&M Plan are as follows:

    Type: LESCO® 28-0-12 (Lawn Fertilizer)
    MERIT® 0.2 Plus Turf Fertilizer
    MOMENTUM™ Force Weed & Feed

  - Suggested Aeration Program
    In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The

depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

The spring aeration should consist of two passes at opposite directions with 1/4" hollow core tines penetrating 3-5" into the soil profile. Aeration should occur when the soil is moist but not saturated. The soil cores should be shattered in place and dragged or swept back into the turf to control thatch. If desired the cores may also be removed and the area top-dressed with sand or sandy loam. If the area drains on average too slowly, the topdressing should contain a higher percentage of sand. If it is draining on average too quickly, the top dressing should contain a higher percentage of soil and organic matter.

- Landscape Maintenance Program Practices:
  - Lawn
    1. Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cute, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate.
    2. Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth.
    3. Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture.
    4. Do not remove grass clippings after mowing.
    5. Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
  - Shrubs
    1. Mulch not more than 3” depth with shredded pine or fir bark.

2. Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals are to occur within 6″ of the ground to open up shrub and maintain two-year wood (the blooming wood).
3. Hand-prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.

- Trees
  1. Provide aftercare of new tree plantings for the first three years.
  2. Do not fertilize trees, it artificially stimulates them (unless tree health warrants).
  3. Water once a week for the first year; twice a month for the second; once a month for the third year.
  4. Prune trees on a four-year cycle.
- Invasive Species
  1. Inform the Conservation Commission Agent prior to the removal of invasive species proposed either through hand work or through chemical removal.

- Storage and Use of Herbicides and Pesticides
  Integrated Pest Management is the combination of all methods (of pest control) which may prevent, reduce, suppress, eliminate, or repel an insect population. The main requirements necessary to support any pest population are food, shelter and water, and any upset of the balance of these will assist in controlling a pest population. Scientific pest management is the knowledgeable use of all pest control methods (sanitation, mechanical, chemical) to benefit mankind's health, welfare, comfort, property and food. A Pest Management Professional (PMP) should be retained who is licensed with the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Department of Agricultural Resources.

  The site manager will be provided with approved bulletin before entering into or renewing an agreement to apply pesticides for the control of indoor household or structural pests, refer to 333 CMR 13.08.

  Before beginning each application, the applicator must post a Department approved notice on all of the entrances to the treated room or area. The applicator must leave such notices posted after the application. The notice will be posted at conspicuous point(s) of access to the area treated. The location and number of signs will be determined by the configuration of the area to be treated based on the applicator's best judgment. It is intended to give sufficient notice so that no one comes into an area being treated unaware that the applicator is working and pesticides are being applied. However, if the contracting entity does not want the signs posted, he/she may sign a Department approved waiver indicating this.

The applicator or employer will provide to any person upon their request the following information on previously conducted applications:

1. Name and phone number of pest control company;
2. Date and time of the application;
3. Name and license number of the applicator;
4. Target pests; and
5. Name and EPA Registration Number of pesticide products applied.

- Pet Waste Management
  The owner's landscape crew (or designee) shall remove any obvious pet waste that has been left behind by pet owners within the development. The pet waste shall be disposed of in accordance with local and state regulations.
- Operations and Management of Septic Systems
  There are no proposed septic systems within the limits of the project.
- Management of Deicing Chemicals and Snow
  Snow will be stockpiled on site until the accumulated snow becomes a hazard to the daily operations of the site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to MassDEP, Bureau of Resource Protection – Snow Disposal Guideline #BRPG01-01, governing the proper disposal of snow. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations

  The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. If used, the de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. If used, de-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand.

Long-Term Maintenance Plan – Facilities Description

A maintenance log will be kept (i.e. report) summarizing inspections, maintenance, and any corrective actions taken. The log will include the date on which each inspection or maintenance task was performed, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. The log will be made accessible to department staff and a copy provided to the department upon request.

The following is a description of the Stormwater Management System for the project site.

Stormwater Collection System – On-Site:

The stormwater collection system is a series of inlets located at low points within the limits of the paved area. All of the proposed on-site catch basins incorporate a deep sump and hooded outlet. The catch basins are connected by a closed gravity pipe network that pass through proprietary separators prior to entering the pipe detention systems or gabion walls.

Structural Pretreatment BMPs: Regular maintenance of these BMPs is especially critical because they typically receive the highest concentration of suspended solids during the first flush of a storm event.

- Deep Sump Catch Basin:
  Deep sump catch basins, also known as oil and grease or hooded catch basins, are underground retention systems designed to remove trash, debris, and coarse sediment from stormwater runoff, and serve as temporary spill containment devices for floatables such as oils and greases.

Treatment BMPs:

- Proprietary Separator:
  A proprietary separator is a flow-through structure with a settling or separation unit to remove sediments and other pollutants. They typically use the power of swirling or flowing water to separate floatables and coarser sediments, are typically designed and manufactured by private businesses, and come in different sizes to accommodate different design storms and flow conditions.

Infiltration BMPs:

- Dry Well:
  Dry wells are small excavated pits, backfilled with aggregate, and used to infiltrate uncontaminated runoff from non-metal roofs or metal roofs located outside the Zone II or Interim Wellhead Protection Area of a public water supply and outside an industrial site. Do not use dry wells to infiltrate any runoff that could be significantly contaminated with sediment and other pollutants. Never use dry wells to infiltrate runoff from land uses with higher potential pollutant loads, including parking lot runoff.

Other BMPs:

- Dry Detention Basin
  A dry detention basin is an impoundment or excavated basin for the short-term detention of stormwater runoff from a completed development that allows controlled release from the structure at downstream, pre-development flow rates. Conventional dry detention basins typically control peak runoff for 2-year and 10-year 24-hour storms. They are not specifically designed to provide extended dewatering times, wet pools, or groundwater recharge. Sometimes flows can be controlled using an outlet pipe of the appropriate size but this approach typically cannot control multiple design storms.

BMP Accessories:

- Level Spreader (Gabion Wall):
  A level spreader receives concentrated flow from channels, outlet structures, or other conveyance structures, and converts it to sheet flow where it can disperse uniformly across a stable slope. A level spreader is not a pollutant reduction device. It improves the efficiency of other BMPs, such as vegetated swales, filter strips, or infiltration systems that depend on sheet flow to operate properly.

Other Maintenance Activity:

- Street Sweeping - Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring. Accumulations on pavement may be removed by pavement sweeping. Accumulations of sand along road shoulders may be removed by grading excess sand to the pavement edge and removing it manually or by a front-end loader.

Inspection and Maintenance Frequency and Corrective Measures
In accordance with MA DEP Stormwater Handbook: Volume 2, Chapter 2; the previously described BMPs will be inspected and the identified deficiencies will be corrected. Clean-out must include the removal and legal disposal of any accumulated sediments, trash, and debris. In any and all cases, operations, inspections, and maintenance activities shall utilize best practical measures to avoid and minimize impacts to wetland resource areas outside the footprint of the SMS.

Supplemental Information

- Long-Term Operation & Maintenance (O&M) Plan
- MASSDEP Snow Disposal Regulations
- CDS Maintenance Procedures
- Retain-It Owners Maintenance Manual

OPERATION AND MAINTENANCE PLAN SCHEDULE

Date: 10-05-2021

ALLEN & MAJOR ASSOCIATES, INC.

Project: 2889-01
Project Address: Skyview Estates, Main Street, Leicester, MA

Responsible for O&M Plan: MKEP 770 LLC
Address: 265 Sunrise Highway, Suite 1368, Rockville Center, NY 11570
Phone: (646) 483-2517

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	INSPECTION PERFORMED	
				DATE:	BY:
STRUCTURAL PRETREATMENT BMPs	DEEP SUMP CATCH BASIN	Four times per year (quarterly).	Inspect and clean catch basin units whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin.		
	PROPRIETARY SEPARATORS	In accordance with manufacturers requirements, but no less than twice a year following installation and once a year thereafter.	Remove sediment and other trapped pollutants at frequency or level specified by manufacturer.		
INFILTRATION BMPs	DRY WELL	Inspect after every major storm in the first few months following construction. Thereafter, inspect annually.	Inspect dry wells. Measure the water depth in the observation well at 24- and 48-hour intervals after a storm. Calculate clearance rates by dividing the drop in water level (inches) by the time elapsed (hr.).		

OPERATION AND MAINTENANCE PLAN SCHEDULE **Date: 10-05-2021**

ALLEN & MAJOR ASSOCIATES, INC.

Project: 2889-01
Project Address: Skyview Estates, Main Street, Leicester, MA

Responsible for O&M Plan: MKEP 770 LLC
Address: 265 Sunrise Highway, Suite 1368, Rockville Center, NY 11570
Phone: (646) 483-2517

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	INSPECTION PERFORMED	
				DATE:	BY:
OTHER BMPs	DRY DETENTION	Inspect basin operation at least once a year and after large storms to determine if the basin is meeting the expected detention times	Inspect detention pipes to ensure they are operating as designed. Check the outlet structures for accumulated sediment, trash, and debris and remove it. Remove sediment from the basin as needed.		
BMP ACCESSORIES	LEVEL SPREADERS	Inspect regularly, especially after large rainfall events.	Inspect level spreaders regularly, especially after large rainfall events. Note and repair any erosion or low spots in the spreader.		
	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.		

OPERATION AND MAINTENANCE PLAN SCHEDULE

Date: 10-05-2021

Project: 2889-01
Project Address: Skyview Estates, Main Street, Leicester, MA

Responsible for O&M Plan: MKEP 770 LLC
Address: 265 Sunrise Highway, Suite 1368, Rockville Center, NY 11570
Phone: (646) 483-2517

All information within table is derived from Massachussetts Stormwater Handbook: Volume 2, Chapter 2

BMP CATEGORY	BMP OR MAINTENANCE ACTIVITY	SCHEDULE/ FREQUENCY	NOTES	INSPECTION PERFORMED	
				DATE:	BY:
OTHER MAINTENANCE ACTIVITIES	SNOW STORAGE	Clear and remove snow to approved storage locations as necessary to ensure systems are working properly and are protected from meltwater pollutants.	Carefully select snow disposal sites before winter. Avoid dumping removed snow over catch basins, or in detention ponds, sediment forebays, rivers, wetlands, and flood plains. It is also prohibited to dump snow in the bioretention basins or gravel swales.		
	STREET SWEEPING	Clear accumulations of winter sand in parking lots and along roadways at least once a year, preferably in the spring.	Sweep, power broom or vacuum paved areas. Submit information that confirms that all street sweepings have been completed in accordance with state and local requirements		

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

One Winter Street Boston, MA 02108 • 617-292-5500

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Kathleen A. Theoharides
Secretary

Martin Suuberg
Commissioner

Massachusetts Department of Environmental Protection
Bureau of Water Resources
Snow Disposal Guidance

Effective Date: December 11, 2020

Applicability: Applies to all federal, state, regional and local agencies, as well as to private businesses.

Supersedes: Bureau of Resource Protection (BRP) Snow Disposal Guideline No. BRPG97-1 issued December 12, 1997 and BRPG01-01 issued March 8, 2001; Bureau of Water Resources (BWR) snow disposal guidance issued December 21, 2015 and December 12, 2018.

Approved by: Kathleen Baskin, Assistant Commissioner, Bureau of Water Resources

PURPOSE: To provide guidelines to all government agencies and private businesses regarding snow disposal site selection, site preparation and maintenance, and emergency snow disposal options that are protective of wetlands, drinking water, and water bodies, and are acceptable to the Massachusetts Department of Environmental Protection (MassDEP), Bureau of Water Resources.

APPLICABILITY: These Guidelines are issued by MassDEP's Bureau of Water Resources on behalf of all Bureau Programs (including Drinking Water Supply, Wetlands and Waterways, Wastewater Management, and Watershed Planning and Permitting). They apply to all federal agencies, state agencies, state authorities, municipal agencies and private businesses disposing of snow in the Commonwealth of Massachusetts.

INTRODUCTION

Finding a place to dispose of collected snow poses a challenge to municipalities and businesses as they clear roads, parking lots, bridges, and sidewalks. While MassDEP is aware of the threats to public safety caused by snow, collected snow that is contaminated with road salt, sand, litter, and automotive pollutants such as oil also threatens public health and the environment.

As snow melts, road salt, sand, litter, and other pollutants are transported into surface water or through the soil where they may eventually reach the groundwater. Road salt and other pollutants can contaminate water supplies and are toxic to aquatic life at certain levels. Sand washed into waterbodies can create sand bars or fill in wetlands and ponds, impacting aquatic life, causing flooding, and affecting our use of these resources.

There are several steps that communities can take to minimize the impacts of snow disposal on public health and the environment. These steps will help communities avoid the costs of a contaminated water supply, degraded waterbodies, and flooding. Everything that occurs on the land has the potential to impact the Commonwealth's water resources. Given the authority of local government over the use of the land, municipal officials and staff have a critically important role to play in protecting our water resources.

The purpose of these guidelines is to help federal agencies, state agencies, state authorities, municipalities and businesses select, prepare, and maintain appropriate snow disposal sites before the snow begins to accumulate through the winter. Following these guidelines and obtaining the necessary approvals may also help municipalities in cases when seeking reimbursement for snow disposal costs from the Federal Emergency Management Agency is possible.

RECOMMENDED GUIDELINES

These snow disposal guidelines address: (1) site selection; (2) site preparation and maintenance; and (3) emergency snow disposal.

1. SITE SELECTION

The key to selecting effective snow disposal sites is to locate them adjacent to or on pervious surfaces in upland areas or upland locations on impervious surfaces away from water resources and drinking water wells. At these locations, the snow meltwater can filter into the soil, leaving behind sand and debris which can be removed in the spring. The following conditions should be followed:

- Within water supply Zone A and Zone II, avoid storage or disposal of snow and ice containing deicing chemicals that has been collected from streets located outside these zones. Municipalities may have a water supply protection land use control that prohibits the disposal of snow and ice containing deicing chemicals from outside the Zone A and Zone II, subject to the Massachusetts Drinking Water Regulations at 310 CMR 22.20C and 310 CMR 22.21(2).
- Avoid storage or disposal of snow or ice in Interim Wellhead Protection Areas (IWPA) of public water supply wells, and within 75 feet of a private well, where road salt may contaminate water supplies.
- Avoid dumping snow into any waterbody, including rivers, the ocean, reservoirs, ponds, or wetlands. In addition to water quality impacts and flooding, snow disposed of in open water can cause navigational hazards when it freezes into ice blocks.
- Avoid dumping snow on MassDEP-designated high and medium-yield aquifers where it may contaminate groundwater.
- Avoid dumping snow in sanitary landfills and gravel pits. Snow meltwater will create more contaminated leachate in landfills posing a greater risk to groundwater, and in gravel pits, there is little opportunity for pollutants to be filtered out of the meltwater because groundwater is close to the land surface.

- Avoid disposing of snow on top of storm drain catch basins or in stormwater drainage systems including detention basins, swales or ditches. Snow combined with sand and debris may block a stormwater drainage system, causing localized flooding. A high volume of sand, sediment, and litter released from melting snow also may be quickly transported through the system into surface water.

Recommended Site Selection Procedures

It is important that the municipal Department of Public Works or Highway Department, Conservation Commission, and Board of Health work together to select appropriate snow disposal sites. The following steps should be taken:

- Estimate how much snow disposal capacity may be needed for the season so that an adequate number of disposal sites can be selected and prepared.
- Identify sites that could potentially be used for snow disposal, such as municipal open space (e.g., parking lots or parks).
- Select sites located in upland locations that are not likely to impact sensitive environmental resources first.
- If more storage space is still needed, prioritize the sites with the least environmental impact (using the site selection criteria, and local or MassGIS maps as a guide).

Snow Disposal Mapping Assistance

MassDEP has an online mapping tool to assist in identifying possible locations to potentially dispose of snow. MassDEP encourages municipalities to use this tool to identify possible snow disposal options. The tool identifies wetland resource areas, public drinking water supplies and other sensitive locations where snow should not be disposed. The tool may be accessed through the Internet at the following web address:
https://maps.env.state.ma.us/dep/arcgis/js/templates/PSF/.

2. SITE PREPARATION AND MAINTENANCE

In addition to carefully selecting disposal sites before the winter begins, it is important to prepare and maintain these sites to maximize their effectiveness. The following maintenance measures should be undertaken for all snow disposal sites:

- A silt fence or equivalent barrier should be placed securely on the downgradient side of the snow disposal site.
- Wherever possible maintain a 50-foot vegetated buffer between the disposal site and adjacent waterbodies to filter pollutants from the meltwater.
- Clear debris from the site prior to using the site for snow disposal.
- Clear debris from the site and properly dispose of it at the end of the snow season, and no later than May 15.

3. SNOW DISPOSAL APPROVALS

Proper snow disposal may be undertaken through one of the following approval procedures:

- Routine snow disposal – Minimal, if any, administrative review is required in these cases when upland and pervious snow disposal locations or upland locations on impervious surfaces that have functioning and maintained stormwater management systems have been identified, mapped, and used for snow disposal following ordinary snowfalls. Use of upland and pervious snow disposal sites avoids wetland resource areas and allows snow meltwater to recharge groundwater and will help filter pollutants, sand, and other debris. This process will address the majority of snow removal efforts until an entity exhausts all available upland snow disposal sites. The location and mapping of snow disposal sites will help facilitate each entity's routine snow management efforts.
- Emergency Certifications – If an entity demonstrates that there is no remaining capacity at upland snow disposal locations, local conservation commissions may issue an Emergency Certification under the Massachusetts Wetlands Protection regulations to authorize snow disposal in buffer zones to wetlands, certain open water areas, and certain wetland resource areas (i.e. within flood plains). Emergency Certifications can only be issued at the request of a public agency or by order of a public agency for the protection of the health or safety of citizens, and are limited to those activities necessary to abate the emergency. See 310 CMR 10.06(1)-(4). Use the following guidelines in these emergency situations:
  - Dispose of snow in open water with adequate flow and mixing to prevent ice dams from forming.
  - Do not dispose of snow in salt marshes, vegetated wetlands, certified vernal pools, shellfish beds, mudflats, drinking water reservoirs and their tributaries, Zone IIs or IWPAs of public water supply wells, Outstanding Resource Waters, or Areas of Critical Environmental Concern.
  - Do not dispose of snow where trucks may cause shoreline damage or erosion.
  - Consult with the municipal Conservation Commission to ensure that snow disposal in open water complies with local ordinances and bylaws.
- Severe Weather Emergency Declarations – In the event of a large-scale severe weather event, MassDEP may issue a broader Emergency Declaration under the Wetlands Protection Act which allows federal agencies, state agencies, state authorities, municipalities, and businesses greater flexibility in snow disposal practices. Emergency Declarations typically authorize greater snow disposal options while protecting especially sensitive resources such as public drinking water supplies, vernal pools, land containing shellfish, FEMA designated floodways, coastal dunes, and salt marsh. In the event of severe winter storm emergencies, the snow disposal site maps created by municipalities will enable MassDEP and the Massachusetts Emergency Management Agency (MEMA) in helping communities identify appropriate snow disposal locations.

  If upland disposal sites have been exhausted, the Emergency Declaration issued by MassDEP allows for snow disposal near water bodies. In these situations, a buffer of at least 50 feet, preferably vegetated, should still be maintained between the site and the waterbody. Furthermore, it is essential that the other guidelines for preparing and maintaining snow disposal sites be followed to minimize the threat to adjacent waterbodies.

Under extraordinary conditions, when all land-based snow disposal options are exhausted, the Emergency Declaration issued by MassDEP may allow disposal of snow in certain waterbodies under certain conditions. ***A federal agency, state agency, state authority, municipality or business seeking to dispose of snow in a waterbody should take the following steps***:

- Call the emergency contact phone number [(888) 304-1133)] and notify the MEMA of the municipality's intent.
- MEMA will ask for some information about where the requested disposal will take place.
- MEMA will confirm that the disposal is consistent with MassDEP's Severe Weather Emergency Declaration and these guidelines and is therefore approved.

During declared statewide snow emergency events, MassDEP's website will also highlight the emergency contact phone number [(888) 304-1133)] for authorizations and inquiries. For further non-emergency information about this Guidance you may contact your MassDEP Regional Office Service Center:

Northeast Regional Office, Wilmington, 978-694-3246
Southeast Regional Office, Lakeville, 508-946-2714
Central Regional Office, Worcester, 508-792-7650
Western Regional Office, Springfield, 413-755-2114

CONTECH
ENGINEERED SOLUTIONS

CDS Guide
Operation, Design, Performance and Maintenance

CDS®

Using patented continuous deflective separation technology, the CDS system screens, separates and traps debris, sediment, and oil and grease from stormwater runoff. The indirect screening capability of the system allows for 100% removal of floatables and neutrally buoyant material without blinding. Flow and screening controls physically separate captured solids, and minimize the re-suspension and release of previously trapped pollutants. Inline units can treat up to 6 cfs, and internally bypass flows in excess of 50 cfs (1416 L/s). Available precast or cast-in-place, offline units can treat flows from 1 to 300 cfs (28.3 to 8495 L/s). The pollutant removal capacity of the CDS system has been proven in lab and field testing.

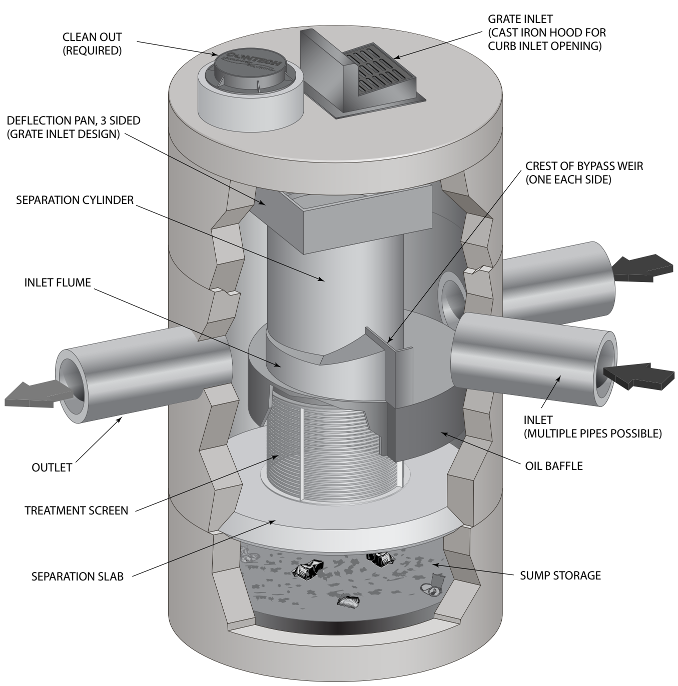
Operation Overview

Stormwater enters the diversion chamber where the diversion weir guides the flow into the unit's separation chamber and pollutants are removed from the flow. All flows up to the system's treatment design capacity enter the separation chamber and are treated.

Swirl concentration and screen deflection force floatables and solids to the center of the separation chamber where 100% of floatables and neutrally buoyant debris larger than the screen apertures are trapped.

Stormwater then moves through the separation screen, under the oil baffle and exits the system. The separation screen remains clog free due to continuous deflection.

During the flow events exceeding the treatment design capacity, the diversion weir bypasses excessive flows around the separation chamber, so captured pollutants are retained in the separation cylinder.



Design Basics

There are three primary methods of sizing a CDS system. The Water Quality Flow Rate Method determines which model size provides the desired removal efficiency at a given flow rate for a defined particle size. The Rational Rainfall Method™ or the and Probabilistic Method is used when a specific removal efficiency of the net annual sediment load is required.

Typically in the Unites States, CDS systems are designed to achieve an 80% annual solids load reduction based on lab generated performance curves for a gradation with an average particle size (d50) of 125 microns (μm). For some regulatory environments, CDS systems can also be designed to achieve an 80% annual solids load reduction based on an average particle size (d50) of 75 microns (μm) or 50 microns (μm).

Water Quality Flow Rate Method

In some cases, regulations require that a specific treatment rate, often referred to as the water quality design flow (WQQ), be treated. This WQQ represents the peak flow rate from either an event with a specific recurrence interval, e.g. the six-month storm, or a water quality depth, e.g. 1/2-inch (13 mm) of rainfall.

The CDS is designed to treat all flows up to the WQQ. At influent rates higher than the WQQ, the diversion weir will direct most flow exceeding the WQQ around the separation chamber. This allows removal efficiency to remain relatively constant in the separation chamber and eliminates the risk of washout during bypass flows regardless of influent flow rates.

Treatment flow rates are defined as the rate at which the CDS will remove a specific gradation of sediment at a specific removal efficiency. Therefore the treatment flow rate is variable, based on the gradation and removal efficiency specified by the design engineer.

Rational Rainfall Method™

Differences in local climate, topography and scale make every site hydraulically unique. It is important to take these factors into consideration when estimating the long-term performance of any stormwater treatment system. The Rational Rainfall Method combines site-specific information with laboratory generated performance data, and local historical precipitation records to estimate removal efficiencies as accurately as possible.

Short duration rain gauge records from across the United States and Canada were analyzed to determine the percent of the total annual rainfall that fell at a range of intensities. US stations' depths were totaled every 15 minutes, or hourly, and recorded in 0.01-inch increments. Depths were recorded hourly with 1-mm resolution at Canadian stations. One trend was consistent at all sites; the vast majority of precipitation fell at low intensities and high intensity storms contributed relatively little to the total annual depth.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Rainfall Method. Since most sites are relatively small and highly impervious, the Rational Rainfall Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS system are determined. Performance efficiency curve determined from full scale laboratory tests on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Probabilistic Rational Method

The Probabilistic Rational Method is a sizing program Contech developed to estimate a net annual sediment load reduction for a particular CDS model based on site size, site runoff coefficient, regional rainfall intensity distribution, and anticipated pollutant characteristics.

The Probabilistic Method is an extension of the Rational Method used to estimate peak discharge rates generated by storm events of varying statistical return frequencies (e.g. 2-year storm event). Under the Rational Method, an adjustment factor is used to adjust the runoff coefficient estimated for the 10-year event, correlating a known hydrologic parameter with the target storm event. The rainfall intensities vary depending on the return frequency of the storm event under consideration. In general, these two frequency dependent parameters (rainfall intensity and runoff coefficient) increase as the return frequency increases while the drainage area remains constant.

These intensities, along with the total drainage area and runoff coefficient for each specific site, are translated into flow rates using the Rational Method. Since most sites are relatively small and highly impervious, the Rational Method is appropriate. Based on the runoff flow rates calculated for each intensity, operating rates within a proposed CDS are determined. Performance efficiency curve on defined sediment PSDs is applied to calculate solids removal efficiency. The relative removal efficiency at each operating rate is added to produce a net annual pollutant removal efficiency estimate.

Treatment Flow Rate

The inlet throat area is sized to ensure that the WQQ passes through the separation chamber at a water surface elevation equal to the crest of the diversion weir. The diversion weir bypasses excessive flows around the separation chamber, thus preventing re-suspension or re-entrainment of previously captured particles.

Hydraulic Capacity

The hydraulic capacity of a CDS system is determined by the length and height of the diversion weir and by the maximum allowable head in the system. Typical configurations allow hydraulic capacities of up to ten times the treatment flow rate. The crest of the diversion weir may be lowered and the inlet throat may be widened to increase the capacity of the system at a given water surface elevation. The unit is designed to meet project specific hydraulic requirements.

Performance

Full-Scale Laboratory Test Results

A full-scale CDS system (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This CDS unit was evaluated under controlled laboratory conditions of influent flow rate and addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSDs) of the test materials were analyzed using standard method "Gradation ASTM D-422 "Standard Test Method for Particle-Size Analysis of Soils" by a certified laboratory.

UF Sediment is a mixture of three different products produced by the U.S. Silica Company: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d50 = 20 to 30 μm) covering a wide size range (Coefficient of Uniformity, C averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d50 (d50 for NJDEP is approximately 50 μm) (NJDEP, 2003).

The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d50) of 106 microns. The PSDs for the test material are shown in Figure 1.

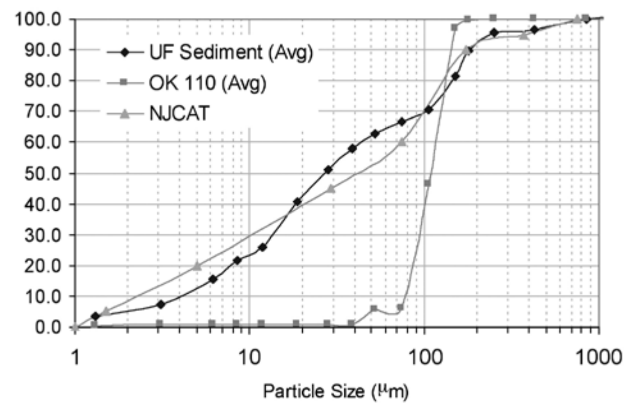


Figure 1. Particle size distributions

Tests were conducted to quantify the performance of a specific CDS unit (1.1 cfs (31.3-L/s) design capacity) at various flow rates, ranging from 1% up to 125% of the treatment design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations of approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC) testing using ASTM D3977-97 "Standard Test Methods for Determining Sediment Concentration in Water Samples", and particle size distribution analysis.

Results and Modeling

Based on the data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve representative of the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation, assuming the particles are inorganic sandy-silt. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand) as a function of operating rate.

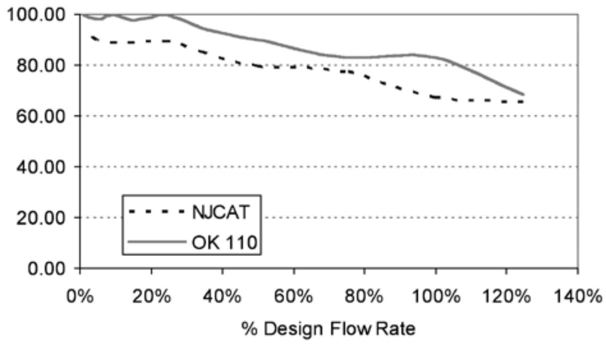


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d50) of 125 microns (e.g. Washington State Department of Ecology — WASDOE - 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). The model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at the design (100%) flow rate, for this particle size distribution (d50 = 125 μm).

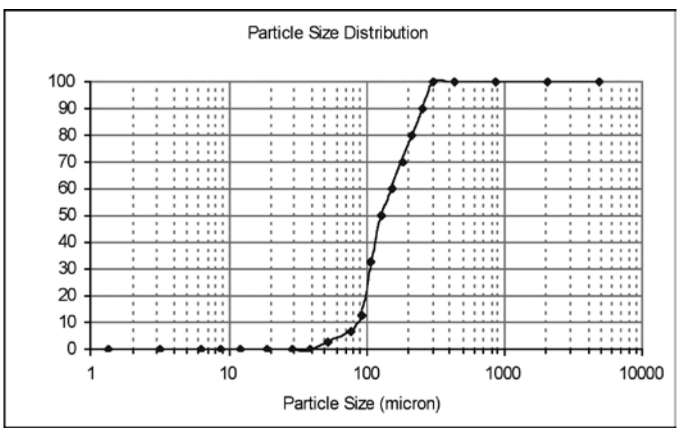


Figure 3. WASDOE PSD

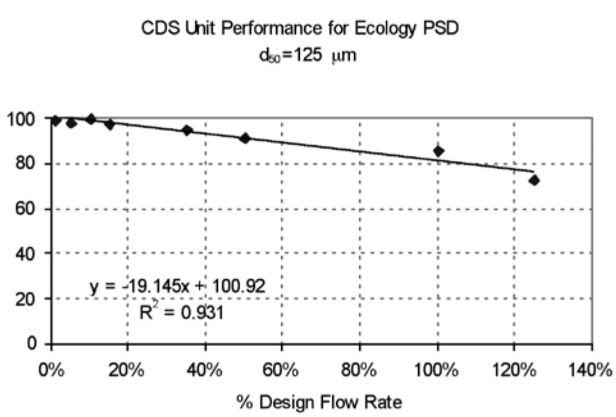


Figure 4. Modeled performance for WASDOE PSD.

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified

during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

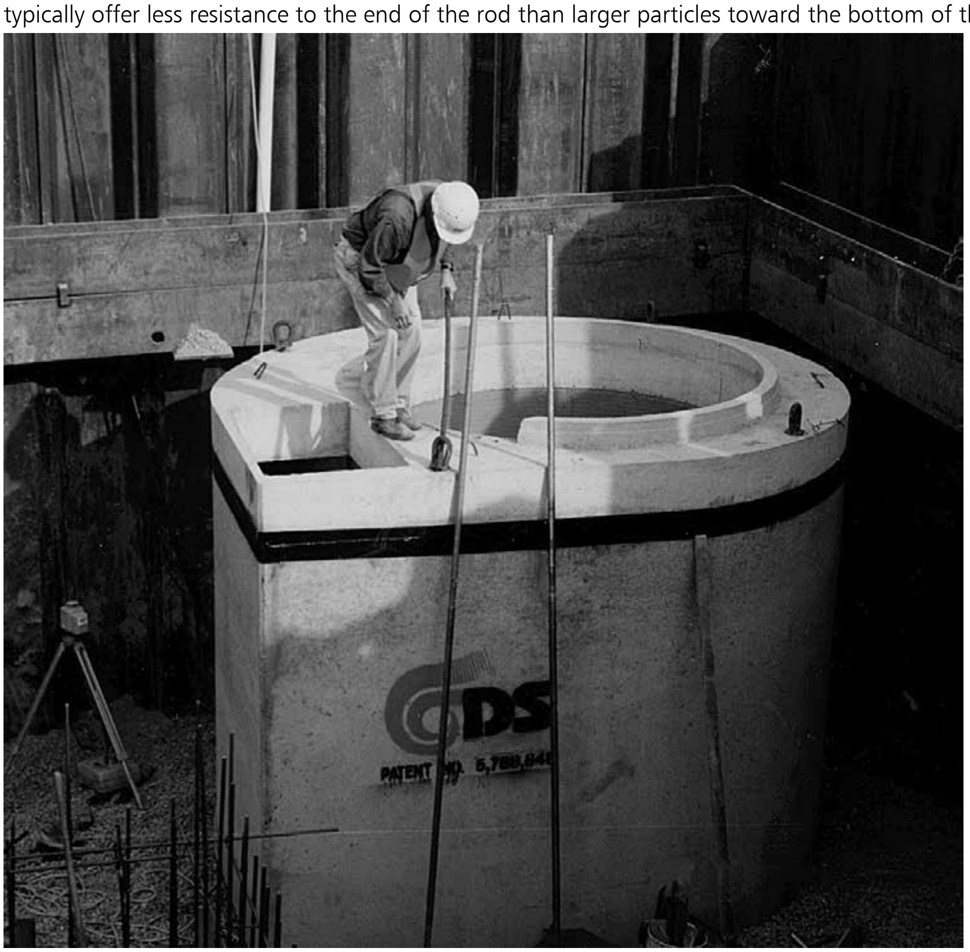
In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be cleaned to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes. Check your local regulations for specific requirements on disposal.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.5	3.0	0.9	1.3	1.0
CDS2020	5	1.5	3.5	1.1	1.3	1.0
CDS2025	5	1.5	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Note: To avoid underestimating the volume of sediment in the chamber, carefully lower the measuring device to the top of the sediment pile. Finer silty particles at the top of the pile may be more difficult to feel with a measuring stick. These finer particles typically offer less resistance to the end of the rod than larger particles toward the bottom of the pile.



CDS Inspection & Maintenance Log

CDS Model: ______________________ Location: ______________________

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile**.

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

SUPPORT

- Drawings and specifications are available at www.ContechES.com.
- Site-specific design support is available from our engineers.

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The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other patents pending.

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RECYCLED PAPER

retain-it®
Stormwater Management Systems

OWNERS MAINTENANCE MANUAL

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Granby, CT 06035
(860) 413-3050

retain-it ®

Owners Maintenance Manual

Table of Contents

Description

retain-it ® is a subsurface Storm Water Management system constructed of precast concrete structures. They are installed in a side by side configuration creating a continuous internal flow channel integrated throughout the system. Systems are constructed with designated inlet and outlet modules, some with multiple inlets and outlets depending on the site storm water system layout. Infiltration systems typically have an inlet and sidewalls/ base constructed on a stone infiltration blanket with geofabric installed at the native soil interface. Other systems incorporate outlet flow control devices. Detention systems are typically lined with a watertight membrane and have inlet and outlet control devices.

The retain-it ® system can consist of multiple varying layouts, with no two the same. Given this, it should be noted that the operation and maintenance requirements are very similar regardless of the intended layout. It is important that the end user know the specific elements of each system so as to understand how best to optimize it's operation.

Installation per Design: Operation is simple to follow where the installation was performed in accordance with the design specifications, drawings and calculations. Specifics shall be identified in the design drawings. As-built drawings will benefit the locating of specific design modules where the system has been buried below a parking lot area. Optional access manholes or removable grates may be installed above every inlet/outlet pipe and at critical design elements designated by the design.

Daily Operation and Long Term Maintenance: In general, daily usage of the system is self sufficient and will operate without requiring any outside assistance, except for periodic inspection to verify optimal performance and maintenance for removal of collected pollutants. A longer term maintenance program should incorporate a more thorough inspection of the all elements of the system to verify proper operating condition. This is more important with the infiltration type of systems where the soil infiltration surface may become restricted due to fine particle build up. Long term maintenance should include provisions for cleaning and removal of collected solids, oils and debris from the system.

System Operation: The system operational function is initiated according to rainfall runoff flows entering the structure. Internally, the runoff flows in a set pattern or sequence throughout the module layout in accordance with the hydraulic design conditions. The flows primarily operate on system head derived from the changes in elevation from the internal water surface and the outlet invert elevation. Some designs incorporate internal flow controls to satisfy hydraulic conditions that enhance water quality treatment or other intended purposes. Modified systems may incorporate a pump, but in general there are no mechanical apparatus required.

End user operations primarily consist of inspection and maintenance of the system over time.

Periodic Inspection: Important note - All storm water management systems react differently depending on the conditions that are characteristic to the contributing water shed. Variables such as storm intensity, runoff flow rates, site geology, surface stabilization and pollution load will affect the system operation. As does the inspection and maintenance frequency to ensure optimum effectiveness.

Inspections should be done periodically, with a greater number scheduled during the system start up and less frequently as the operator becomes familiar with the system performance characteristics. It is recommended that the end user keep records of the performance using the inspection log record sheet found in the back of this manual. These records shall identify the cycle of maintenance “system calibration” required for the specific applications based on the contributing water shed variables operating under “normal” conditions.

Please note that immediate maintenance may be required during “non-normal” events such as during adverse weather conditions or emergency fuel spills. See information on emergency spills in this manual.

Visual inspection of all assessable components shall be performed throughout the lifetime of the system. Access has been supplied at critical points to monitor hydraulic performance and removed pollutants buildup.

Standard Maintenance:

After construction has been completed and all disturbed surfaces have been stabilized by means of vegetation, asphalt or concrete surfaces, and all drainage system components have been constructed and are free of construction debris and sediments; then the storm water management system can be considered in an operational status.

Periodic visual inspections will help to identify issues of concern.The usual indicators are signs of slow flows, backed up water, visible oil, trash and debris or an excessive amount of sediment in the storage area.

Normal operational flows can be observed to flow freely at the predicted design elevations, from the inlet to the outlet module, following a serpintine path thru the storage and attenuation modules. Note that some modules are designed to permanently retain water where others may hold water and slowly release it over a typical 24 hour period. During a storm water event, the flows and water surface elevations will fluctuate from a low flow to a high flow/ storage status. The storage modules should fill during the event and drain down within a 24 hour period after the event has stopped. All pipes, orifices, weirs and standpipes should pass flows freely and at optimum capacity.

Standard maintenance is performed using a vacuum truck to suction the accumulated sediments, oils and greases and trash and debris from the system. Whereas an on-site maintenance staff can remove these items by hand, it is preferred that the vacuum truck be used as dictated by specific system conditions. When a specialized module designed to have a permanent water level is used, the vacuum truck should pump the liquid level down to inspect the below water elevation structures and sump storage areas.

Oils and greases can be handled by on-site staff by utilizing absorbent products that soak up the oils (and not) converting the oils from a liquid into a manageable solid form. These oil soaked absorbent materials should be disposed of in an approved manner.

Sediments, trash and debris shall be removed and disposed of in an approved manner.

Any indications of hazardous material, determined by visual inspection, testing, smell or abnormality, should be reported and handled per appropriate regulations.

Flow Conditions

System operators should familiarize themselves with proper hydraulic flow condition indicators, acceptable depths of sedimentation, debris and trash build up, and concentrations of oils and greases.

Hydraulic flow conditions are those that are established by the design as either a flow/storage or as a water quality treatment function. Both have performance characteristics that can be visually identified so as to determine the effective and efficient operation of the system.

The engineering design drawings should note the various expected water surface level elevations that are achieved during different design storms within the various modules. Since it is difficult for a visual inspection to coincide with the exact time given water elevations are predicted, the following guidelines are given for evaluation.

Visual Inspection Guide:

<u>Internal Flow Evaluation</u>

Low flow: water should flow freely from the inlet to the outlet, travelling the intended attenuation path thru the system with the water surface elevation below the structure beam height (12” deep), the system should drain completely 24 hours after a storm event,

Medium flow: the system should hold and maintain a water level during the 24 hour storm event and yet continually fill as the storm increases or drain downward as the event recedes. Flow within the system should occur freely from inlet to outlet only being restricted when a flow control structure has been integrally designed in place. Flow control devices may result in a water level backing up either temporarily or permanently; noting devices such as water quality modules may require a permanent water level to operate properly (see water quality treatment). Other system applications should drain completely 24 hours after a storm event.

High flow: the system should fill to the maximum design storm water level elevation (hydraulic grade line) per design. In most cases, that is the highest storage elevation available in the system, at the underside of the module top slab, or the invert of the overflow pipe. As the storm event recedes, the water level should begin to drain down via flow thru the system and discharge. The system should drain completely within 24 hours after a storm event.

Pollutant Storage Capacities

<u>Oil and Grease</u>

Oil and Grease Collection (with optional Oil water separator module specified) - Oil and grease accumulation is generally a function related to vehicle parking lot and drive areas, oil generating land uses or emergency spill conditions. It is important to maintain the system from accumulating excessive volumes of oils in that they may wash over into other sections of the system potentially clogging and reducing the infiltration capacity, blocking control devices and contaminating the overall system. The following standards apply.

Oil should not accumulate more than a visible sheen on the water surface in the oil water separation module only. A sheen is described as a fine, thin oil layer on the water surface identified by the glossy rainbow colors. A dipstick (dry wooden stick) can be used as a probe to determine the thickness of oil on the surface.

Accumulated oils could be associated with insufficient maintenance or a potential large volume oil resource. Any accumulation of oil should be promptly maintained by an experienced waste handler. Emergency spills such as those generated by an accidental spill shall be contained and removed immediately before the next storm event. Spills shall be handled in accordance with local environmental regulations. See spill and accumulated oil maintenance procedures.

Sediments

Sediments (with optional primary grit module or sedimentation modules specified) - Sediments shall be periodically removed from the system as they accumulate within the designated storage modules. The inlet modules are generally equipped with a sediment storage sump located in the base of the inlet structure. Inspection should be performed after major storm events or a minimum of annually, unless a different inspection cycle has been determined to be sufficient. Inspection shall consist of using a probe to determine the presence of and depth of the accumulated solids. Access is via the 24” manhole.

Note that excessive volumes of sediments will reduce the performance and efficiency of the system. Regional accumulations of solids such as those associated with ice and snow, may result in large springtime volumes of sand and gravels used for traction and ice control.

Trash and Debris

Trash and Debris (with optional trash and debris module specified) - Trash and debris accumulates in the inlet module in three forms; floating debris, neutrally buoyant, and heavy material. The floating debris is visible from the access manhole floating on the water surface in the form of but not limited to wood, paper, plastic, foam, bottles and cans. The neutrally buoyant material resides below the surface and combines with the natural flow regime of the system. It is hard to detect and can only be recognized when at a high concentration appears as a thickening of the water viscosity. Heavier material will simply settle to the sump base and combine with the sediments.

Note that trash and debris typically cause the most problems when they become lodged in a flow control device such as an outlet elbow, riser pipe, and orifice or weir structure. This can be detected visibly when the system is pumped down during maintenance. It can also be evaluated as a condition when flow is impeded and the water level backs up higher than the design elevations.

Emergency Spill Conditions (with optional emergency spill control module specified):

Emergency spill conditions are defined as an excessive accumulation of hydrocarbons such as oil, gasoline, diesel fuel, transmission oil or antifreeze usually resulting from an accidental discharge. Excessive accumulation is described as any amount larger than a thin “sheen” visible on the water surface.

Care should be given in handling these types of fluids. The incident should be reported to the appropriate authorities and should be mitigated by a hazardous waste consultant approved for such matters.

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Maintenance Log

Storm Water Management System

Location: ID #:

Date	Inspection Notes	Inspector

Note the following conditions:

Inlet Module

Outlet Module

Water Quality Module

Oil Elbow

Oil Accumulation

Sedimentation Accumulation

Trash and Debris Quantity

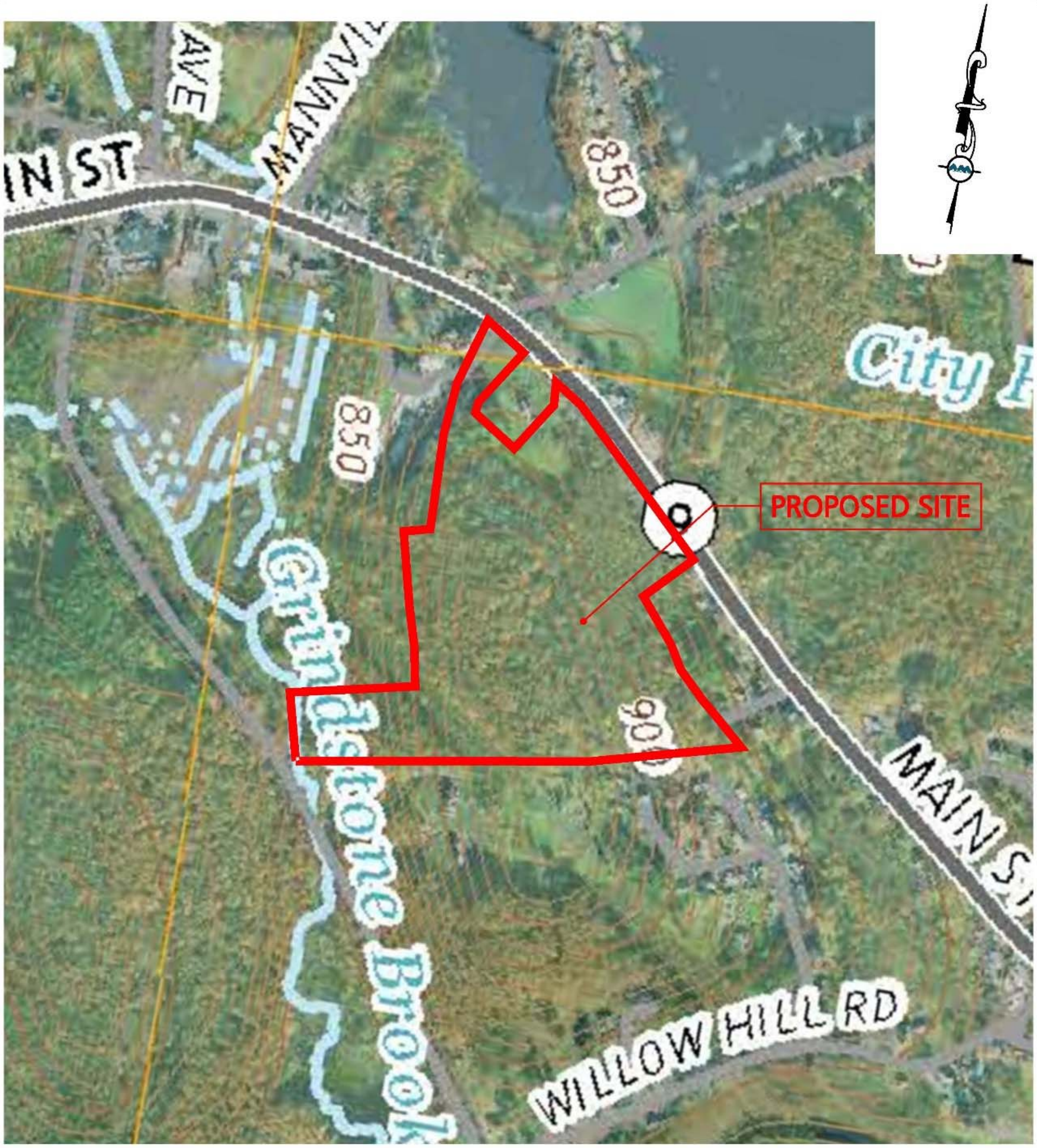
Flow Conditions

Flow Control Outlet Structure

Overflow Pipe

SECTION 3.0 -
EXHIBITS

USGS Site Locus Map



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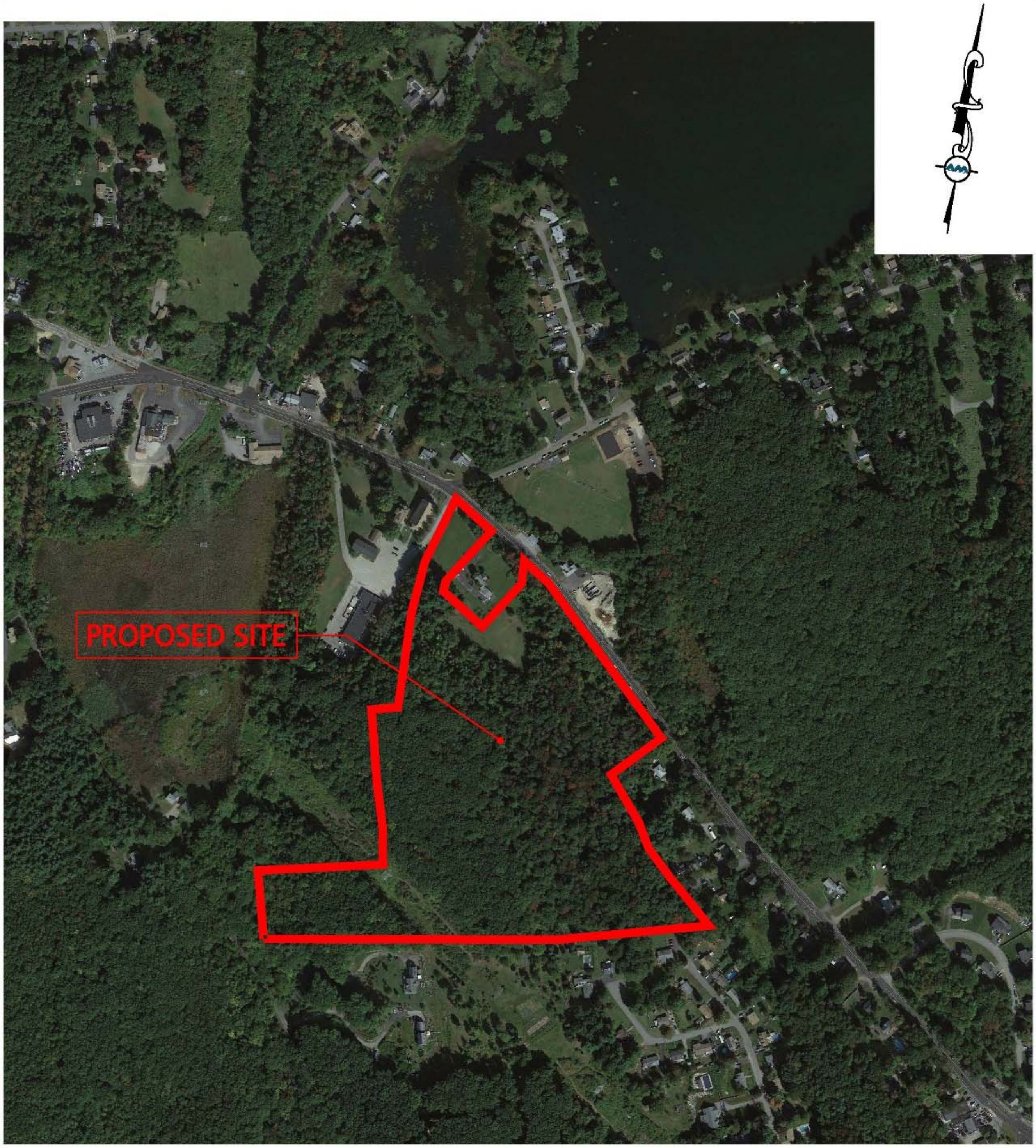
PROJECT:

SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

USGS SITE LOCUS MAP

PROJECT NO.	2889-01	DATE:	07-16-2021
SCALE:	1"=500'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JG	CHECKED BY:	MAM

SHEET No. EX-1



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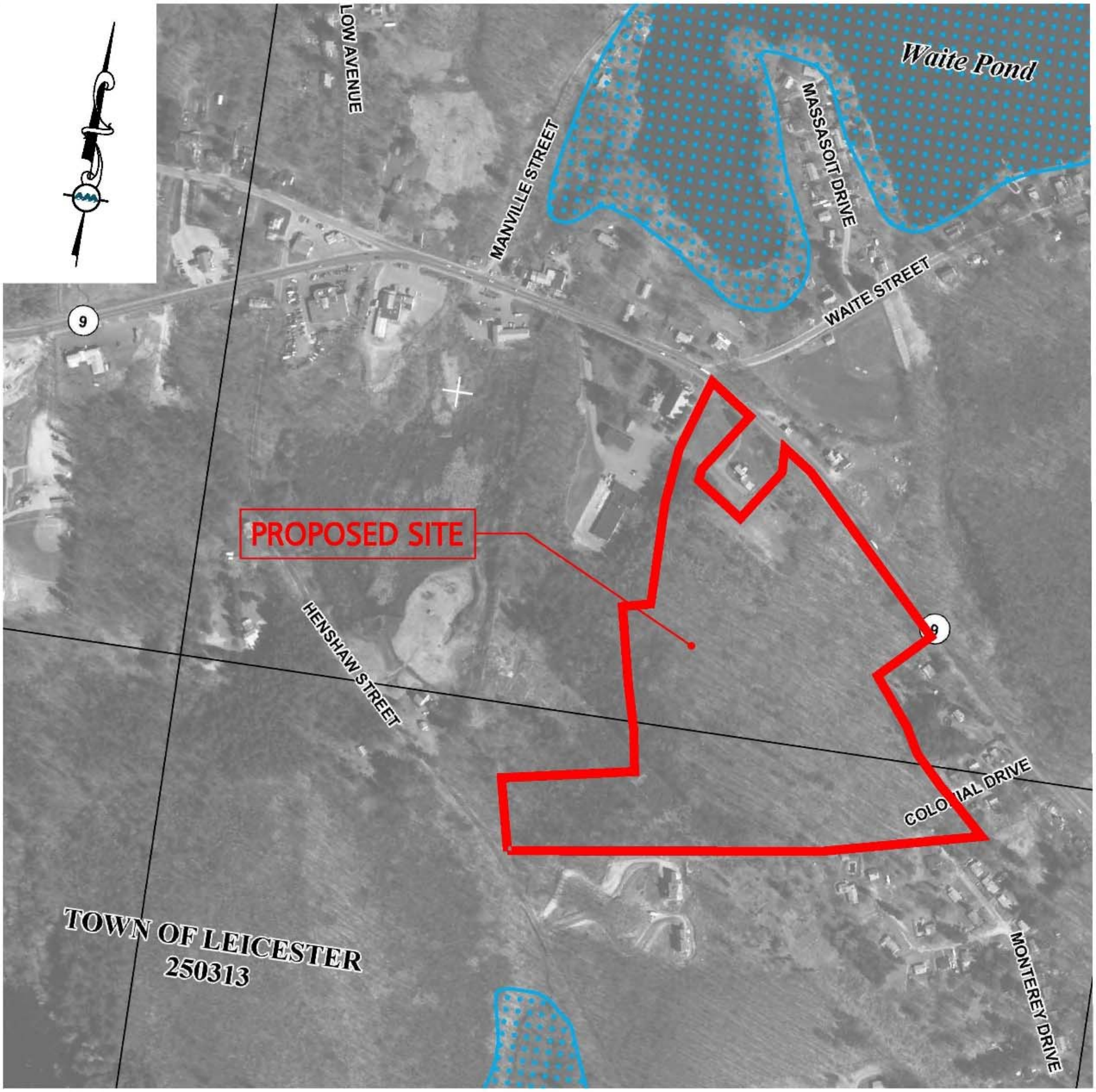
PROJECT:

SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

AERIAL PHOTO

PROJECT NO.	2889-01	DATE:	07-16-2021
SCALE:	1" = 500'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JG	CHECKED BY:	MAM

SHEET No.
EX-2



NOTES:

1. THE SITE IS LOCATED WITHIN ZONE X – AREAS DETERMINED TO BE OUTSIDE OF THE 0.2 % ANNUAL CHANCE FLOODPLAIN.
2. FEMA FIRM MAP WORCESTER COUNTY, MASSACHUSETTS #25027C0782E, PANEL 782 OF 1075

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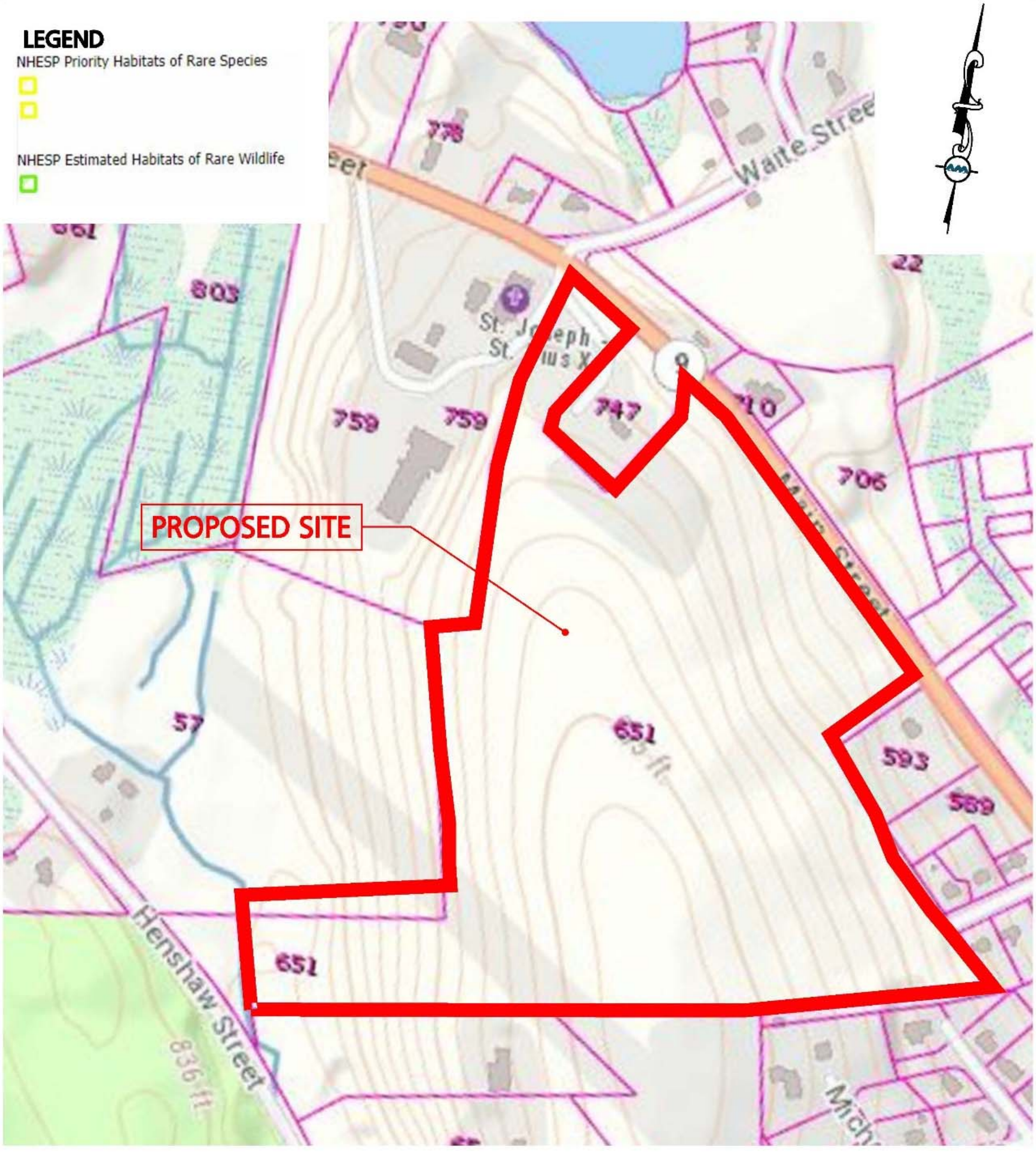
PROJECT:
SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

FEMA FIRM MAP

PROJECT NO.	2889-01	DATE:	07-16-2021
SCALE:	1"=500'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JG	CHECKED BY:	MAM

SHEET No.
EX-3



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PROJECT:

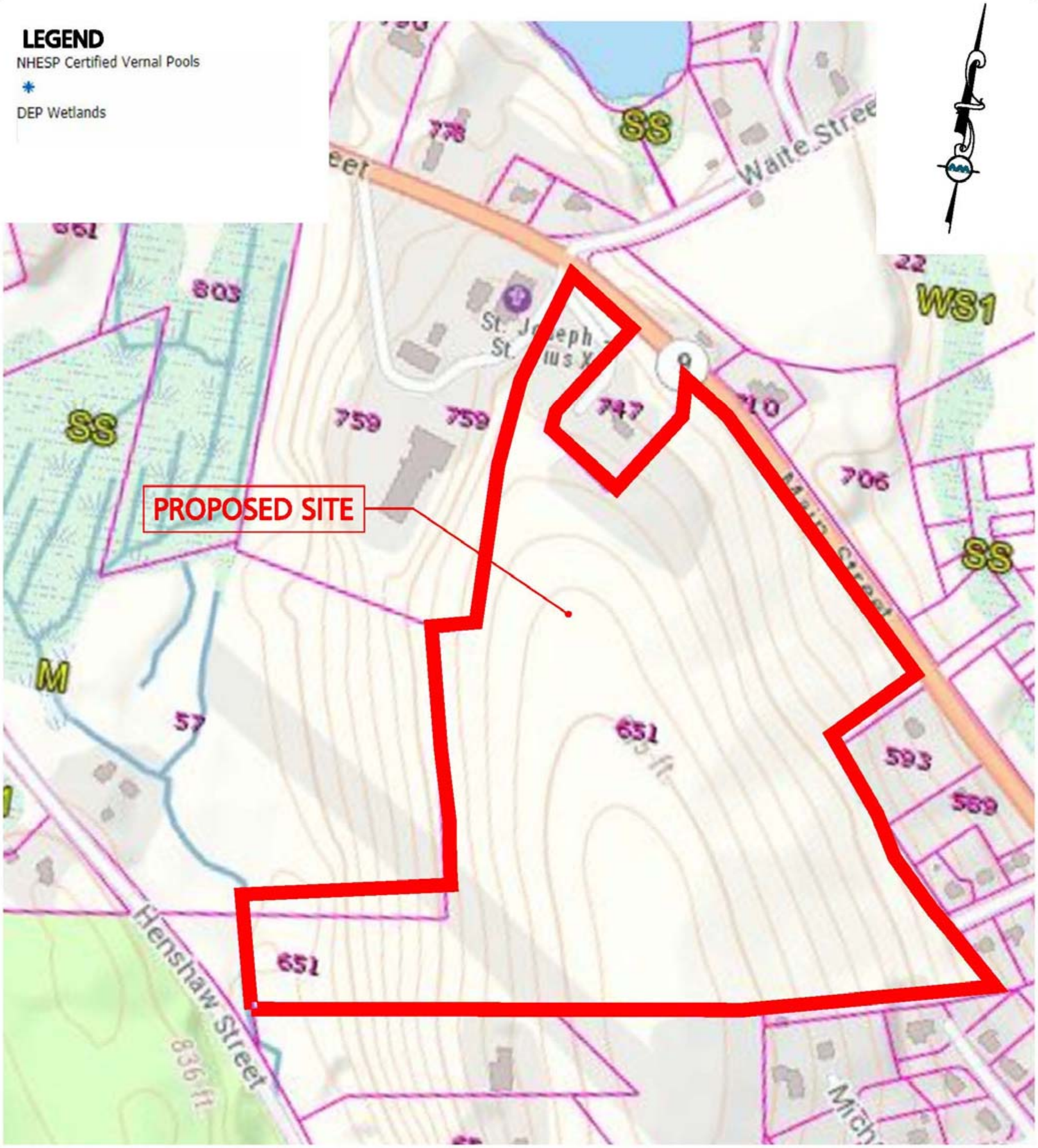
SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

PRIORITY & ESTIMATED HABITATS

PROJECT NO.	2889-01	DATE:	07-16-2021
SCALE:	1"=300'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JG	CHECKED BY:	MAM

SHEET No.

EX-4



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PROJECT:

SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

MA GIS WETLANDS MAP

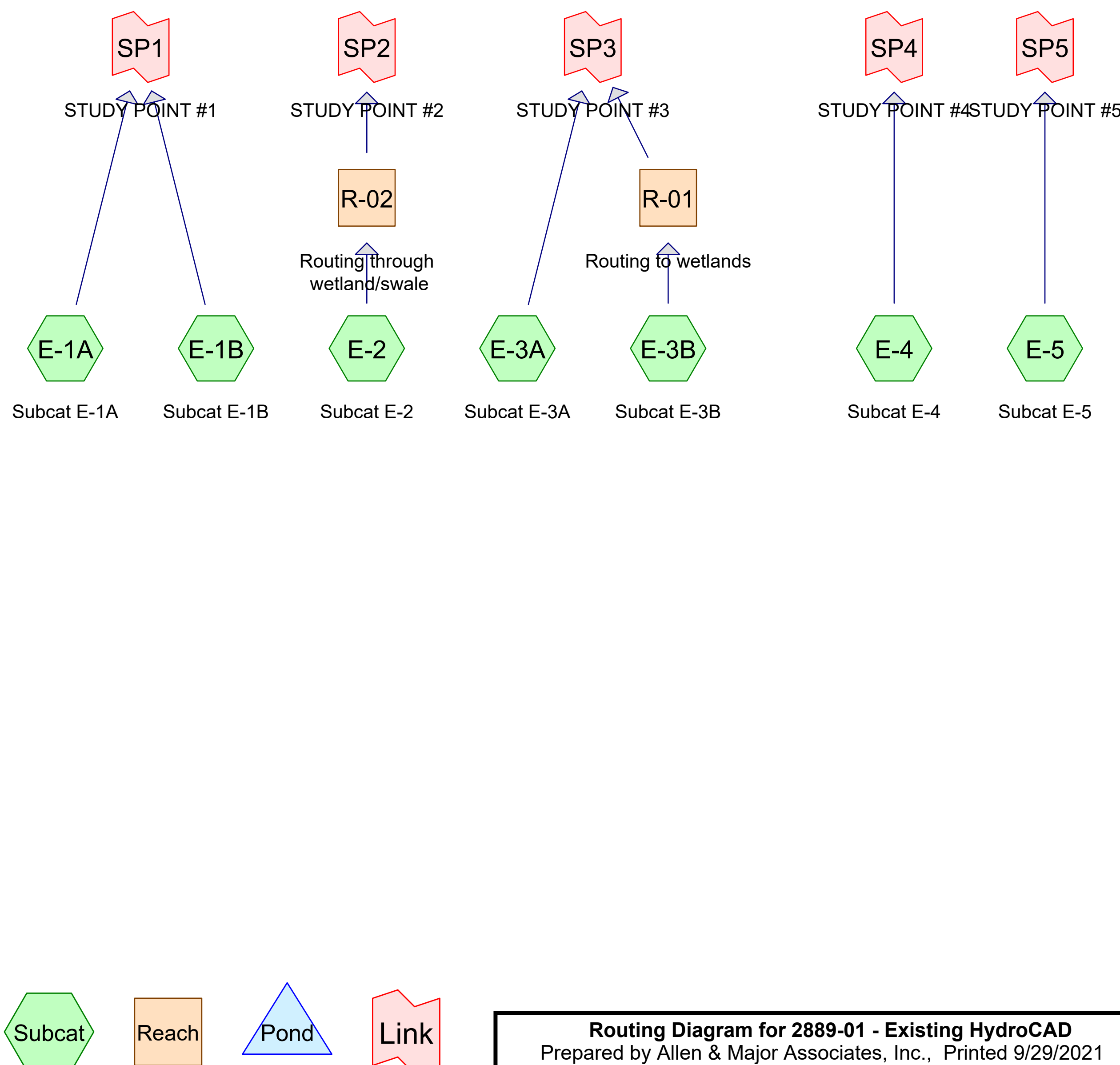
PROJECT NO.	2889-01	DATE:	07-16-2021
SCALE:	1"=300'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JG	CHECKED BY:	MAM

SHEET No.

EX-5

SECTION 4.0 -
EXISTING DRAINAGE ANALYSIS

Existing HydroCAD



Routing Diagram for 2889-01 - Existing HydroCAD
Prepared by Allen & Major Associates, Inc., Printed 9/29/2021
HydroCAD® 10.10-6a s/n 02947 © 2020 HydroCAD Software Solutions LLC

Rainfall Events Listing

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	3.23	2
2	10-year	Type III 24-hr		Default	24.00	1	4.85	2
3	25-year	Type III 24-hr		Default	24.00	1	6.12	2
4	50-year	Type III 24-hr		Default	24.00	1	7.30	2
5	100-year	Type III 24-hr		Default	24.00	1	8.72	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.210	61	>75% Grass cover, Good, HSG B (E-1B, E-4)
1.474	74	>75% Grass cover, Good, HSG C (E-1A, E-1B, E-2, E-4, E-5)
2.164	65	Brush, Good, HSG C (E-2, E-3A, E-3B)
0.067	98	Paved parking, HSG B (E-1B, E-4)
0.002	98	Paved parking, HSG C (E-1B)
0.749	55	Woods, Good, HSG B (E-1A, E-1B)
24.519	70	Woods, Good, HSG C (E-1A, E-1B, E-2, E-3A, E-3B, E-4, E-5)
29.185	**69**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
1.026	HSG B	E-1A, E-1B, E-4
28.159	HSG C	E-1A, E-1B, E-2, E-3A, E-3B, E-4, E-5
0.000	HSG D	
0.000	Other	
29.185		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.210	1.474	0.000	0.000	1.684	>75% Grass cover, Good	E-1A, E-1B, E-2, E-4, E-5
0.000	0.000	2.164	0.000	0.000	2.164	Brush, Good	E-2, E-3A, E-3B
0.000	0.067	0.002	0.000	0.000	0.069	Paved parking	E-1B, E-4
0.000	0.749	24.519	0.000	0.000	25.268	Woods, Good	E-1A, E-1B, E-2, E-3A, E-3B, E-4, E-5
0.000	**1.026**	**28.159**	**0.000**	**0.000**	**29.185**	**TOTAL AREA**	

Summary for Subcatchment E-1A: Subcat E-1A

Runoff = 3.62 cfs @ 12.25 hrs, Volume= 0.399 af, Depth= 0.80"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
32,115	55	Woods, Good, HSG B
33,840	74	>75% Grass cover, Good, HSG C
196,179	70	Woods, Good, HSG C
262,134	69	Weighted Average
262,134		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0680	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.0	431	0.0570	1.19		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.8	126	0.1350	2.57		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
1.4	192	0.2000	2.24		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
15.7	799	Total			

Summary for Subcatchment E-1B: Subcat E-1B

Runoff = 0.47 cfs @ 12.13 hrs, Volume= 0.040 af, Depth= 0.95"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
90	98	Paved parking, HSG C
2,609	98	Paved parking, HSG B
7,321	61	>75% Grass cover, Good, HSG B
506	55	Woods, Good, HSG B
0	70	Woods, Good, HSG C
11,330	74	>75% Grass cover, Good, HSG C
21,857	72	Weighted Average
19,157		87.65% Pervious Area
2,699		12.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0960	0.13		**Sheet Flow, A-B** Grass: Bermuda n= 0.410 P2= 3.28"
1.4	183	0.0960	2.17		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.2	82	0.0840	5.88		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
8.2	315	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 5.58 cfs @ 12.42 hrs, Volume= 0.739 af, Depth= 0.85"
Routed to Reach R-02 : Routing through wetland/swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
18,004	65	Brush, Good, HSG C
1,039	74	>75% Grass cover, Good, HSG C
437,960	70	Woods, Good, HSG C
457,003	70	Weighted Average
457,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	50	0.0050	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.1	562	0.1370	1.85		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
26.3	612	Total			

Summary for Subcatchment E-3A: Subcat E-3A

Runoff = 3.00 cfs @ 12.31 hrs, Volume= 0.357 af, Depth= 0.80"
Routed to Link SP3 : STUDY POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (ac)	CN	Description
3.800	70	Woods, Good, HSG C
1.578	65	Brush, Good, HSG C
5.378	69	Weighted Average
5.378		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0180	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
1.0	91	0.0850	1.46		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.1	204	0.1800	2.97		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
4.4	545	0.1700	2.06		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.2	890	Total			

Summary for Subcatchment E-3B: Subcat E-3B

Runoff = 2.70 cfs @ 12.23 hrs, Volume= 0.287 af, Depth= 0.85"
Routed to Reach R-01 : Routing to wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (ac)	CN	Description
0.172	65	Brush, Good, HSG C
3.902	70	Woods, Good, HSG C
4.074	70	Weighted Average
4.074		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0380	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.4	517	0.1000	1.58		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
14.8	567	Total			

Summary for Subcatchment E-4: Subcat E-4

Runoff = 1.57 cfs @ 12.16 hrs, Volume= 0.144 af, Depth= 0.85"
Routed to Link SP4 : STUDY POINT #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
0.007	98	Paved parking, HSG B
0.255	74	>75% Grass cover, Good, HSG C
1.744	70	Woods, Good, HSG C
2.049	70	Weighted Average
2.042		99.65% Pervious Area
0.007		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0670	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
2.5	208	0.0770	1.39		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
10.0	258	Total			

Summary for Subcatchment E-5: Subcat E-5

Runoff = 0.46 cfs @ 12.26 hrs, Volume= 0.050 af, Depth= 0.90"
Routed to Link SP5 : STUDY POINT #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
6,877	74	>75% Grass cover, Good, HSG C
22,427	70	Woods, Good, HSG C
29,304	71	Weighted Average
29,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.8	456	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.5	62	0.0760	1.93		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.5	568	Total			

Summary for Reach R-01: Routing to wetlands

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

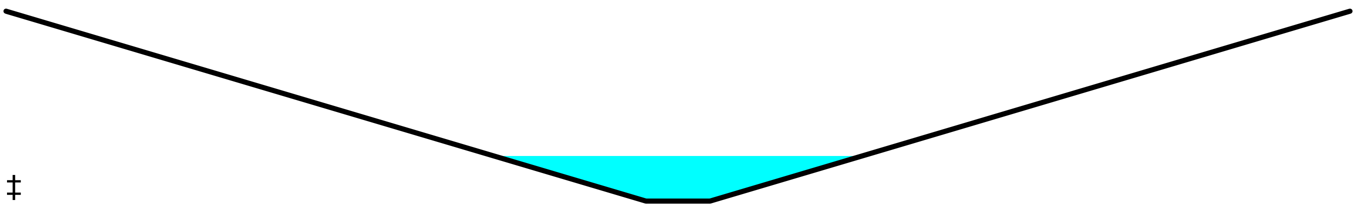
This reach demonstrates a procedure for performing a shallow concetrated flow routing through woods. In this case, the "reach" is defined as a channel with very low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 4.074 ac, 0.00% Impervious, Inflow Depth = 0.85" for 2-year event
Inflow = 2.70 cfs @ 12.23 hrs, Volume= 0.287 af
Outflow = 1.32 cfs @ 12.59 hrs, Volume= 0.287 af, Atten= 51%, Lag= 21.7 min
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.33 fps, Min. Travel Time= 36.6 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 89.0 min

Peak Storage= 2,890 cf @ 12.59 hrs
Average Depth at Peak Storage= 0.24' , Surface Width= 28.73'
Bank-Full Depth= 1.00' Flow Area= 55.0 sf, Capacity= 43.77 cfs

5.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 50.0 '/' Top Width= 105.00'
Length= 722.0' Slope= 0.1087 '/'
Inlet Invert= 889.50', Outlet Invert= 811.00'



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Summary for Reach R-02: Routing through wetland/swale

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

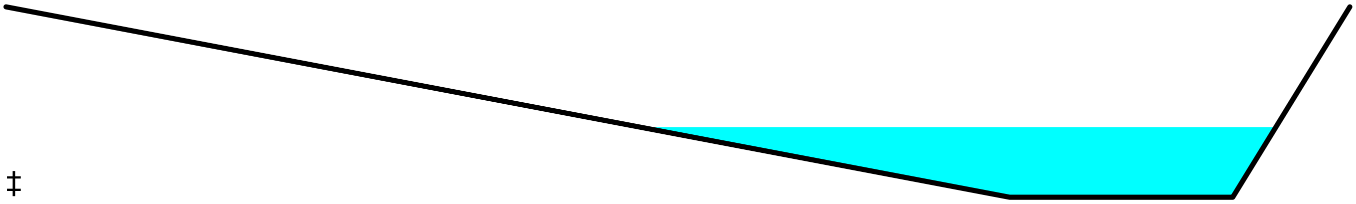
This reach demonstrates a procedure for performing a shallow concetrated flow routing through the wooded wetland/swale adjacent to the stone wall. In this case, the "reach" is defined as a channel with low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 10.491 ac, 0.00% Impervious, Inflow Depth = 0.85" for 2-year event
Inflow = 5.58 cfs @ 12.42 hrs, Volume= 0.739 af
Outflow = 2.81 cfs @ 12.84 hrs, Volume= 0.738 af, Atten= 50%, Lag= 25.5 min
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.26 fps, Min. Travel Time= 46.3 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 114.6 min

Peak Storage= 7,825 cf @ 12.84 hrs
Average Depth at Peak Storage= 0.55' , Surface Width= 28.52'
Bank-Full Depth= 1.50' Flow Area= 52.7 sf, Capacity= 24.55 cfs

10.00' x 1.50' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 30.0 3.5 '/' Top Width= 60.25'
Length= 735.0' Slope= 0.0189 '/'
Inlet Invert= 877.70', Outlet Invert= 863.80'



Summary for Link SP1: STUDY POINT #1

Inflow Area =	6.520 ac,	0.95% Impervious, Inflow Depth = 0.81"	for 2-year event	
Inflow =	3.95 cfs @	12.24 hrs, Volume=	0.439 af	
Primary =	3.95 cfs @	12.24 hrs, Volume=	0.439 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area =	10.491 ac,	0.00% Impervious, Inflow Depth > 0.84"	for 2-year event	
Inflow =	2.81 cfs @	12.84 hrs, Volume=	0.738 af	
Primary =	2.81 cfs @	12.84 hrs, Volume=	0.738 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP3: STUDY POINT #3

Inflow Area =	9.452 ac,	0.00% Impervious, Inflow Depth > 0.82"	for 2-year event	
Inflow =	3.94 cfs @	12.35 hrs, Volume=	0.644 af	
Primary =	3.94 cfs @	12.35 hrs, Volume=	0.644 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP4: STUDY POINT #4

Inflow Area =	2.049 ac,	0.35% Impervious, Inflow Depth = 0.85"	for 2-year event	
Inflow =	1.57 cfs @	12.16 hrs, Volume=	0.144 af	
Primary =	1.57 cfs @	12.16 hrs, Volume=	0.144 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP5: STUDY POINT #5

Inflow Area =	0.673 ac,	0.00% Impervious, Inflow Depth = 0.90"	for 2-year event	
Inflow =	0.46 cfs @	12.26 hrs, Volume=	0.050 af	
Primary =	0.46 cfs @	12.26 hrs, Volume=	0.050 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1A: Subcat E-1A

Runoff = 9.32 cfs @ 12.23 hrs, Volume= 0.927 af, Depth= 1.85"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (sf)	CN	Description
32,115	55	Woods, Good, HSG B
33,840	74	>75% Grass cover, Good, HSG C
196,179	70	Woods, Good, HSG C
262,134	69	Weighted Average
262,134		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0680	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.0	431	0.0570	1.19		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.8	126	0.1350	2.57		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
1.4	192	0.2000	2.24		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
15.7	799	Total			

Summary for Subcatchment E-1B: Subcat E-1B

Runoff = 1.10 cfs @ 12.12 hrs, Volume= 0.087 af, Depth= 2.08"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (sf)	CN	Description
90	98	Paved parking, HSG C
2,609	98	Paved parking, HSG B
7,321	61	>75% Grass cover, Good, HSG B
506	55	Woods, Good, HSG B
0	70	Woods, Good, HSG C
11,330	74	>75% Grass cover, Good, HSG C
21,857	72	Weighted Average
19,157		87.65% Pervious Area
2,699		12.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0960	0.13		**Sheet Flow, A-B** Grass: Bermuda n= 0.410 P2= 3.28"
1.4	183	0.0960	2.17		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.2	82	0.0840	5.88		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
8.2	315	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 13.83 cfs @ 12.39 hrs, Volume= 1.684 af, Depth= 1.93"
Routed to Reach R-02 : Routing through wetland/swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (sf)	CN	Description
18,004	65	Brush, Good, HSG C
1,039	74	>75% Grass cover, Good, HSG C
437,960	70	Woods, Good, HSG C
457,003	70	Weighted Average
457,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	50	0.0050	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.1	562	0.1370	1.85		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
26.3	612	Total			

Summary for Subcatchment E-3A: Subcat E-3A

Runoff = 7.71 cfs @ 12.28 hrs, Volume= 0.829 af, Depth= 1.85"
Routed to Link SP3 : STUDY POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (ac)	CN	Description
3.800	70	Woods, Good, HSG C
1.578	65	Brush, Good, HSG C
5.378	69	Weighted Average
5.378		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0180	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
1.0	91	0.0850	1.46		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.1	204	0.1800	2.97		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
4.4	545	0.1700	2.06		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.2	890	Total			

Summary for Subcatchment E-3B: Subcat E-3B

Runoff = 6.79 cfs @ 12.22 hrs, Volume= 0.654 af, Depth= 1.93"
Routed to Reach R-01 : Routing to wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (ac)	CN	Description
0.172	65	Brush, Good, HSG C
3.902	70	Woods, Good, HSG C
4.074	70	Weighted Average
4.074		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0380	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.4	517	0.1000	1.58		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
14.8	567	Total			

Summary for Subcatchment E-4: Subcat E-4

Runoff = 3.91 cfs @ 12.15 hrs, Volume= 0.329 af, Depth= 1.93"
Routed to Link SP4 : STUDY POINT #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
0.007	98	Paved parking, HSG B
0.255	74	>75% Grass cover, Good, HSG C
1.744	70	Woods, Good, HSG C
2.049	70	Weighted Average
2.042		99.65% Pervious Area
0.007		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0670	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
2.5	208	0.0770	1.39		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
10.0	258	Total			

Summary for Subcatchment E-5: Subcat E-5

Runoff = 1.12 cfs @ 12.24 hrs, Volume= 0.112 af, Depth= 2.00"
Routed to Link SP5 : STUDY POINT #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-year Rainfall=4.85"

Area (sf)	CN	Description
6,877	74	>75% Grass cover, Good, HSG C
22,427	70	Woods, Good, HSG C
29,304	71	Weighted Average
29,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.8	456	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.5	62	0.0760	1.93		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.5	568	Total			

Summary for Reach R-01: Routing to wetlands

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

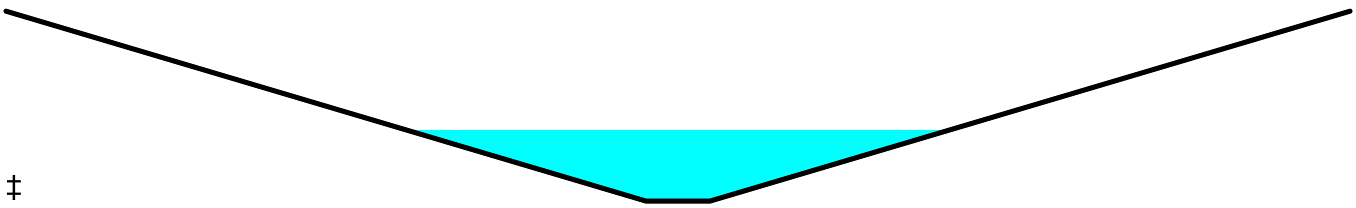
This reach demonstrates a procedure for performing a shallow concetrated flow routing through woods. In this case, the "reach" is defined as a channel with very low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 4.074 ac, 0.00% Impervious, Inflow Depth = 1.93" for 10-year event
Inflow = 6.79 cfs @ 12.22 hrs, Volume= 0.654 af
Outflow = 3.84 cfs @ 12.49 hrs, Volume= 0.654 af, Atten= 43%, Lag= 16.6 min
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.43 fps, Min. Travel Time= 27.9 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 76.2 min

Peak Storage= 6,423 cf @ 12.49 hrs
Average Depth at Peak Storage= 0.37' , Surface Width= 42.47'
Bank-Full Depth= 1.00' Flow Area= 55.0 sf, Capacity= 43.77 cfs

5.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 50.0 '/' Top Width= 105.00'
Length= 722.0' Slope= 0.1087 '/'
Inlet Invert= 889.50', Outlet Invert= 811.00'



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Summary for Reach R-02: Routing through wetland/swale

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

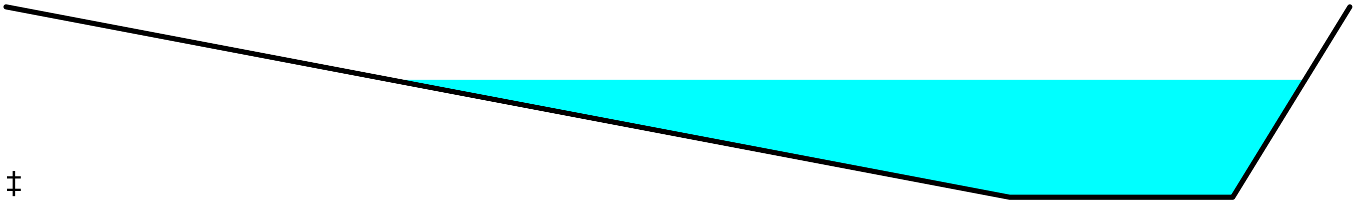
This reach demonstrates a procedure for performing a shallow concetrated flow routing through the wooded wetland/swale adjacent to the stone wall. In this case, the "reach" is defined as a channel with low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 10.491 ac, 0.00% Impervious, Inflow Depth = 1.93" for 10-year event
Inflow = 13.83 cfs @ 12.39 hrs, Volume= 1.684 af
Outflow = 8.34 cfs @ 12.72 hrs, Volume= 1.682 af, Atten= 40%, Lag= 19.8 min
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.35 fps, Min. Travel Time= 34.7 min
Avg. Velocity = 0.13 fps, Avg. Travel Time= 96.0 min

Peak Storage= 17,368 cf @ 12.72 hrs
Average Depth at Peak Storage= 0.93' , Surface Width= 41.03'
Bank-Full Depth= 1.50' Flow Area= 52.7 sf, Capacity= 24.55 cfs

10.00' x 1.50' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 30.0 3.5 '/' Top Width= 60.25'
Length= 735.0' Slope= 0.0189 '/'
Inlet Invert= 877.70', Outlet Invert= 863.80'



Summary for Link SP1: STUDY POINT #1

Inflow Area =	6.520 ac,	0.95% Impervious,	Inflow Depth = 1.87"	for 10-year event	
Inflow =	10.15 cfs @	12.22 hrs,	Volume=	1.014 af	
Primary =	10.15 cfs @	12.22 hrs,	Volume=	1.014 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area =	10.491 ac,	0.00% Impervious,	Inflow Depth > 1.92"	for 10-year event	
Inflow =	8.34 cfs @	12.72 hrs,	Volume=	1.682 af	
Primary =	8.34 cfs @	12.72 hrs,	Volume=	1.682 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP3: STUDY POINT #3

Inflow Area =	9.452 ac,	0.00% Impervious,	Inflow Depth = 1.88"	for 10-year event	
Inflow =	10.91 cfs @	12.32 hrs,	Volume=	1.482 af	
Primary =	10.91 cfs @	12.32 hrs,	Volume=	1.482 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP4: STUDY POINT #4

Inflow Area =	2.049 ac,	0.35% Impervious,	Inflow Depth = 1.93"	for 10-year event	
Inflow =	3.91 cfs @	12.15 hrs,	Volume=	0.329 af	
Primary =	3.91 cfs @	12.15 hrs,	Volume=	0.329 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP5: STUDY POINT #5

Inflow Area =	0.673 ac,	0.00% Impervious,	Inflow Depth = 2.00"	for 10-year event	
Inflow =	1.12 cfs @	12.24 hrs,	Volume=	0.112 af	
Primary =	1.12 cfs @	12.24 hrs,	Volume=	0.112 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1A: Subcat E-1A

Runoff = 14.52 cfs @ 12.22 hrs, Volume= 1.407 af, Depth= 2.81"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (sf)	CN	Description
32,115	55	Woods, Good, HSG B
33,840	74	>75% Grass cover, Good, HSG C
196,179	70	Woods, Good, HSG C
262,134	69	Weighted Average
262,134		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0680	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.0	431	0.0570	1.19		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.8	126	0.1350	2.57		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
1.4	192	0.2000	2.24		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
15.7	799	Total			

Summary for Subcatchment E-1B: Subcat E-1B

Runoff = 1.66 cfs @ 12.12 hrs, Volume= 0.129 af, Depth= 3.09"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (sf)	CN	Description
90	98	Paved parking, HSG C
2,609	98	Paved parking, HSG B
7,321	61	>75% Grass cover, Good, HSG B
506	55	Woods, Good, HSG B
0	70	Woods, Good, HSG C
11,330	74	>75% Grass cover, Good, HSG C
21,857	72	Weighted Average
19,157		87.65% Pervious Area
2,699		12.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0960	0.13		**Sheet Flow, A-B** Grass: Bermuda n= 0.410 P2= 3.28"
1.4	183	0.0960	2.17		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.2	82	0.0840	5.88		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
8.2	315	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 21.23 cfs @ 12.37 hrs, Volume= 2.536 af, Depth= 2.90"
Routed to Reach R-02 : Routing through wetland/swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (sf)	CN	Description
18,004	65	Brush, Good, HSG C
1,039	74	>75% Grass cover, Good, HSG C
437,960	70	Woods, Good, HSG C
457,003	70	Weighted Average
457,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	50	0.0050	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.1	562	0.1370	1.85		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
26.3	612	Total			

Summary for Subcatchment E-3A: Subcat E-3A

Runoff = 11.99 cfs @ 12.27 hrs, Volume= 1.258 af, Depth= 2.81"
Routed to Link SP3 : STUDY POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (ac)	CN	Description
3.800	70	Woods, Good, HSG C
1.578	65	Brush, Good, HSG C
5.378	69	Weighted Average
5.378		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0180	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
1.0	91	0.0850	1.46		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.1	204	0.1800	2.97		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
4.4	545	0.1700	2.06		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.2	890	Total			

Summary for Subcatchment E-3B: Subcat E-3B

Runoff = 10.42 cfs @ 12.21 hrs, Volume= 0.985 af, Depth= 2.90"
Routed to Reach R-01 : Routing to wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (ac)	CN	Description
0.172	65	Brush, Good, HSG C
3.902	70	Woods, Good, HSG C
4.074	70	Weighted Average
4.074		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0380	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.4	517	0.1000	1.58		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
14.8	567	Total			

Summary for Subcatchment E-4: Subcat E-4

Runoff = 5.98 cfs @ 12.15 hrs, Volume= 0.495 af, Depth= 2.90"
Routed to Link SP4 : STUDY POINT #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
0.007	98	Paved parking, HSG B
0.255	74	>75% Grass cover, Good, HSG C
1.744	70	Woods, Good, HSG C
2.049	70	Weighted Average
2.042		99.65% Pervious Area
0.007		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0670	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
2.5	208	0.0770	1.39		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
10.0	258	Total			

Summary for Subcatchment E-5: Subcat E-5

Runoff = 1.70 cfs @ 12.23 hrs, Volume= 0.168 af, Depth= 3.00"
Routed to Link SP5 : STUDY POINT #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-year Rainfall=6.12"

Area (sf)	CN	Description
6,877	74	>75% Grass cover, Good, HSG C
22,427	70	Woods, Good, HSG C
29,304	71	Weighted Average
29,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.8	456	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.5	62	0.0760	1.93		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.5	568	Total			

Summary for Reach R-01: Routing to wetlands

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

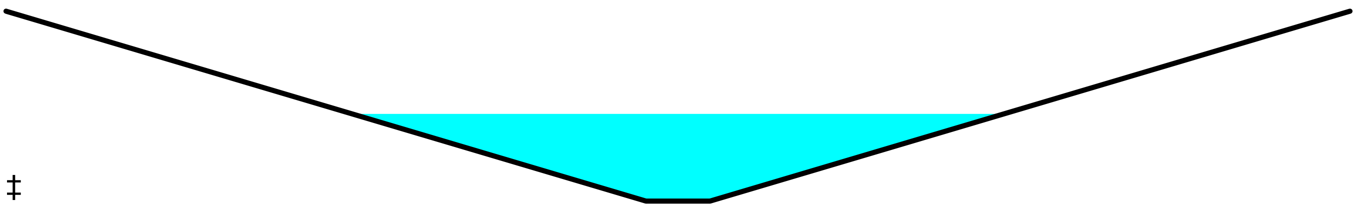
This reach demonstrates a procedure for performing a shallow concetrated flow routing through woods. In this case, the "reach" is defined as a channel with very low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 4.074 ac, 0.00% Impervious, Inflow Depth = 2.90" for 25-year event
Inflow = 10.42 cfs @ 12.21 hrs, Volume= 0.985 af
Outflow = 6.28 cfs @ 12.45 hrs, Volume= 0.985 af, Atten= 40%, Lag= 14.4 min
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.49 fps, Min. Travel Time= 24.6 min
Avg. Velocity = 0.17 fps, Avg. Travel Time= 70.1 min

Peak Storage= 9,269 cf @ 12.45 hrs
Average Depth at Peak Storage= 0.46' , Surface Width= 50.92'
Bank-Full Depth= 1.00' Flow Area= 55.0 sf, Capacity= 43.77 cfs

5.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 50.0 '/' Top Width= 105.00'
Length= 722.0' Slope= 0.1087 '/'
Inlet Invert= 889.50', Outlet Invert= 811.00'



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Summary for Reach R-02: Routing through wetland/swale

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

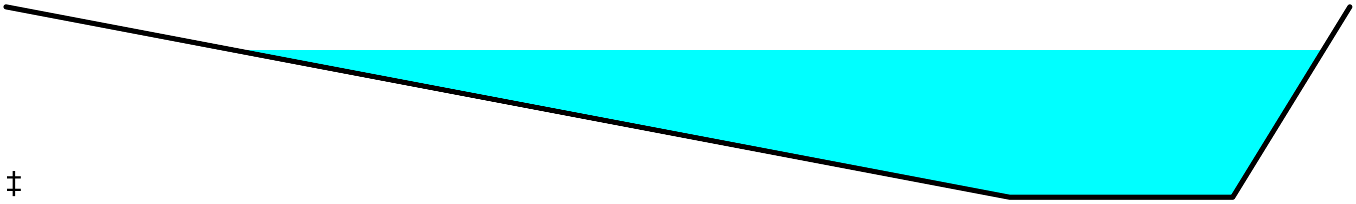
This reach demonstrates a procedure for performing a shallow concetrated flow routing through the wooded wetland/swale adjacent to the stone wall. In this case, the "reach" is defined as a channel with low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 10.491 ac, 0.00% Impervious, Inflow Depth = 2.90" for 25-year event
Inflow = 21.23 cfs @ 12.37 hrs, Volume= 2.536 af
Outflow = 13.67 cfs @ 12.67 hrs, Volume= 2.534 af, Atten= 36%, Lag= 17.8 min
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.40 fps, Min. Travel Time= 30.6 min
Avg. Velocity = 0.14 fps, Avg. Travel Time= 87.5 min

Peak Storage= 25,053 cf @ 12.67 hrs
Average Depth at Peak Storage= 1.16' , Surface Width= 48.82'
Bank-Full Depth= 1.50' Flow Area= 52.7 sf, Capacity= 24.55 cfs

10.00' x 1.50' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 30.0 3.5 '/' Top Width= 60.25'
Length= 735.0' Slope= 0.0189 '/'
Inlet Invert= 877.70', Outlet Invert= 863.80'



Summary for Link SP1: STUDY POINT #1

Inflow Area =	6.520 ac,	0.95% Impervious, Inflow Depth = 2.83"	for 25-year event	
Inflow =	15.72 cfs @	12.22 hrs, Volume=	1.537 af	
Primary =	15.72 cfs @	12.22 hrs, Volume=	1.537 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area =	10.491 ac,	0.00% Impervious, Inflow Depth > 2.90"	for 25-year event	
Inflow =	13.67 cfs @	12.67 hrs, Volume=	2.534 af	
Primary =	13.67 cfs @	12.67 hrs, Volume=	2.534 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP3: STUDY POINT #3

Inflow Area =	9.452 ac,	0.00% Impervious, Inflow Depth = 2.85"	for 25-year event	
Inflow =	17.41 cfs @	12.31 hrs, Volume=	2.243 af	
Primary =	17.41 cfs @	12.31 hrs, Volume=	2.243 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP4: STUDY POINT #4

Inflow Area =	2.049 ac,	0.35% Impervious, Inflow Depth = 2.90"	for 25-year event	
Inflow =	5.98 cfs @	12.15 hrs, Volume=	0.495 af	
Primary =	5.98 cfs @	12.15 hrs, Volume=	0.495 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP5: STUDY POINT #5

Inflow Area =	0.673 ac,	0.00% Impervious, Inflow Depth = 3.00"	for 25-year event	
Inflow =	1.70 cfs @	12.23 hrs, Volume=	0.168 af	
Primary =	1.70 cfs @	12.23 hrs, Volume=	0.168 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1A: Subcat E-1A

Runoff = 19.62 cfs @ 12.22 hrs, Volume= 1.886 af, Depth= 3.76"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (sf)	CN	Description
32,115	55	Woods, Good, HSG B
33,840	74	>75% Grass cover, Good, HSG C
196,179	70	Woods, Good, HSG C
262,134	69	Weighted Average
262,134		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0680	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.0	431	0.0570	1.19		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.8	126	0.1350	2.57		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
1.4	192	0.2000	2.24		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
15.7	799	Total			

Summary for Subcatchment E-1B: Subcat E-1B

Runoff = 2.20 cfs @ 12.12 hrs, Volume= 0.171 af, Depth= 4.09"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (sf)	CN	Description
90	98	Paved parking, HSG C
2,609	98	Paved parking, HSG B
7,321	61	>75% Grass cover, Good, HSG B
506	55	Woods, Good, HSG B
0	70	Woods, Good, HSG C
11,330	74	>75% Grass cover, Good, HSG C
21,857	72	Weighted Average
19,157		87.65% Pervious Area
2,699		12.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0960	0.13		**Sheet Flow, A-B** Grass: Bermuda n= 0.410 P2= 3.28"
1.4	183	0.0960	2.17		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.2	82	0.0840	5.88		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
8.2	315	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 28.49 cfs @ 12.37 hrs, Volume= 3.383 af, Depth= 3.87"
Routed to Reach R-02 : Routing through wetland/swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (sf)	CN	Description
18,004	65	Brush, Good, HSG C
1,039	74	>75% Grass cover, Good, HSG C
437,960	70	Woods, Good, HSG C
457,003	70	Weighted Average
457,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	50	0.0050	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.1	562	0.1370	1.85		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
26.3	612	Total			

Summary for Subcatchment E-3A: Subcat E-3A

Runoff = 16.19 cfs @ 12.27 hrs, Volume= 1.686 af, Depth= 3.76"
Routed to Link SP3 : STUDY POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (ac)	CN	Description
3.800	70	Woods, Good, HSG C
1.578	65	Brush, Good, HSG C
5.378	69	Weighted Average
5.378		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0180	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
1.0	91	0.0850	1.46		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.1	204	0.1800	2.97		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
4.4	545	0.1700	2.06		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.2	890	Total			

Summary for Subcatchment E-3B: Subcat E-3B

Runoff = 13.99 cfs @ 12.21 hrs, Volume= 1.314 af, Depth= 3.87"
Routed to Reach R-01 : Routing to wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (ac)	CN	Description
0.172	65	Brush, Good, HSG C
3.902	70	Woods, Good, HSG C
4.074	70	Weighted Average
4.074		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0380	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.4	517	0.1000	1.58		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
14.8	567	Total			

Summary for Subcatchment E-4: Subcat E-4

Runoff = 8.02 cfs @ 12.15 hrs, Volume= 0.661 af, Depth= 3.87"
Routed to Link SP4 : STUDY POINT #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
0.007	98	Paved parking, HSG B
0.255	74	>75% Grass cover, Good, HSG C
1.744	70	Woods, Good, HSG C
2.049	70	Weighted Average
2.042		99.65% Pervious Area
0.007		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0670	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
2.5	208	0.0770	1.39		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
10.0	258	Total			

Summary for Subcatchment E-5: Subcat E-5

Runoff = 2.27 cfs @ 12.23 hrs, Volume= 0.223 af, Depth= 3.98"
Routed to Link SP5 : STUDY POINT #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 50-year Rainfall=7.30"

Area (sf)	CN	Description
6,877	74	>75% Grass cover, Good, HSG C
22,427	70	Woods, Good, HSG C
29,304	71	Weighted Average
29,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.8	456	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.5	62	0.0760	1.93		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.5	568	Total			

Summary for Reach R-01: Routing to wetlands

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

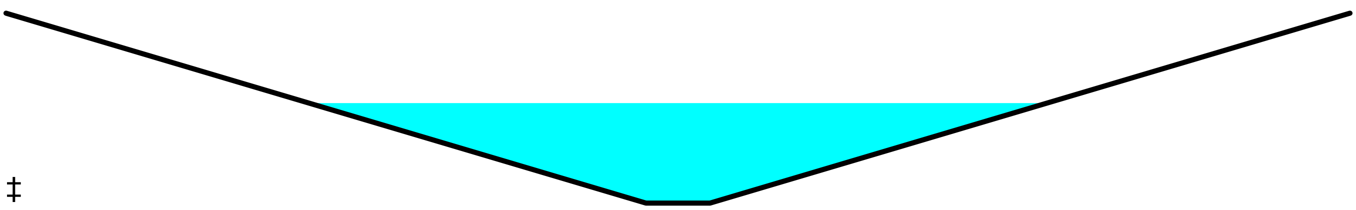
This reach demonstrates a procedure for performing a shallow concetrated flow routing through woods. In this case, the "reach" is defined as a channel with very low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 4.074 ac, 0.00% Impervious, Inflow Depth = 3.87" for 50-year event
Inflow = 13.99 cfs @ 12.21 hrs, Volume= 1.314 af
Outflow = 8.76 cfs @ 12.42 hrs, Volume= 1.314 af, Atten= 37%, Lag= 13.0 min
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.53 fps, Min. Travel Time= 22.7 min
Avg. Velocity = 0.18 fps, Avg. Travel Time= 66.0 min

Peak Storage= 11,895 cf @ 12.42 hrs
Average Depth at Peak Storage= 0.53' , Surface Width= 57.62'
Bank-Full Depth= 1.00' Flow Area= 55.0 sf, Capacity= 43.77 cfs

5.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 50.0 '/' Top Width= 105.00'
Length= 722.0' Slope= 0.1087 '/'
Inlet Invert= 889.50', Outlet Invert= 811.00'



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Summary for Reach R-02: Routing through wetland/swale

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

This reach demonstrates a procedure for performing a shallow concetrated flow routing through the wooded wetland/swale adjacent to the stone wall. In this case, the "reach" is defined as a channel with low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

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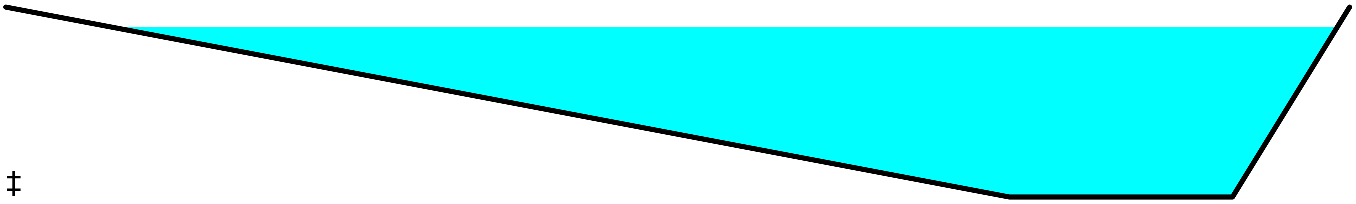
[55] Hint: Peak inflow is 116% of Manning's capacity

Inflow Area = 10.491 ac, 0.00% Impervious, Inflow Depth = 3.87" for 50-year event
Inflow = 28.49 cfs @ 12.37 hrs, Volume= 3.383 af
Outflow = 19.08 cfs @ 12.65 hrs, Volume= 3.381 af, Atten= 33%, Lag= 16.6 min
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.44 fps, Min. Travel Time= 28.0 min
Avg. Velocity = 0.15 fps, Avg. Travel Time= 82.0 min

Peak Storage= 32,102 cf @ 12.65 hrs
Average Depth at Peak Storage= 1.34' , Surface Width= 55.01'
Bank-Full Depth= 1.50' Flow Area= 52.7 sf, Capacity= 24.55 cfs

10.00' x 1.50' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 30.0 3.5 '/' Top Width= 60.25'
Length= 735.0' Slope= 0.0189 '/'
Inlet Invert= 877.70', Outlet Invert= 863.80'



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Summary for Link SP1: STUDY POINT #1

Inflow Area = 6.520 ac, 0.95% Impervious, Inflow Depth = 3.79" for 50-year event
Inflow = 21.20 cfs @ 12.21 hrs, Volume= 2.057 af
Primary = 21.20 cfs @ 12.21 hrs, Volume= 2.057 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 10.491 ac, 0.00% Impervious, Inflow Depth > 3.87" for 50-year event
Inflow = 19.08 cfs @ 12.65 hrs, Volume= 3.381 af
Primary = 19.08 cfs @ 12.65 hrs, Volume= 3.381 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP3: STUDY POINT #3

Inflow Area = 9.452 ac, 0.00% Impervious, Inflow Depth = 3.81" for 50-year event
Inflow = 23.93 cfs @ 12.30 hrs, Volume= 2.999 af
Primary = 23.93 cfs @ 12.30 hrs, Volume= 2.999 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP4: STUDY POINT #4

Inflow Area = 2.049 ac, 0.35% Impervious, Inflow Depth = 3.87" for 50-year event
Inflow = 8.02 cfs @ 12.15 hrs, Volume= 0.661 af
Primary = 8.02 cfs @ 12.15 hrs, Volume= 0.661 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP5: STUDY POINT #5

Inflow Area = 0.673 ac, 0.00% Impervious, Inflow Depth = 3.98" for 50-year event
Inflow = 2.27 cfs @ 12.23 hrs, Volume= 0.223 af
Primary = 2.27 cfs @ 12.23 hrs, Volume= 0.223 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Subcatchment E-1A: Subcat E-1A

Runoff = 25.97 cfs @ 12.22 hrs, Volume= 2.491 af, Depth= 4.97"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
32,115	55	Woods, Good, HSG B
33,840	74	>75% Grass cover, Good, HSG C
196,179	70	Woods, Good, HSG C
262,134	69	Weighted Average
262,134		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0680	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.0	431	0.0570	1.19		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.8	126	0.1350	2.57		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
1.4	192	0.2000	2.24		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
15.7	799	Total			

Summary for Subcatchment E-1B: Subcat E-1B

Runoff = 2.86 cfs @ 12.12 hrs, Volume= 0.223 af, Depth= 5.33"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
90	98	Paved parking, HSG C
2,609	98	Paved parking, HSG B
7,321	61	>75% Grass cover, Good, HSG B
506	55	Woods, Good, HSG B
0	70	Woods, Good, HSG C
11,330	74	>75% Grass cover, Good, HSG C
21,857	72	Weighted Average
19,157		87.65% Pervious Area
2,699		12.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0960	0.13		**Sheet Flow, A-B** Grass: Bermuda n= 0.410 P2= 3.28"
1.4	183	0.0960	2.17		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.2	82	0.0840	5.88		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
8.2	315	Total			

Summary for Subcatchment E-2: Subcat E-2

Runoff = 37.51 cfs @ 12.36 hrs, Volume= 4.449 af, Depth= 5.09"
Routed to Reach R-02 : Routing through wetland/swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
18,004	65	Brush, Good, HSG C
1,039	74	>75% Grass cover, Good, HSG C
437,960	70	Woods, Good, HSG C
457,003	70	Weighted Average
457,003		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	50	0.0050	0.04		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.1	562	0.1370	1.85		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
26.3	612	Total			

Summary for Subcatchment E-3A: Subcat E-3A

Runoff = 21.44 cfs @ 12.27 hrs, Volume= 2.226 af, Depth= 4.97"
Routed to Link SP3 : STUDY POINT #3

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
3.800	70	Woods, Good, HSG C
1.578	65	Brush, Good, HSG C
5.378	69	Weighted Average
5.378		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0180	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
1.0	91	0.0850	1.46		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.1	204	0.1800	2.97		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
4.4	545	0.1700	2.06		**Shallow Concentrated Flow, D-E** Woodland Kv= 5.0 fps
19.2	890	Total			

Summary for Subcatchment E-3B: Subcat E-3B

Runoff = 18.41 cfs @ 12.21 hrs, Volume= 1.728 af, Depth= 5.09"
Routed to Reach R-01 : Routing to wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.172	65	Brush, Good, HSG C
3.902	70	Woods, Good, HSG C
4.074	70	Weighted Average
4.074		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.4	50	0.0380	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
5.4	517	0.1000	1.58		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
14.8	567	Total			

Summary for Subcatchment E-4: Subcat E-4

Runoff = 10.55 cfs @ 12.14 hrs, Volume= 0.869 af, Depth= 5.09"
Routed to Link SP4 : STUDY POINT #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.042	61	>75% Grass cover, Good, HSG B
0.007	98	Paved parking, HSG B
0.255	74	>75% Grass cover, Good, HSG C
1.744	70	Woods, Good, HSG C
2.049	70	Weighted Average
2.042		99.65% Pervious Area
0.007		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0670	0.11		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
2.5	208	0.0770	1.39		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
10.0	258	Total			

Summary for Subcatchment E-5: Subcat E-5

Runoff = 2.98 cfs @ 12.23 hrs, Volume= 0.292 af, Depth= 5.21"
Routed to Link SP5 : STUDY POINT #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
6,877	74	>75% Grass cover, Good, HSG C
22,427	70	Woods, Good, HSG C
29,304	71	Weighted Average
29,304		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
6.8	456	0.0500	1.12		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
0.5	62	0.0760	1.93		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
16.5	568	Total			

Summary for Reach R-01: Routing to wetlands

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

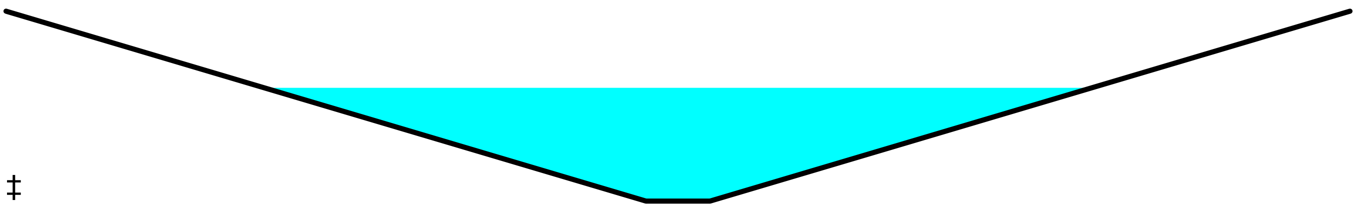
This reach demonstrates a procedure for performing a shallow concetrated flow routing through woods. In this case, the "reach" is defined as a channel with very low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 4.074 ac, 0.00% Impervious, Inflow Depth = 5.09" for 100-year event
Inflow = 18.41 cfs @ 12.21 hrs, Volume= 1.728 af
Outflow = 11.93 cfs @ 12.41 hrs, Volume= 1.728 af, Atten= 35%, Lag= 12.0 min
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.57 fps, Min. Travel Time= 20.9 min
Avg. Velocity = 0.19 fps, Avg. Travel Time= 62.3 min

Peak Storage= 14,989 cf @ 12.41 hrs
Average Depth at Peak Storage= 0.60' , Surface Width= 64.63'
Bank-Full Depth= 1.00' Flow Area= 55.0 sf, Capacity= 43.77 cfs

5.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 50.0 '/' Top Width= 105.00'
Length= 722.0' Slope= 0.1087 '/'
Inlet Invert= 889.50', Outlet Invert= 811.00'



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Summary for Reach R-02: Routing through wetland/swale

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

This reach demonstrates a procedure for performing a shallow concetrated flow routing through the wooded wetland/swale adjacent to the stone wall. In this case, the "reach" is defined as a channel with low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

---

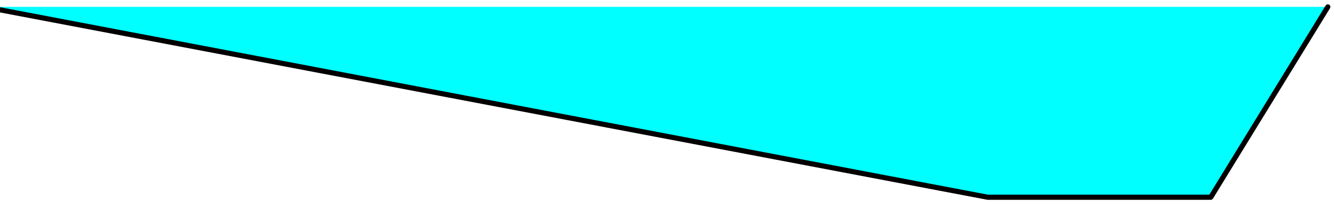
[91] Warning: Storage range exceeded by 0.04'
[55] Hint: Peak inflow is 153% of Manning's capacity

Inflow Area = 10.491 ac, 0.00% Impervious, Inflow Depth = 5.09" for 100-year event
Inflow = 37.51 cfs @ 12.36 hrs, Volume= 4.449 af
Outflow = 25.99 cfs @ 12.62 hrs, Volume= 4.447 af, Atten= 31%, Lag= 15.4 min
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.47 fps, Min. Travel Time= 25.9 min
Avg. Velocity = 0.16 fps, Avg. Travel Time= 77.0 min

Peak Storage= 40,416 cf @ 12.62 hrs
Average Depth at Peak Storage= 1.54' , Surface Width= 61.53'
Bank-Full Depth= 1.50' Flow Area= 52.7 sf, Capacity= 24.55 cfs

10.00' x 1.50' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 30.0 3.5 '/' Top Width= 60.25'
Length= 735.0' Slope= 0.0189 '/'
Inlet Invert= 877.70', Outlet Invert= 863.80'



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Summary for Link SP1: STUDY POINT #1

Inflow Area =	6.520 ac,	0.95% Impervious, Inflow Depth = 5.00"	for 100-year event
Inflow =	28.02 cfs @	12.21 hrs, Volume=	2.714 af
Primary =	28.02 cfs @	12.21 hrs, Volume=	2.714 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area =	10.491 ac,	0.00% Impervious, Inflow Depth > 5.09"	for 100-year event
Inflow =	25.99 cfs @	12.62 hrs, Volume=	4.447 af
Primary =	25.99 cfs @	12.62 hrs, Volume=	4.447 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP3: STUDY POINT #3

Inflow Area =	9.452 ac,	0.00% Impervious, Inflow Depth = 5.02"	for 100-year event
Inflow =	32.17 cfs @	12.30 hrs, Volume=	3.954 af
Primary =	32.17 cfs @	12.30 hrs, Volume=	3.954 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP4: STUDY POINT #4

Inflow Area =	2.049 ac,	0.35% Impervious, Inflow Depth = 5.09"	for 100-year event
Inflow =	10.55 cfs @	12.14 hrs, Volume=	0.869 af
Primary =	10.55 cfs @	12.14 hrs, Volume=	0.869 af, Atten= 0%, Lag= 0.0 min

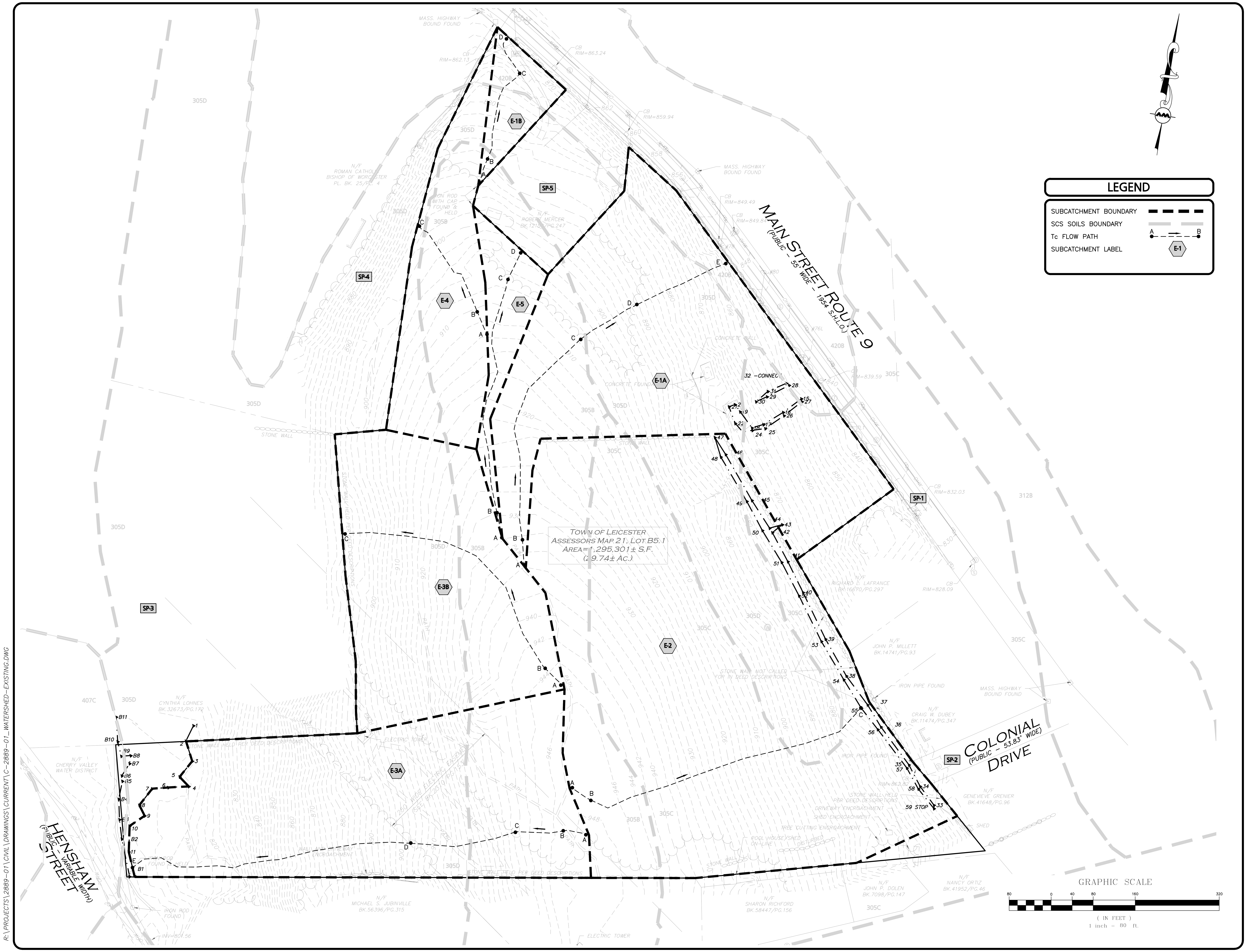
Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP5: STUDY POINT #5

Inflow Area =	0.673 ac,	0.00% Impervious, Inflow Depth = 5.21"	for 100-year event
Inflow =	2.98 cfs @	12.23 hrs, Volume=	0.292 af
Primary =	2.98 cfs @	12.23 hrs, Volume=	0.292 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Existing Watershed Plan



APPLICANT:
MKEP 770 LLC
265 SUNRISE HIGHWAY, SUITE 1368
ROCKVILLE CENTER, NY 11570

PROJECT:
SKYVIEW ESTATES
RESIDENTIAL DEVELOPMENT
MAIN STREET
LEICESTER, MA

REV	DATE	DESCRIPTION

PROJECT NO.	2889-01	DATE:	10-05-21
SCALE:	1" = 80'	DWG.:	C-2889-01_Watershed-Existing
DESIGNED BY:	SM	CHECKED BY:	MAM

PREPARED BY:

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DRAWING TITLE: EXISTING WATERSHED PLAN

SHEET No. WS-1

SECTION 5.0 -
PROPOSED DRAINAGE ANALYSIS

Proposed HydroCAD

Routing Diagram for 2889-01 - Proposed HydroCAD_rev2
Prepared by Allen & Major Associates, Inc, Printed 8/31/2022
HydroCAD® 10.20-2d s/n 02881 © 2021 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.516	61	>75% Grass cover, Good, HSG B (P-1A, P-1B, P-1C, P-1D, P-1E, P-4)
13.826	74	>75% Grass cover, Good, HSG C (P-1A, P-1B, P-1C, P-1D, P-1E, P-1F, P-2A, P-2B, P-2E, P-2F, P-2G, P-2H, P-3A, P-3B, P-3C, P-3D, P-3E, P-3F, P-4, P-5)
2.057	65	Brush, Good, HSG C (P-2B, P-3A, P-3B)
0.283	98	Paved parking, HSG B (P-1A, P-1B, P-1C, P-1D, P-1E)
3.990	98	Paved parking, HSG C (P-1A, P-1B, P-1C, P-1D, P-1E, P-1F, P-2A, P-2B, P-2E, P-2F, P-2G, P-2H, P-3C, P-3D, P-3E, P-3F, P-4)
0.059	98	Roofs, HSG B (P-1A)
4.563	98	Roofs, HSG C (P-1A, P-1D, P-1F, P-2A, P-2B, P-2E, P-2F, P-2G, P-2H, P-3B, P-3C, P-3D, P-3E, P-3F, P-4)
0.168	55	Woods, Good, HSG B (P-1A)
3.724	70	Woods, Good, HSG C (P-1A, P-1B, P-2A, P-2B, P-3A, P-3B, P-4, P-5)
29.185	**80**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
1.026	HSG B	P-1A, P-1B, P-1C, P-1D, P-1E, P-4
28.159	HSG C	P-1A, P-1B, P-1C, P-1D, P-1E, P-1F, P-2A, P-2B, P-2E, P-2F, P-2G, P-2H, P-3A, P-3B, P-3C, P-3D, P-3E, P-3F, P-4, P-5
0.000	HSG D	
0.000	Other	
29.185		**TOTAL AREA**

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 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 P-1A: Subcat P-1A Runoff Area=3.168 ac 17.98% Impervious Runoff Depth=5.70"
Flow Length=782' Tc=13.3 min CN=75 Runoff=16.51 cfs 1.504 af

Subcatchment P-1B: Subcat P-1B Runoff Area=24,871 sf 23.27% Impervious Runoff Depth=6.06"
Flow Length=315' Tc=8.2 min CN=78 Runoff=3.66 cfs 0.288 af

Subcatchment P-1C: Subcat P-1C Runoff Area=0.337 ac 20.77% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=75 Runoff=2.19 cfs 0.160 af

Subcatchment P-1D: Subcat P-1D Runoff Area=0.715 ac 12.28% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=75 Runoff=4.64 cfs 0.340 af

Subcatchment P-1E: Subcat P-1E Runoff Area=0.382 ac 53.49% Impervious Runoff Depth=6.91"
Tc=6.0 min CN=85 Runoff=2.90 cfs 0.220 af

Subcatchment P-1F: Subcat P-1F Runoff Area=1.697 ac 56.32% Impervious Runoff Depth=7.27"
Tc=6.0 min CN=88 Runoff=13.33 cfs 1.029 af

Subcatchment P-2A: Subcat P-2A Runoff Area=2.217 ac 8.54% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=75 Runoff=14.39 cfs 1.052 af

Subcatchment P-2B: Subcat P-2B Runoff Area=2.577 ac 15.70% Impervious Runoff Depth=5.82"
Tc=6.0 min CN=76 Runoff=17.04 cfs 1.249 af

Subcatchment P-2E: Subcat P-2E Runoff Area=2.368 ac 52.75% Impervious Runoff Depth=7.15"
Tc=6.0 min CN=87 Runoff=18.39 cfs 1.411 af

Subcatchment P-2F: Subcat P-2F Runoff Area=1.509 ac 42.50% Impervious Runoff Depth=6.79"
Tc=6.0 min CN=84 Runoff=11.31 cfs 0.853 af

Subcatchment P-2G: Subcat P-2G Runoff Area=1.045 ac 52.81% Impervious Runoff Depth=7.15"
Tc=6.0 min CN=87 Runoff=8.12 cfs 0.623 af

Subcatchment P-2H: Subcat P-2H Runoff Area=0.555 ac 66.39% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=90 Runoff=4.44 cfs 0.348 af

Subcatchment P-3A: Subcat P-3A Runoff Area=5.016 ac 0.00% Impervious Runoff Depth=5.09"
Flow Length=644' Tc=16.1 min CN=70 Runoff=21.97 cfs 2.127 af

Subcatchment P-3B: Subcat P-3B Runoff Area=1.323 ac 0.00% Impervious Runoff Depth=5.33"
Tc=6.0 min CN=72 Runoff=8.08 cfs 0.588 af

Subcatchment P-3C: Subcat P-3C Runoff Area=0.370 ac 63.48% Impervious Runoff Depth=7.39"
Tc=6.0 min CN=89 Runoff=2.94 cfs 0.228 af

Subcatchment P-3D: Subcat P-3D Runoff Area=1.714 ac 72.83% Impervious Runoff Depth=7.64"
Tc=6.0 min CN=91 Runoff=13.83 cfs 1.091 af

Subcatchment P-3E: Subcat P-3E Runoff Area=1.519 ac 66.06% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=90 Runoff=12.15 cfs 0.951 af

Subcatchment P-3F: Subcat P-3F Runoff Area=1.339 ac 68.60% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=90 Runoff=10.71 cfs 0.839 af

Subcatchment P-4: Subcat P-4 Runoff Area=26,375 sf 10.67% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=75 Runoff=3.93 cfs 0.287 af

Subcatchment P-5: Subcat P-5 Runoff Area=6,874 sf 0.00% Impervious Runoff Depth=5.45"
Tc=6.0 min CN=73 Runoff=0.98 cfs 0.072 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.37' Max Vel=0.43 fps Inflow=8.08 cfs 0.588 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=3.77 cfs 0.588 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=1.24' Max Vel=0.42 fps Inflow=28.98 cfs 3.966 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=15.84 cfs 3.963 af

Reach SW-1: swale Avg. Flow Depth=0.31' Max Vel=4.29 fps Inflow=4.45 cfs 0.322 af
n=0.041 L=252.0' S=0.1052 '/' Capacity=49.36 cfs Outflow=4.38 cfs 0.322 af

Reach SW-2: swale Avg. Flow Depth=0.25' Max Vel=3.90 fps Inflow=2.90 cfs 0.220 af
n=0.041 L=228.0' S=0.1110 '/' Capacity=50.70 cfs Outflow=2.89 cfs 0.220 af

Pond DB-1: detention Peak Elev=814.91' Storage=74,533 cf Inflow=54.69 cfs 4.965 af
Primary=15.12 cfs 4.704 af Secondary=7.64 cfs 0.240 af Outflow=22.76 cfs 4.945 af

Pond dmh01: dmh Peak Elev=853.04' Inflow=2.89 cfs 0.220 af
12.0" Round Culvert n=0.013 L=12.0' S=0.0100 '/' Outflow=2.89 cfs 0.220 af

Pond dmh05: dmh Peak Elev=873.82' Inflow=12.79 cfs 0.934 af
15.0" Round Culvert n=0.013 L=97.0' S=0.0351 '/' Outflow=12.79 cfs 0.934 af

Pond dmh20: dmh Peak Elev=911.96' Inflow=10.85 cfs 0.779 af
15.0" Round Culvert n=0.013 L=205.0' S=0.0119 '/' Outflow=10.85 cfs 0.779 af

Pond dmh21: dmh Peak Elev=905.55' Inflow=28.52 cfs 2.095 af
24.0" Round Culvert n=0.013 L=190.0' S=0.0100 '/' Outflow=28.52 cfs 2.095 af

Pond dmh23: dmh Peak Elev=902.95' Inflow=36.32 cfs 2.661 af
30.0" Round Culvert n=0.013 L=27.0' S=0.0130 '/' Outflow=36.32 cfs 2.661 af

Pond dmh25: dmh Peak Elev=924.37' Inflow=4.27 cfs 0.328 af
12.0" Round Culvert n=0.013 L=97.0' S=0.0697 '/' Outflow=4.27 cfs 0.328 af

Pond dmh50: dmh Peak Elev=931.30' Inflow=10.29 cfs 0.761 af
15.0" Round Culvert n=0.013 L=102.0' S=0.0799 '/' Outflow=10.29 cfs 0.761 af

Pond dmh51: dmh Peak Elev=923.05' Inflow=10.29 cfs 0.761 af
15.0" Round Culvert n=0.013 L=127.0' S=0.0780 '/' Outflow=10.29 cfs 0.761 af

Pond dmh52: dmh Peak Elev=896.17' Inflow=10.29 cfs 0.761 af
15.0" Round Culvert n=0.013 L=62.0' S=0.0802 '/' Outflow=10.29 cfs 0.761 af

Pond dmh53: dmh Peak Elev=919.46' Inflow=11.67 cfs 0.846 af
18.0" Round Culvert n=0.013 L=31.0' S=0.0465 '/' Outflow=11.67 cfs 0.846 af

Pond dmh55: dmh Peak Elev=906.33' Inflow=24.95 cfs 1.849 af
24.0" Round Culvert n=0.013 L=72.0' S=0.0374 '/' Outflow=24.95 cfs 1.849 af

Pond dmh56: dmh Peak Elev=900.37' Inflow=27.81 cfs 2.077 af
30.0" Round Culvert n=0.013 L=20.0' S=0.0100 '/' Outflow=27.81 cfs 2.077 af

Pond dmh57: dmh Peak Elev=899.37' Inflow=27.81 cfs 2.077 af
30.0" Round Culvert n=0.013 L=103.0' S=0.0080 '/' Outflow=27.81 cfs 2.077 af

Pond dmh58: dmh Peak Elev=898.23' Inflow=27.81 cfs 2.077 af
30.0" Round Culvert n=0.013 L=278.0' S=0.0080 '/' Outflow=27.81 cfs 2.077 af

Pond dmh59: dmh Peak Elev=896.19' Inflow=27.81 cfs 2.077 af
30.0" Round Culvert n=0.013 L=82.0' S=0.0091 '/' Outflow=27.81 cfs 2.077 af

Pond dmh60: dmh Peak Elev=895.03' Inflow=27.81 cfs 2.077 af
30.0" Round Culvert n=0.013 L=258.0' S=0.0115 '/' Outflow=27.81 cfs 2.077 af

Pond dmh61: dmh Peak Elev=892.13' Inflow=27.81 cfs 2.077 af
30.0" Round Culvert n=0.013 L=278.0' S=0.0100 '/' Outflow=27.81 cfs 2.077 af

Pond dmh62: dmh Peak Elev=890.29' Inflow=38.10 cfs 2.838 af
30.0" Round Culvert n=0.013 L=62.0' S=0.0248 '/' Outflow=38.10 cfs 2.838 af

Pond dmh69: dmh Peak Elev=816.32' Inflow=38.10 cfs 2.838 af
30.0" Round Culvert n=0.013 L=29.0' S=0.0338 '/' Outflow=38.10 cfs 2.838 af

Pond DS-1a: detention Peak Elev=852.95' Storage=20,287 cf Inflow=20.00 cfs 1.475 af
Outflow=9.63 cfs 1.475 af

Pond DS-1b: detention Peak Elev=862.60' Storage=4,545 cf Inflow=3.66 cfs 0.288 af
Outflow=0.80 cfs 0.288 af

Pond DS-2a: detention Peak Elev=902.50' Storage=48,125 cf Inflow=40.59 cfs 2.989 af
Outflow=21.69 cfs 2.986 af

Pond DS-2b: detention Peak Elev=865.14' Storage=10,362 cf Inflow=16.34 cfs 1.177 af
Outflow=7.74 cfs 1.176 af

Pond DW-1: House Drywell Peak Elev=3.50' Storage=1,963 cf Inflow=13.33 cfs 1.029 af
Discarded=0.03 cfs 0.076 af Primary=12.79 cfs 0.934 af Outflow=12.83 cfs 1.010 af

Pond DW-10: House Drywell Peak Elev=3.50' Storage=0.054 af Inflow=16.51 cfs 1.504 af
Discarded=0.04 cfs 0.083 af Primary=0.19 cfs 0.217 af Secondary=16.06 cfs 1.182 af Outflow=16.28 cfs 1.482 af

Pond DW-11: House Drywell Peak Elev=3.50' Storage=0.036 af Inflow=17.04 cfs 1.249 af
Discarded=0.03 cfs 0.056 af Primary=16.34 cfs 1.177 af Outflow=16.37 cfs 1.234 af

Pond DW-12: House Drywell Peak Elev=3.50' Storage=0.036 af Inflow=14.39 cfs 1.052 af
Discarded=0.03 cfs 0.056 af Primary=13.79 cfs 0.981 af Outflow=13.82 cfs 1.037 af

Pond DW-2: House Drywell Peak Elev=3.50' Storage=0.009 af Inflow=4.64 cfs 0.340 af
Discarded=0.01 cfs 0.014 af Primary=4.45 cfs 0.322 af Outflow=4.46 cfs 0.336 af

Pond DW-3: House Drywell Peak Elev=3.50' Storage=0.041 af Inflow=13.83 cfs 1.091 af
Discarded=0.03 cfs 0.071 af Primary=13.29 cfs 1.003 af Outflow=13.32 cfs 1.073 af

Pond DW-4: House Drywell Peak Elev=3.50' Storage=0.050 af Inflow=12.15 cfs 0.951 af
Discarded=0.04 cfs 0.084 af Primary=11.67 cfs 0.846 af Outflow=11.70 cfs 0.930 af

Pond DW-5: House Drywell Peak Elev=3.50' Storage=0.036 af Inflow=11.31 cfs 0.853 af
Discarded=0.03 cfs 0.059 af Primary=10.85 cfs 0.779 af Outflow=10.88 cfs 0.838 af

Pond DW-6: House Drywell Peak Elev=3.50' Storage=0.036 af Inflow=10.71 cfs 0.839 af
Discarded=0.03 cfs 0.062 af Primary=10.29 cfs 0.761 af Outflow=10.31 cfs 0.823 af

Pond DW-7: House Drywell Peak Elev=3.50' Storage=0.045 af Inflow=18.39 cfs 1.411 af
Discarded=0.03 cfs 0.076 af Primary=17.67 cfs 1.316 af Outflow=17.70 cfs 1.392 af

Pond DW-8: House Drywell Peak Elev=3.50' Storage=0.009 af Inflow=4.44 cfs 0.348 af
Discarded=0.01 cfs 0.016 af Primary=4.27 cfs 0.328 af Outflow=4.28 cfs 0.344 af

Pond DW-9: House Drywell Peak Elev=3.50' Storage=0.027 af Inflow=8.12 cfs 0.623 af
Discarded=0.02 cfs 0.045 af Primary=7.80 cfs 0.566 af Outflow=7.82 cfs 0.611 af

Pond G1: gabion Peak Elev=879.43' Storage=443 cf Inflow=21.69 cfs 2.986 af
Outflow=21.96 cfs 2.985 af

Pond G2: gabion Peak Elev=811.58' Storage=129 cf Inflow=15.12 cfs 4.704 af
Outflow=15.13 cfs 4.704 af

Link SP1: STUDY POINT #1 Inflow=26.84 cfs 3.322 af
Primary=26.84 cfs 3.322 af

Link SP2: STUDY POINT #2 Inflow=23.37 cfs 5.138 af
Primary=23.37 cfs 5.138 af

Link SP3: STUDY POINT #3 Inflow=26.15 cfs 5.532 af
Primary=26.15 cfs 5.532 af

Link SP4: STUDY POINT #4 Inflow=3.93 cfs 0.287 af
Primary=3.93 cfs 0.287 af

Link SP5: STUDY POINT #5 Inflow=0.98 cfs 0.072 af
Primary=0.98 cfs 0.072 af

Total Runoff Area = 29.185 ac Runoff Volume = 15.260 af Average Runoff Depth = 6.27"
69.52% Pervious = 20.290 ac 30.48% Impervious = 8.895 ac

Summary for Subcatchment P-1A: Subcat P-1A

Runoff = 16.51 cfs @ 12.18 hrs, Volume= 1.504 af, Depth= 5.70"
Routed to Pond DW-10 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.168	55	Woods, Good, HSG B
0.059	98	Roofs, HSG B
0.085	98	Paved parking, HSG B
0.183	61	>75% Grass cover, Good, HSG B
1.282	74	>75% Grass cover, Good, HSG C
0.966	70	Woods, Good, HSG C
0.046	98	Paved parking, HSG C
0.379	98	Roofs, HSG C
3.168	75	Weighted Average
2.599		82.02% Pervious Area
0.569		17.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.8	55	0.1670	0.09		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.28"
1.1	105	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	622	0.0280	4.24	4.11	**Trap/Vee/Rect Channel Flow,** Bot.W=1.00' D=0.25' Z= 3.0 & 20.0 '/' Top.W=6.75' n= 0.016 Asphalt, rough
13.3	782	Total			

Summary for Subcatchment P-1B: Subcat P-1B

Runoff = 3.66 cfs @ 12.12 hrs, Volume= 0.288 af, Depth= 6.06"
Routed to Pond DS-1b : detention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
4,342	98	Paved parking, HSG C
1,445	98	Paved parking, HSG B
3,282	61	>75% Grass cover, Good, HSG B
13,797	74	>75% Grass cover, Good, HSG C
2,004	70	Woods, Good, HSG C
24,871	78	Weighted Average
19,083		76.73% Pervious Area
5,787		23.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.6	50	0.0960	0.13		**Sheet Flow, A-B** Grass: Bermuda n= 0.410 P2= 3.28"
1.4	183	0.0960	2.17		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.2	82	0.0840	5.88		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
8.2	315	Total			

Summary for Subcatchment P-1C: Subcat P-1C

Runoff = 2.19 cfs @ 12.09 hrs, Volume= 0.160 af, Depth= 5.70"
Routed to Link SP1 : STUDY POINT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.002	98	Paved parking, HSG C
0.068	98	Paved parking, HSG B
0.111	61	>75% Grass cover, Good, HSG B
0.156	74	>75% Grass cover, Good, HSG C
0.337	75	Weighted Average
0.267		79.23% Pervious Area
0.070		20.77% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-1D: Subcat P-1D

Runoff = 4.64 cfs @ 12.09 hrs, Volume= 0.340 af, Depth= 5.70"
Routed to Pond DW-2 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.105	61	>75% Grass cover, Good, HSG B
0.060	98	Paved parking, HSG B
0.000	98	Roofs, HSG C
0.027	98	Paved parking, HSG C
0.523	74	>75% Grass cover, Good, HSG C
0.715	75	Weighted Average
0.628		87.72% Pervious Area
0.088		12.28% Impervious Area

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

Summary for Subcatchment P-1E: Subcat P-1E

Runoff = 2.90 cfs @ 12.09 hrs, Volume= 0.220 af, Depth= 6.91"
Routed to Reach SW-2 : swale

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.040	61	>75% Grass cover, Good, HSG B
0.037	98	Paved parking, HSG B
0.168	98	Paved parking, HSG C
0.138	74	>75% Grass cover, Good, HSG C
0.382	85	Weighted Average
0.178		46.51% Pervious Area
0.204		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-1F: Subcat P-1F

Runoff = 13.33 cfs @ 12.09 hrs, Volume= 1.029 af, Depth= 7.27"
Routed to Pond DW-1 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.741	74	>75% Grass cover, Good, HSG C
0.494	98	Roofs, HSG C
0.461	98	Paved parking, HSG C
1.697	88	Weighted Average
0.741		43.68% Pervious Area
0.956		56.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-2A: Subcat P-2A

Runoff = 14.39 cfs @ 12.09 hrs, Volume= 1.052 af, Depth= 5.70"
Routed to Pond DW-12 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.188	98	Roofs, HSG C
0.001	98	Paved parking, HSG C
0.636	70	Woods, Good, HSG C
1.391	74	>75% Grass cover, Good, HSG C
2.217	75	Weighted Average
2.027		91.46% Pervious Area
0.189		8.54% Impervious Area

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

Summary for Subcatchment P-2B: Subcat P-2B

Runoff = 17.04 cfs @ 12.09 hrs, Volume= 1.249 af, Depth= 5.82"
Routed to Pond DW-11 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
1.178	74	>75% Grass cover, Good, HSG C
0.687	70	Woods, Good, HSG C
0.307	65	Brush, Good, HSG C
0.021	98	Paved parking, HSG C
0.384	98	Roofs, HSG C
2.577	76	Weighted Average
2.172		84.30% Pervious Area
0.405		15.70% Impervious Area

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

Summary for Subcatchment P-2E: Subcat P-2E

Runoff = 18.39 cfs @ 12.09 hrs, Volume= 1.411 af, Depth= 7.15"
Routed to Pond DW-7 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
1.119	74	>75% Grass cover, Good, HSG C
0.672	98	Roofs, HSG C
0.577	98	Paved parking, HSG C
2.368	87	Weighted Average
1.119		47.25% Pervious Area
1.249		52.75% Impervious Area

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

Summary for Subcatchment P-2F: Subcat P-2F

Runoff = 11.31 cfs @ 12.09 hrs, Volume= 0.853 af, Depth= 6.79"
Routed to Pond DW-5 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.868	74	>75% Grass cover, Good, HSG C
0.357	98	Roofs, HSG C
0.284	98	Paved parking, HSG C
1.509	84	Weighted Average
0.868		57.50% Pervious Area
0.641		42.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-2G: Subcat P-2G

Runoff = 8.12 cfs @ 12.09 hrs, Volume= 0.623 af, Depth= 7.15"
Routed to Pond DW-9 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.493	74	>75% Grass cover, Good, HSG C
0.206	98	Roofs, HSG C
0.346	98	Paved parking, HSG C
1.045	87	Weighted Average
0.493		47.19% Pervious Area
0.552		52.81% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-2H: Subcat P-2H

Runoff = 4.44 cfs @ 12.09 hrs, Volume= 0.348 af, Depth= 7.52"
Routed to Pond DW-8 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.187	74	>75% Grass cover, Good, HSG C
0.108	98	Roofs, HSG C
0.261	98	Paved parking, HSG C
0.555	90	Weighted Average
0.187		33.61% Pervious Area
0.368		66.39% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-3A: Subcat P-3A

Runoff = 21.97 cfs @ 12.22 hrs, Volume= 2.127 af, Depth= 5.09"
Routed to Pond DB-1 : detention

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
2.591	74	>75% Grass cover, Good, HSG C
0.847	70	Woods, Good, HSG C
1.578	65	Brush, Good, HSG C
5.016	70	Weighted Average
5.016		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	50	0.0180	0.07		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.28"
1.0	91	0.0850	1.46		**Shallow Concentrated Flow, B-C** Woodland Kv= 5.0 fps
1.1	204	0.1800	2.97		**Shallow Concentrated Flow, C-D** Short Grass Pasture Kv= 7.0 fps
1.3	299	0.3000	3.83		**Shallow Concentrated Flow, D-E** Short Grass Pasture Kv= 7.0 fps
16.1	644	Total			

Summary for Subcatchment P-3B: Subcat P-3B

Runoff = 8.08 cfs @ 12.09 hrs, Volume= 0.588 af, Depth= 5.33"
Routed to Reach R-01 : Routing to wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.000	98	Roofs, HSG C
0.172	65	Brush, Good, HSG C
0.273	70	Woods, Good, HSG C
0.878	74	>75% Grass cover, Good, HSG C
1.323	72	Weighted Average
1.323		100.00% Pervious Area
0.000		0.00% Impervious Area

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

Summary for Subcatchment P-3C: Subcat P-3C

Runoff = 2.94 cfs @ 12.09 hrs, Volume= 0.228 af, Depth= 7.39"
Routed to Pond dmh56 : dmh

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.135	74	>75% Grass cover, Good, HSG C
0.018	98	Roofs, HSG C
0.217	98	Paved parking, HSG C
0.370	89	Weighted Average
0.135		36.52% Pervious Area
0.235		63.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-3D: Subcat P-3D

Runoff = 13.83 cfs @ 12.09 hrs, Volume= 1.091 af, Depth= 7.64"
Routed to Pond DW-3 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.466	74	>75% Grass cover, Good, HSG C
0.685	98	Roofs, HSG C
0.563	98	Paved parking, HSG C
1.714	91	Weighted Average
0.466		27.17% Pervious Area
1.248		72.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr-55 min**

Summary for Subcatchment P-3E: Subcat P-3E

Runoff = 12.15 cfs @ 12.09 hrs, Volume= 0.951 af, Depth= 7.52"
Routed to Pond DW-4 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.516	74	>75% Grass cover, Good, HSG C
0.575	98	Roofs, HSG C
0.428	98	Paved parking, HSG C
1.519	90	Weighted Average
0.516		33.94% Pervious Area
1.004		66.06% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-3F: Subcat P-3F

Runoff = 10.71 cfs @ 12.09 hrs, Volume= 0.839 af, Depth= 7.52"
Routed to Pond DW-6 : House Drywell

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (ac)	CN	Description
0.420	74	>75% Grass cover, Good, HSG C
0.495	98	Roofs, HSG C
0.423	98	Paved parking, HSG C
1.339	90	Weighted Average
0.420		31.40% Pervious Area
0.919		68.60% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, TR-55 MIN**

Summary for Subcatchment P-4: Subcat P-4

Runoff = 3.93 cfs @ 12.09 hrs, Volume= 0.287 af, Depth= 5.70"
Routed to Link SP4 : STUDY POINT #4

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
56	61	>75% Grass cover, Good, HSG B
14,249	74	>75% Grass cover, Good, HSG C
9,257	70	Woods, Good, HSG C
0	98	Roofs, HSG C
2,814	98	Paved parking, HSG C
26,375	75	Weighted Average
23,561		89.33% Pervious Area
2,814		10.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, tr55 min**

Summary for Subcatchment P-5: Subcat P-5

Runoff = 0.98 cfs @ 12.09 hrs, Volume= 0.072 af, Depth= 5.45"
Routed to Link SP5 : STUDY POINT #5

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-year Rainfall=8.72"

Area (sf)	CN	Description
2,401	70	Woods, Good, HSG C
4,473	74	>75% Grass cover, Good, HSG C
6,874	73	Weighted Average
6,874		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry, TR-55 Min.**
5.0	0	Total, Increased to minimum Tc = 6.0 min			

Summary for Reach R-01: Routing to wetlands

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

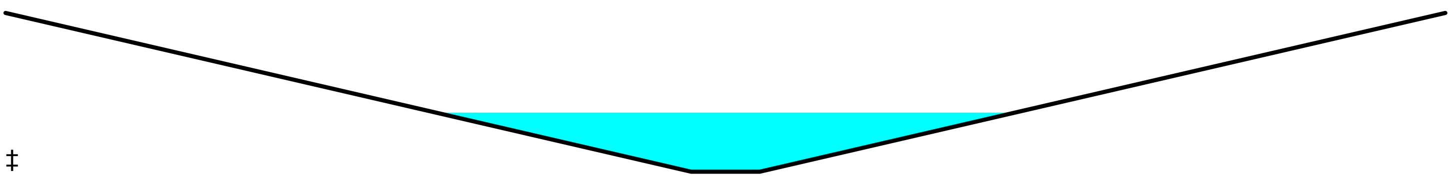
This reach demonstrates a procedure for performing a shallow concetrated flow routing through woods. In this case, the "reach" is defined as a channel with very low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 1.323 ac, 0.00% Impervious, Inflow Depth = 5.33" for 100-year event
Inflow = 8.08 cfs @ 12.09 hrs, Volume= 0.588 af
Outflow = 3.77 cfs @ 12.28 hrs, Volume= 0.588 af, Atten= 53%, Lag= 11.2 min
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.43 fps, Min. Travel Time= 28.0 min
Avg. Velocity = 0.15 fps, Avg. Travel Time= 80.8 min

Peak Storage= 6,328 cf @ 12.28 hrs
Average Depth at Peak Storage= 0.37' , Surface Width= 42.16'
Bank-Full Depth= 1.00' Flow Area= 55.0 sf, Capacity= 43.77 cfs

5.00' x 1.00' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 50.0 '/' Top Width= 105.00'
Length= 722.0' Slope= 0.1087 '/'
Inlet Invert= 889.50', Outlet Invert= 811.00'



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Summary for Reach R-02: Routing through wetland/swale

A subcatchment performs runoff calculations, including the associated Tc anc CN determinations. It does not have any facility for routing an inflow hydrograph from another source. However, a reach may be used to perform this type of specialized routing.

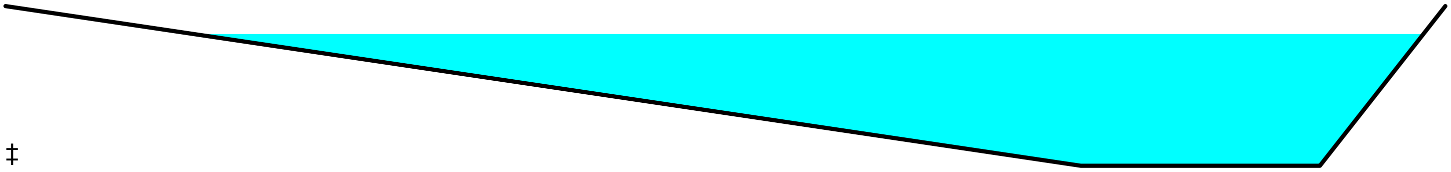
This reach demonstrates a procedure for performing a shallow concetrated flow routing through the wooded wetland/swale adjacent to the stone wall. In this case, the "reach" is defined as a channel with low side slopes. The Manning's value of 0.40 is selected from the table of sheet flow roughness coefficients, which is comparable to the Manning's value for "woods with light underbrush".

Inflow Area = 7.693 ac, 38.99% Impervious, Inflow Depth > 6.19" for 100-year event
Inflow = 28.98 cfs @ 12.28 hrs, Volume= 3.966 af
Outflow = 15.84 cfs @ 12.50 hrs, Volume= 3.963 af, Atten= 45%, Lag= 13.4 min
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.42 fps, Min. Travel Time= 29.4 min
Avg. Velocity = 0.17 fps, Avg. Travel Time= 72.1 min

Peak Storage= 27,952 cf @ 12.50 hrs
Average Depth at Peak Storage= 1.24' , Surface Width= 51.46'
Bank-Full Depth= 1.50' Flow Area= 52.7 sf, Capacity= 24.55 cfs

10.00' x 1.50' deep channel, n= 0.400 Sheet flow: Woods+light brush
Side Slope Z-value= 30.0 3.5 '/' Top Width= 60.25'
Length= 735.0' Slope= 0.0189 '/'
Inlet Invert= 877.70', Outlet Invert= 863.80'



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Summary for Reach SW-1: swale

Inflow Area = 0.715 ac, 12.28% Impervious, Inflow Depth = 5.40" for 100-year event
Inflow = 4.45 cfs @ 12.11 hrs, Volume= 0.322 af
Outflow = 4.38 cfs @ 12.13 hrs, Volume= 0.322 af, Atten= 2%, Lag= 0.9 min
Routed to Pond DS-1a : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.29 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.44 fps, Avg. Travel Time= 2.9 min

Peak Storage= 256 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.31' , Surface Width= 4.50'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 49.36 cfs

2.00' x 1.00' deep channel, n= 0.041 Riprap, 2-inch
Side Slope Z-value= 4.0 '/' Top Width= 10.00'
Length= 252.0' Slope= 0.1052 '/'
Inlet Invert= 884.00', Outlet Invert= 857.50'

‡

Summary for Reach SW-2: swale

Inflow Area = 0.382 ac, 53.49% Impervious, Inflow Depth = 6.91" for 100-year event
Inflow = 2.90 cfs @ 12.09 hrs, Volume= 0.220 af
Outflow = 2.89 cfs @ 12.10 hrs, Volume= 0.220 af, Atten= 0%, Lag= 0.8 min
Routed to Pond dmh01 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.90 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 1.13 fps, Avg. Travel Time= 3.4 min

Peak Storage= 169 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.25' , Surface Width= 3.98'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 50.70 cfs

2.00' x 1.00' deep channel, n= 0.041 Riprap, 2-inch
Side Slope Z-value= 4.0 '/' Top Width= 10.00'
Length= 228.0' Slope= 0.1110 '/'
Inlet Invert= 880.00', Outlet Invert= 854.70'

‡

Summary for Pond DB-1: detention

Inflow Area = 9.959 ac, 34.20% Impervious, Inflow Depth = 5.98" for 100-year event
Inflow = 54.69 cfs @ 12.13 hrs, Volume= 4.965 af
Outflow = 22.76 cfs @ 12.48 hrs, Volume= 4.945 af, Atten= 58%, Lag= 21.0 min
Primary = 15.12 cfs @ 12.48 hrs, Volume= 4.704 af
Routed to Pond G2 : gabion
Secondary = 7.64 cfs @ 12.48 hrs, Volume= 0.240 af
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 814.91' @ 12.48 hrs Surf.Area= 22,732 sf Storage= 74,533 cf
Flood Elev= 816.00' Surf.Area= 24,900 sf Storage= 100,504 cf

Plug-Flow detention time= 79.0 min calculated for 4.938 af (99% of inflow)
Center-of-Mass det. time= 77.2 min (881.5 - 804.3)

Volume	Invert	Avail.Storage	Storage Description
#1	811.00'	100,504 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
811.00	15,556	576.0	0	0	15,556
812.00	17,303	594.0	16,422	16,422	17,331
813.00	19,115	613.0	18,201	34,623	19,253
814.00	20,984	632.0	20,042	54,665	21,236
815.00	22,910	651.0	21,940	76,605	23,279
816.00	24,900	670.0	23,898	100,504	25,383

Device	Routing	Invert	Outlet Devices
#1	Primary	811.00'	**18.0" Round Culvert** L= 32.0' Ke= 0.500 Inlet / Outlet Invert= 811.00' / 810.30' S= 0.0219 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf
#2	Device 1	811.00'	**8.0" Vert. (2) 8" Orifice (2yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	811.90'	**12.0" Vert. (2) 12" Orifice (10yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	813.20'	**24.0" x 24.0" Horiz. 24" Top of Structure** C= 0.600 Limited to weir flow at low heads
#5	Secondary	814.40'	**8.0' long x 8.0' 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) 2.43 2.54 2.70 2.69 2.68 2.68 2.66 2.64 2.64 2.64 2.65 2.65 2.66 2.66 2.68 2.70 2.74

Primary OutFlow Max=15.12 cfs @ 12.48 hrs HW=814.91' TW=811.58' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 15.12 cfs @ 8.55 fps)
  ├─**2=(2) 8" Orifice (2yr)** (Passes < 6.13 cfs potential flow)
  ├─**3=(2) 12" Orifice (10yr)** (Passes < 11.97 cfs potential flow)
  └─**4=24" Top of Structure** (Passes < 25.16 cfs potential flow)

Secondary OutFlow Max=7.56 cfs @ 12.48 hrs HW=814.91' TW=0.00' (Dynamic Tailwater)
└─**5=Broad-Crested Rectangular Weir** (Weir Controls 7.56 cfs @ 1.87 fps)

Summary for Pond dmh01: dmh

Inflow Area = 0.382 ac, 53.49% Impervious, Inflow Depth = 6.91" for 100-year event
Inflow = 2.89 cfs @ 12.10 hrs, Volume= 0.220 af
Outflow = 2.89 cfs @ 12.10 hrs, Volume= 0.220 af, Atten= 0%, Lag= 0.0 min
Primary = 2.89 cfs @ 12.10 hrs, Volume= 0.220 af
Routed to Pond DS-1a : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 853.04' @ 12.34 hrs
Flood Elev= 855.31'

Device	Routing	Invert	Outlet Devices
#1	Primary	849.34'	**12.0" Round Culvert** L= 12.0' Ke= 0.500 Inlet / Outlet Invert= 849.34' / 849.22' S= 0.0100 '/' Cc= 0.900

n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 12.10 hrs HW=851.32' TW=851.43' (Dynamic Tailwater)
└─**1=Culvert** (Controls 0.00 cfs)

Summary for Pond dmh05: dmh

Inflow Area = 1.697 ac, 56.32% Impervious, Inflow Depth = 6.60" for 100-year event
Inflow = 12.79 cfs @ 12.11 hrs, Volume= 0.934 af
Outflow = 12.79 cfs @ 12.11 hrs, Volume= 0.934 af, Atten= 0%, Lag= 0.0 min
Primary = 12.79 cfs @ 12.11 hrs, Volume= 0.934 af
Routed to Pond DS-1a : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 873.82' @ 12.11 hrs
Flood Elev= 883.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	868.52'	**15.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 868.52' / 865.12' S= 0.0351 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=12.52 cfs @ 12.11 hrs HW=873.64' TW=851.58' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 12.52 cfs @ 10.20 fps)

Summary for Pond dmh20: dmh

Inflow Area = 1.509 ac, 42.50% Impervious, Inflow Depth = 6.20" for 100-year event
Inflow = 10.85 cfs @ 12.11 hrs, Volume= 0.779 af
Outflow = 10.85 cfs @ 12.11 hrs, Volume= 0.779 af, Atten= 0%, Lag= 0.0 min
Primary = 10.85 cfs @ 12.11 hrs, Volume= 0.779 af
Routed to Pond dmh21 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 911.96' @ 12.14 hrs
Flood Elev= 907.61'

Device	Routing	Invert	Outlet Devices
#1	Primary	902.74'	**15.0" Round Culvert** L= 205.0' Ke= 0.500 Inlet / Outlet Invert= 902.74' / 900.30' S= 0.0119 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=9.21 cfs @ 12.11 hrs HW=910.87' TW=905.38' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 9.21 cfs @ 7.50 fps)

Summary for Pond dmh21: dmh

Inflow Area = 3.876 ac, 48.76% Impervious, Inflow Depth = 6.48" for 100-year event
Inflow = 28.52 cfs @ 12.11 hrs, Volume= 2.095 af
Outflow = 28.52 cfs @ 12.11 hrs, Volume= 2.095 af, Atten= 0%, Lag= 0.0 min
Primary = 28.52 cfs @ 12.11 hrs, Volume= 2.095 af
Routed to Pond dmh23 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 905.55' @ 12.13 hrs
Flood Elev= 905.24'

Device	Routing	Invert	Outlet Devices
#1	Primary	899.55'	**24.0" Round Culvert** L= 190.0' Ke= 0.500 Inlet / Outlet Invert= 899.55' / 897.65' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=26.00 cfs @ 12.11 hrs HW=905.38' TW=901.26' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 26.00 cfs @ 8.28 fps)

Summary for Pond dmh23: dmh

Inflow Area = 4.921 ac, 49.62% Impervious, Inflow Depth = 6.49" for 100-year event
Inflow = 36.32 cfs @ 12.11 hrs, Volume= 2.661 af
Outflow = 36.32 cfs @ 12.11 hrs, Volume= 2.661 af, Atten= 0%, Lag= 0.0 min
Primary = 36.32 cfs @ 12.11 hrs, Volume= 2.661 af
Routed to Pond DS-2a : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 902.95' @ 12.32 hrs
Flood Elev= 910.71'

Device	Routing	Invert	Outlet Devices
#1	Primary	897.55'	**30.0" Round Culvert** L= 27.0' Ke= 0.500 Inlet / Outlet Invert= 897.55' / 897.20' S= 0.0130 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=28.27 cfs @ 12.11 hrs HW=901.26' TW=899.83' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 28.27 cfs @ 5.76 fps)

Summary for Pond dmh25: dmh

Inflow Area = 0.555 ac, 66.39% Impervious, Inflow Depth = 7.09" for 100-year event
Inflow = 4.27 cfs @ 12.11 hrs, Volume= 0.328 af
Outflow = 4.27 cfs @ 12.11 hrs, Volume= 0.328 af, Atten= 0%, Lag= 0.0 min
Primary = 4.27 cfs @ 12.11 hrs, Volume= 0.328 af
Routed to Pond DS-2a : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 924.37' @ 12.11 hrs
Flood Elev= 930.54'

Device	Routing	Invert	Outlet Devices
#1	Primary	922.60'	**12.0" Round Culvert** L= 97.0' Ke= 0.500 Inlet / Outlet Invert= 922.60' / 915.84' S= 0.0697 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=4.18 cfs @ 12.11 hrs HW=924.32' TW=899.82' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 4.18 cfs @ 5.32 fps)

Summary for Pond dmh50: dmh

Inflow Area = 1.339 ac, 68.60% Impervious, Inflow Depth = 6.82" for 100-year event
Inflow = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Outflow = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af, Atten= 0%, Lag= 0.0 min
Primary = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Routed to Pond dmh51 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 931.30' @ 12.11 hrs
Flood Elev= 933.94'

Device	Routing	Invert	Outlet Devices
#1	Primary	927.65'	**15.0" Round Culvert** L= 102.0' Ke= 0.500 Inlet / Outlet Invert= 927.65' / 919.50' S= 0.0799 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=10.07 cfs @ 12.11 hrs HW=931.18' TW=922.93' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 10.07 cfs @ 8.21 fps)

Summary for Pond dmh51: dmh

Inflow Area = 1.339 ac, 68.60% Impervious, Inflow Depth = 6.82" for 100-year event
Inflow = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Outflow = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af, Atten= 0%, Lag= 0.0 min
Primary = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Routed to Pond dmh52 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 923.05' @ 12.11 hrs
Flood Elev= 924.04'

Device	Routing	Invert	Outlet Devices
#1	Primary	919.40'	**15.0" Round Culvert** L= 127.0' Ke= 0.500 Inlet / Outlet Invert= 919.40' / 909.50' S= 0.0780 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=10.07 cfs @ 12.11 hrs HW=922.93' TW=896.05' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.07 cfs @ 8.21 fps)

Summary for Pond dmh52: dmh

Inflow Area = 1.339 ac, 68.60% Impervious, Inflow Depth = 6.82" for 100-year event
Inflow = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Outflow = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af, Atten= 0%, Lag= 0.0 min
Primary = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Routed to Pond dmh62 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 896.17' @ 12.11 hrs
Flood Elev= 914.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	892.52'	**15.0" Round Culvert** L= 62.0' Ke= 0.500 Inlet / Outlet Invert= 892.52' / 887.55' S= 0.0802 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf

Primary OutFlow Max=10.07 cfs @ 12.11 hrs HW=896.05' TW=890.19' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.07 cfs @ 8.21 fps)

Summary for Pond dmh53: dmh

Inflow Area = 1.519 ac, 66.06% Impervious, Inflow Depth = 6.68" for 100-year event
Inflow = 11.67 cfs @ 12.11 hrs, Volume= 0.846 af
Outflow = 11.67 cfs @ 12.11 hrs, Volume= 0.846 af, Atten= 0%, Lag= 0.0 min
Primary = 11.67 cfs @ 12.11 hrs, Volume= 0.846 af
Routed to Pond dmh55 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 919.46' @ 12.11 hrs
Flood Elev= 921.46'

Device	Routing	Invert	Outlet Devices
#1	Primary	916.83'	**18.0" Round Culvert** L= 31.0' Ke= 0.500 Inlet / Outlet Invert= 916.83' / 915.39' S= 0.0465 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=11.42 cfs @ 12.11 hrs HW=919.38' TW=906.22' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 11.42 cfs @ 6.46 fps)

Summary for Pond dmh55: dmh

Inflow Area = 3.233 ac, 69.65% Impervious, Inflow Depth = 6.86" for 100-year event
Inflow = 24.95 cfs @ 12.11 hrs, Volume= 1.849 af
Outflow = 24.95 cfs @ 12.11 hrs, Volume= 1.849 af, Atten= 0%, Lag= 0.0 min
Primary = 24.95 cfs @ 12.11 hrs, Volume= 1.849 af
Routed to Pond dmh56 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 906.33' @ 12.11 hrs
Flood Elev= 911.86'

Device	Routing	Invert	Outlet Devices
#1	Primary	902.61'	**24.0" Round Culvert** L= 72.0' Ke= 0.500 Inlet / Outlet Invert= 902.61' / 899.92' S= 0.0374 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=24.44 cfs @ 12.11 hrs HW=906.22' TW=900.23' (Dynamic Tailwater)
1=Culvert (Inlet Controls 24.44 cfs @ 7.78 fps)

Summary for Pond dmh56: dmh

Inflow Area = 3.604 ac, 69.02% Impervious, Inflow Depth = 6.92" for 100-year event
Inflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Outflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min
Primary = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Routed to Pond dmh57 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 900.37' @ 12.14 hrs
Flood Elev= 908.47'

Device	Routing	Invert	Outlet Devices
#1	Primary	896.80'	**30.0" Round Culvert** L= 20.0' Ke= 0.500 Inlet / Outlet Invert= 896.80' / 896.60' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=23.40 cfs @ 12.11 hrs HW=900.22' TW=899.24' (Dynamic Tailwater)
1=Culvert (Inlet Controls 23.40 cfs @ 4.77 fps)

Summary for Pond dmh57: dmh

Inflow Area = 3.604 ac, 69.02% Impervious, Inflow Depth = 6.92" for 100-year event
Inflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Outflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min
Primary = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Routed to Pond dmh58 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 899.37' @ 12.14 hrs
Flood Elev= 908.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	896.50'	**30.0" Round Culvert** L= 103.0' Ke= 0.500 Inlet / Outlet Invert= 896.50' / 895.68' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=23.76 cfs @ 12.11 hrs HW=899.24' TW=898.19' (Dynamic Tailwater)
1=Culvert (Outlet Controls 23.76 cfs @ 5.50 fps)

Summary for Pond dmh58: dmh

Inflow Area = 3.604 ac, 69.02% Impervious, Inflow Depth = 6.92" for 100-year event
Inflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Outflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min
Primary = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Routed to Pond dmh59 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 898.23' @ 12.12 hrs
Flood Elev= 901.46'

Device	Routing	Invert	Outlet Devices
#1	Primary	895.58'	**30.0" Round Culvert** L= 278.0' Ke= 0.500 Inlet / Outlet Invert= 895.58' / 893.35' S= 0.0080 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=26.26 cfs @ 12.11 hrs HW=898.19' TW=896.00' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 26.26 cfs @ 6.36 fps)

Summary for Pond dmh59: dmh

Inflow Area = 3.604 ac, 69.02% Impervious, Inflow Depth = 6.92" for 100-year event
Inflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Outflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min
Primary = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Routed to Pond dmh60 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 896.19' @ 12.14 hrs
Flood Elev= 909.31'

Device	Routing	Invert	Outlet Devices
#1	Primary	893.25'	**30.0" Round Culvert** L= 82.0' Ke= 0.500 Inlet / Outlet Invert= 893.25' / 892.50' S= 0.0091 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=23.81 cfs @ 12.11 hrs HW=896.00' TW=894.99' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 23.81 cfs @ 4.85 fps)

Summary for Pond dmh60: dmh

Inflow Area = 3.604 ac, 69.02% Impervious, Inflow Depth = 6.92" for 100-year event
Inflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Outflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min
Primary = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Routed to Pond dmh61 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 895.03' @ 12.11 hrs
Flood Elev= 901.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	892.40'	**30.0" Round Culvert** L= 258.0' Ke= 0.500 Inlet / Outlet Invert= 892.40' / 889.43' S= 0.0115 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=27.32 cfs @ 12.11 hrs HW=894.99' TW=891.98' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 27.32 cfs @ 5.57 fps)

Summary for Pond dmh61: dmh

Inflow Area = 3.604 ac, 69.02% Impervious, Inflow Depth = 6.92" for 100-year event
Inflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Outflow = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min
Primary = 27.81 cfs @ 12.11 hrs, Volume= 2.077 af
Routed to Pond dmh62 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 892.13' @ 12.14 hrs
Flood Elev= 898.16'

Device	Routing	Invert	Outlet Devices
#1	Primary	889.33'	**30.0" Round Culvert** L= 278.0' Ke= 0.500 Inlet / Outlet Invert= 889.33' / 886.55' S= 0.0100 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=23.90 cfs @ 12.11 hrs HW=891.98' TW=890.21' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 23.90 cfs @ 5.71 fps)

Summary for Pond dmh62: dmh

Inflow Area = 4.942 ac, 68.90% Impervious, Inflow Depth = 6.89" for 100-year event
Inflow = 38.10 cfs @ 12.11 hrs, Volume= 2.838 af
Outflow = 38.10 cfs @ 12.11 hrs, Volume= 2.838 af, Atten= 0%, Lag= 0.0 min
Primary = 38.10 cfs @ 12.11 hrs, Volume= 2.838 af
Routed to Pond dmh69 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 890.29' @ 12.11 hrs
Flood Elev= 902.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	886.45'	**30.0" Round Culvert** L= 62.0' Ke= 0.500 Inlet / Outlet Invert= 886.45' / 884.91' S= 0.0248 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=37.42 cfs @ 12.11 hrs HW=890.21' TW=816.24' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 37.42 cfs @ 7.62 fps)

Summary for Pond dmh69: dmh

Inflow Area = 4.942 ac, 68.90% Impervious, Inflow Depth = 6.89" for 100-year event
Inflow = 38.10 cfs @ 12.11 hrs, Volume= 2.838 af
Outflow = 38.10 cfs @ 12.11 hrs, Volume= 2.838 af, Atten= 0%, Lag= 0.0 min
Primary = 38.10 cfs @ 12.11 hrs, Volume= 2.838 af
Routed to Pond DB-1 : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 816.32' @ 12.11 hrs
Flood Elev= 818.02'

Device	Routing	Invert	Outlet Devices
#1	Primary	812.48'	**30.0" Round Culvert** L= 29.0' Ke= 0.500 Inlet / Outlet Invert= 812.48' / 811.50' S= 0.0338 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 4.91 sf

Primary OutFlow Max=37.42 cfs @ 12.11 hrs HW=816.24' TW=813.57' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 37.42 cfs @ 7.62 fps)

Summary for Pond DS-1a: detention

Inflow Area = 2.795 ac, 44.66% Impervious, Inflow Depth = 6.33" for 100-year event
Inflow = 20.00 cfs @ 12.11 hrs, Volume= 1.475 af
Outflow = 9.63 cfs @ 12.30 hrs, Volume= 1.475 af, Atten= 52%, Lag= 11.3 min
Primary = 9.63 cfs @ 12.30 hrs, Volume= 1.475 af
Routed to Link SP1 : STUDY POINT #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 852.95' @ 12.30 hrs Surf.Area= 7,168 sf Storage= 20,287 cf
Flood Elev= 853.00' Surf.Area= 7,168 sf Storage= 20,434 cf

Plug-Flow detention time= 101.0 min calculated for 1.473 af (100% of inflow)
Center-of-Mass det. time= 101.6 min (898.4 - 796.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	846.50'	0 cf	**64.00'W x 56.00'L x 5.67'H Field A** 20,309 cf Overall - 20,309 cf Embedded = 0 cf
#2A	846.50'	16,000 cf	**retain_it retain_it 5.0'** x 56 Inside #1 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 8 Rows adjusted for 311.7 cf perimeter wall
#3B	851.50'	0 cf	**64.00'W x 56.00'L x 2.17'H Field B** 7,765 cf Overall - 7,765 cf Embedded = 0 cf x 40.0% Voids
#4B	851.50'	4,434 cf	**retain_it retain_it 1.5'** x 56 Inside #3 Inside= 84.0"W x 18.0"H => 9.90 sf x 8.00'L = 79.2 cf Outside= 96.0"W x 26.0"H => 17.33 sf x 8.00'L = 138.7 cf 56 Chambers in 8 Rows
		20,434 cf	Total Available Storage

Storage Group A created with Chamber Wizard
Storage Group B created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	846.40'	**15.0" Round Culvert** L= 129.0' Ke= 0.500 Inlet / Outlet Invert= 846.40' / 845.62' S= 0.0060 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#2	Device 1	846.40'	**2.0" Vert. 2" Orifice (2yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	848.10'	**6.0" Vert. 6" Orifice (10yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#4	Device 1	849.40'	**5.0" Vert. 5" Orifice (25yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#5	Device 1	850.70'	**5.0" Vert. 5" Orifice (50yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#6	Device 1	852.80'	**4.0' long Overflow Weir** 2 End Contraction(s) 4.0' Crest Height

Primary OutFlow Max=9.62 cfs @ 12.30 hrs HW=852.95' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 9.62 cfs of 11.44 cfs potential flow)
  ├─**2=2" Orifice (2yr)** (Orifice Controls 0.53 cfs @ 12.24 fps)
  ├─**3=6" Orifice (10yr)** (Orifice Controls 4.05 cfs @ 10.33 fps)
  ├─**4=5" Orifice (25yr)** (Orifice Controls 2.40 cfs @ 8.80 fps)
  ├─**5=5" Orifice (50yr)** (Orifice Controls 1.88 cfs @ 6.88 fps)
  └─**6=Overflow Weir** (Weir Controls 0.75 cfs @ 1.27 fps)

Summary for Pond DS-1b: detention

Inflow Area = 0.571 ac, 23.27% Impervious, Inflow Depth = 6.06" for 100-year event
Inflow = 3.66 cfs @ 12.12 hrs, Volume= 0.288 af
Outflow = 0.80 cfs @ 12.56 hrs, Volume= 0.288 af, Atten= 78%, Lag= 26.9 min
Primary = 0.80 cfs @ 12.56 hrs, Volume= 0.288 af
Routed to Link SP1 : STUDY POINT #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 862.60' @ 12.56 hrs Surf.Area= 1,536 sf Storage= 4,545 cf
Flood Elev= 862.70' Surf.Area= 1,536 sf Storage= 4,684 cf

Plug-Flow detention time= 71.9 min calculated for 0.288 af (100% of inflow)
Center-of-Mass det. time= 71.7 min (877.9 - 806.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	859.20'	0 cf	**64.00'W x 24.00'L x 4.17'H Field A** 6,400 cf Overall - 6,400 cf Embedded = 0 cf x 40.0% Voids
#2A	859.20'	4,684 cf	**retain_it retain_it 3.5'** x 24 Inside #1 Inside= 84.0"W x 42.0"H => 25.10 sf x 8.00'L = 200.8 cf Outside= 96.0"W x 50.0"H => 33.33 sf x 8.00'L = 266.7 cf 8 Rows adjusted for 135.1 cf perimeter wall
		4,684 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	859.20'	**12.0" Round Culvert** L= 100.0' Ke= 0.500 Inlet / Outlet Invert= 859.20' / 858.10' S= 0.0110 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	859.20'	**4.0" Vert. 4" Orifice** C= 0.600 Limited to weir flow at low heads
#3	Device 1	862.50'	**12.0" Vert. Overflow** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.79 cfs @ 12.56 hrs HW=862.59' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.79 cfs of 5.47 cfs potential flow)
  ├─**2=4" Orifice** (Orifice Controls 0.75 cfs @ 8.65 fps)
  └─**3=Overflow** (Orifice Controls 0.04 cfs @ 1.04 fps)

Summary for Pond DS-2a: detention

Inflow Area = 5.477 ac, 51.32% Impervious, Inflow Depth = 6.55" for 100-year event
Inflow = 40.59 cfs @ 12.11 hrs, Volume= 2.989 af
Outflow = 21.69 cfs @ 12.28 hrs, Volume= 2.986 af, Atten= 47%, Lag= 10.3 min
Primary = 21.69 cfs @ 12.28 hrs, Volume= 2.986 af
Routed to Pond G1 : gabion

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 902.50' @ 12.28 hrs Storage= 48,125 cf
Flood Elev= 902.66' Storage= 48,125 cf

Plug-Flow detention time= 103.4 min calculated for 2.986 af (100% of inflow)
Center-of-Mass det. time= 102.8 min (896.1 - 793.3)

Volume	Invert	Avail.Storage	Storage Description
#1	892.00'	24,073 cf	**retain_it retain_it 5.0'** x 84 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 7 Rows adjusted for 394.8 cf perimeter wall
#2	897.00'	24,052 cf	**retain_it retain_it 5.0'** x 84 Inside= 84.0"W x 60.0"H => 36.41 sf x 8.00'L = 291.3 cf Outside= 96.0"W x 68.0"H => 45.33 sf x 8.00'L = 362.7 cf 6 Rows adjusted for 415.6 cf perimeter wall
		48,125 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	892.00'	**24.0" Round Culvert** L= 46.0' Ke= 0.500 Inlet / Outlet Invert= 892.00' / 890.75' S= 0.0272 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf
#2	Device 1	892.00'	**4.0" Vert. Orifice (2yr) X 2.00** C= 0.600 Limited to weir flow at low heads
#3	Device 1	895.40'	**8.0" Vert. Orifice (10yr)** C= 0.600 Limited to weir flow at low heads
#4	Device 1	898.20'	**8.0" Vert. Orifice (25yr)** C= 0.600 Limited to weir flow at low heads
#5	Device 1	899.90'	**4.0" Vert. Orifice (50yr)** C= 0.600 Limited to weir flow at low heads
#6	Device 1	901.60'	**4.0' long Sharp-Crested Weir Overflow (100yr)** 2 End Contraction(s)

Primary OutFlow Max=20.70 cfs @ 12.28 hrs HW=902.44' TW=879.36' (Dynamic Tailwater)
└─**1=Culvert** (Passes 20.70 cfs of 46.48 cfs potential flow)
  ├─**2=Orifice (2yr)** (Orifice Controls 2.69 cfs @ 15.43 fps)
  ├─**3=Orifice (10yr)** (Orifice Controls 4.35 cfs @ 12.47 fps)
  ├─**4=Orifice (25yr)** (Orifice Controls 3.32 cfs @ 9.52 fps)
  ├─**5=Orifice (50yr)** (Orifice Controls 0.65 cfs @ 7.42 fps)
  └─**6=Sharp-Crested Weir Overflow (100yr)** (Weir Controls 9.68 cfs @ 3.00 fps)

Summary for Pond DS-2b: detention

Inflow Area = 2.577 ac, 15.70% Impervious, Inflow Depth = 5.48" for 100-year event
Inflow = 16.34 cfs @ 12.11 hrs, Volume= 1.177 af
Outflow = 7.74 cfs @ 12.31 hrs, Volume= 1.176 af, Atten= 53%, Lag= 11.7 min
Primary = 7.74 cfs @ 12.31 hrs, Volume= 1.176 af
Routed to Link SP2 : STUDY POINT #2

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 865.14' @ 12.31 hrs Surf.Area= 5,568 sf Storage= 10,362 cf
Flood Elev= 866.00' Surf.Area= 5,568 sf Storage= 14,541 cf

Plug-Flow detention time= 31.4 min calculated for 1.176 af (100% of inflow)
Center-of-Mass det. time= 30.4 min (844.5 - 814.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	863.00'	0 cf	**232.00'W x 24.00'L x 3.67'H Field A** 20,416 cf Overall - 20,416 cf Embedded = 0 cf x 40.0% Voids
#2A	863.00'	14,541 cf	**retain_it retain_it 3.0'** x 87 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 29 Rows adjusted for 302.1 cf perimeter wall
		14,541 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	860.45'	**12.0" Round Culvert** L= 45.0' Ke= 0.500 Inlet / Outlet Invert= 860.45' / 858.44' S= 0.0447 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	863.00'	**24.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.74 cfs @ 12.31 hrs HW=865.13' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 7.74 cfs @ 9.85 fps)
  └─**2=Orifice/Grate** (Passes 7.74 cfs of 16.11 cfs potential flow)

Summary for Pond DW-1: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 1.697 ac, 56.32% Impervious, Inflow Depth = 7.27" for 100-year event
Inflow = 13.33 cfs @ 12.09 hrs, Volume= 1.029 af
Outflow = 12.83 cfs @ 12.11 hrs, Volume= 1.010 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 8.90 hrs, Volume= 0.076 af
Primary = 12.79 cfs @ 12.11 hrs, Volume= 0.934 af
Routed to Pond dmh05 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 8.90 hrs Surf.Area= 958 sf Storage= 1,963 cf

Plug-Flow detention time= 52.7 min calculated for 1.008 af (98% of inflow)
Center-of-Mass det. time= 42.1 min (821.5 - 779.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	68 cf	**7.67'W x 12.50'L x 3.50'H Field A** 335 cf Overall - 166 cf Embedded = 169 cf x 40.0% Voids
#2A	0.67'	129 cf	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		196 cf	x 10.00 = 1,963 cf Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 8.90 hrs HW=3.50' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=873.64' (Dynamic Tailwater)
└**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-10: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 3.168 ac, 17.98% Impervious, Inflow Depth = 5.70" for 100-year event
Inflow = 16.51 cfs @ 12.18 hrs, Volume= 1.504 af
Outflow = 16.28 cfs @ 12.21 hrs, Volume= 1.482 af, Atten= 1%, Lag= 1.6 min
Discarded = 0.04 cfs @ 10.30 hrs, Volume= 0.083 af
Primary = 0.19 cfs @ 10.30 hrs, Volume= 0.217 af
Routed to Link SP1 : STUDY POINT #1
Secondary = 16.06 cfs @ 12.21 hrs, Volume= 1.182 af
Routed to Link SP1 : STUDY POINT #1

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Primary area = Inflow area x 0.142
Peak Elev= 3.50' @ 10.30 hrs Surf.Area= 0.026 ac Storage= 0.054 af

Plug-Flow detention time= 40.2 min calculated for 1.482 af (99% of inflow)
Center-of-Mass det. time= 31.2 min (848.7 - 817.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 12.00 = 0.054 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Secondary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	3.00'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 3.00' / 3.00' S= 0.0000 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.04 cfs @ 10.30 hrs HW=3.50' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.19 cfs @ 10.30 hrs HW=3.50' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Barrel Controls 0.19 cfs @ 2.14 fps)

Secondary OutFlow Max=0.00 cfs @ 12.21 hrs HW=3.50' TW=0.00' (Dynamic Tailwater)

Summary for Pond DW-11: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 2.577 ac, 15.70% Impervious, Inflow Depth = 5.82" for 100-year event
Inflow = 17.04 cfs @ 12.09 hrs, Volume= 1.249 af
Outflow = 16.37 cfs @ 12.11 hrs, Volume= 1.234 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 9.75 hrs, Volume= 0.056 af
Primary = 16.34 cfs @ 12.11 hrs, Volume= 1.177 af
Routed to Pond DS-2b : detention

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 9.75 hrs Surf.Area= 0.018 ac Storage= 0.036 af

Plug-Flow detention time= 32.5 min calculated for 1.232 af (99% of inflow)
Center-of-Mass det. time= 26.0 min (834.5 - 808.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 8.00 = 0.036 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 9.75 hrs HW=3.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=864.55' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-12: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 2.217 ac, 8.54% Impervious, Inflow Depth = 5.70" for 100-year event
Inflow = 14.39 cfs @ 12.09 hrs, Volume= 1.052 af
Outflow = 13.82 cfs @ 12.11 hrs, Volume= 1.037 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 10.10 hrs, Volume= 0.056 af
Primary = 13.79 cfs @ 12.11 hrs, Volume= 0.981 af
Routed to Reach R-02 : Routing through wetland/swale

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 10.10 hrs Surf.Area= 0.018 ac Storage= 0.036 af

Plug-Flow detention time= 37.9 min calculated for 1.035 af (98% of inflow)
Center-of-Mass det. time= 30.0 min (840.7 - 810.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A**
			0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1
			Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf
			Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 8.00 = 0.036 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500
			Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900
			n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 10.10 hrs HW=3.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=878.54' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-2: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 0.715 ac, 12.28% Impervious, Inflow Depth = 5.70" for 100-year event
Inflow = 4.64 cfs @ 12.09 hrs, Volume= 0.340 af
Outflow = 4.46 cfs @ 12.11 hrs, Volume= 0.336 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.01 cfs @ 9.75 hrs, Volume= 0.014 af
Primary = 4.45 cfs @ 12.11 hrs, Volume= 0.322 af
Routed to Reach SW-1 : swale

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 9.75 hrs Surf.Area= 0.004 ac Storage= 0.009 af

Plug-Flow detention time= 29.9 min calculated for 0.335 af (99% of inflow)
Center-of-Mass det. time= 23.9 min (834.6 - 810.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A**
			0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1
			Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf
			Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 2.00 = 0.009 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500
			Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900
			n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.01 cfs @ 9.75 hrs HW=3.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=884.31' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-3: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 1.714 ac, 72.83% Impervious, Inflow Depth = 7.64" for 100-year event
Inflow = 13.83 cfs @ 12.09 hrs, Volume= 1.091 af
Outflow = 13.32 cfs @ 12.11 hrs, Volume= 1.073 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 8.00 hrs, Volume= 0.071 af
Primary = 13.29 cfs @ 12.11 hrs, Volume= 1.003 af
Routed to Pond dmh55 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 8.00 hrs Surf.Area= 0.020 ac Storage= 0.041 af

Plug-Flow detention time= 47.1 min calculated for 1.072 af (98% of inflow)
Center-of-Mass det. time= 38.0 min (808.2 - 770.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 9.00 = 0.041 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 8.00 hrs HW=3.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=906.22' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-4: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 1.519 ac, 66.06% Impervious, Inflow Depth = 7.52" for 100-year event
Inflow = 12.15 cfs @ 12.09 hrs, Volume= 0.951 af
Outflow = 11.70 cfs @ 12.11 hrs, Volume= 0.930 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.04 cfs @ 8.95 hrs, Volume= 0.084 af
Primary = 11.67 cfs @ 12.11 hrs, Volume= 0.846 af
Routed to Pond dmh53 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 8.95 hrs Surf.Area= 0.024 ac Storage= 0.050 af

Plug-Flow detention time= 64.0 min calculated for 0.930 af (98% of inflow)
Center-of-Mass det. time= 50.2 min (823.6 - 773.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A**
			0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1
			Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf
			Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 11.00 = 0.050 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500
			Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900
			n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.04 cfs @ 8.95 hrs HW=3.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=919.38' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-5: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 1.509 ac, 42.50% Impervious, Inflow Depth = 6.79" for 100-year event
Inflow = 11.31 cfs @ 12.09 hrs, Volume= 0.853 af
Outflow = 10.88 cfs @ 12.11 hrs, Volume= 0.838 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 9.40 hrs, Volume= 0.059 af
Primary = 10.85 cfs @ 12.11 hrs, Volume= 0.779 af
Routed to Pond dmh20 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 9.40 hrs Surf.Area= 0.018 ac Storage= 0.036 af

Plug-Flow detention time= 49.2 min calculated for 0.837 af (98% of inflow)
Center-of-Mass det. time= 39.1 min (829.2 - 790.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A**
			0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1
			Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf
			Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 8.00 = 0.036 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500
			Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900
			n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 9.40 hrs HW=3.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=910.87' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-6: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 1.339 ac, 68.60% Impervious, Inflow Depth = 7.52" for 100-year event
Inflow = 10.71 cfs @ 12.09 hrs, Volume= 0.839 af
Outflow = 10.31 cfs @ 12.11 hrs, Volume= 0.823 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 8.55 hrs, Volume= 0.062 af
Primary = 10.29 cfs @ 12.11 hrs, Volume= 0.761 af
Routed to Pond dmh50 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 8.55 hrs Surf.Area= 0.018 ac Storage= 0.036 af

Plug-Flow detention time= 54.0 min calculated for 0.823 af (98% of inflow)
Center-of-Mass det. time= 42.5 min (815.9 - 773.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 8.00 = 0.036 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 8.55 hrs HW=3.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=931.18' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-7: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 2.368 ac, 52.75% Impervious, Inflow Depth = 7.15" for 100-year event
Inflow = 18.39 cfs @ 12.09 hrs, Volume= 1.411 af
Outflow = 17.70 cfs @ 12.11 hrs, Volume= 1.392 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.03 cfs @ 8.45 hrs, Volume= 0.076 af
Primary = 17.67 cfs @ 12.11 hrs, Volume= 1.316 af
Routed to Pond dmh21 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 8.45 hrs Surf.Area= 0.022 ac Storage= 0.045 af

Plug-Flow detention time= 39.3 min calculated for 1.390 af (99% of inflow)
Center-of-Mass det. time= 31.6 min (813.9 - 782.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 10.00 = 0.045 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.03 cfs @ 8.45 hrs HW=3.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=905.38' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-8: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 0.555 ac, 66.39% Impervious, Inflow Depth = 7.52" for 100-year event
Inflow = 4.44 cfs @ 12.09 hrs, Volume= 0.348 af
Outflow = 4.28 cfs @ 12.11 hrs, Volume= 0.344 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.01 cfs @ 7.45 hrs, Volume= 0.016 af
Primary = 4.27 cfs @ 12.11 hrs, Volume= 0.328 af
Routed to Pond dmh25 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 7.45 hrs Surf.Area= 0.004 ac Storage= 0.009 af

Plug-Flow detention time= 34.6 min calculated for 0.344 af (99% of inflow)
Center-of-Mass det. time= 27.5 min (800.9 - 773.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 2.00 = 0.009 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.01 cfs @ 7.45 hrs HW=3.50' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=924.32' (Dynamic Tailwater)
↑—**2=Culvert** (Controls 0.00 cfs)

Summary for Pond DW-9: House Drywell

System sized based on standard 1,000g drywell at each dwelling unit.
Storage multiplyer added to account for number of dwelling units with subcatchment.
Area multiplyer adjusted to the account for the percentage of roof area within subcatchment.

Inflow Area = 1.045 ac, 52.81% Impervious, Inflow Depth = 7.15" for 100-year event
Inflow = 8.12 cfs @ 12.09 hrs, Volume= 0.623 af
Outflow = 7.82 cfs @ 12.11 hrs, Volume= 0.611 af, Atten= 4%, Lag= 1.4 min
Discarded = 0.02 cfs @ 9.05 hrs, Volume= 0.045 af
Primary = 7.80 cfs @ 12.11 hrs, Volume= 0.566 af
Routed to Pond dmh23 : dmh

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 3.50' @ 9.05 hrs Surf.Area= 0.013 ac Storage= 0.027 af

Plug-Flow detention time= 51.8 min calculated for 0.611 af (98% of inflow)
Center-of-Mass det. time= 41.3 min (823.5 - 782.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	0.00'	0.002 af	**7.67'W x 12.50'L x 3.50'H Field A** 0.008 af Overall - 0.004 af Embedded = 0.004 af x 40.0% Voids
#2A	0.67'	0.003 af	**Shea Dry Well 1000gal** Inside #1 Inside= 62.0"W x 30.0"H => 12.86 sf x 10.00'L = 128.6 cf Outside= 68.0"W x 34.0"H => 15.80 sf x 10.50'L = 165.9 cf
		0.005 af	x 6.00 = 0.027 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Primary	3.50'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	0.00'	**0.600 in/hr Exfiltration over Wetted area**
#2	Primary	2.50'	**4.0" Round Culvert** L= 10.0' Ke= 0.500 Inlet / Outlet Invert= 2.50' / 2.40' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.09 sf

Discarded OutFlow Max=0.02 cfs @ 9.05 hrs HW=3.50' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 12.11 hrs HW=3.50' TW=901.26' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond G1: gabion

Inflow Area = 5.477 ac, 51.32% Impervious, Inflow Depth > 6.54" for 100-year event
Inflow = 21.69 cfs @ 12.28 hrs, Volume= 2.986 af
Outflow = 21.96 cfs @ 12.29 hrs, Volume= 2.985 af, Atten= 0%, Lag= 0.1 min
Primary = 21.96 cfs @ 12.29 hrs, Volume= 2.985 af
Routed to Reach R-02 : Routing through wetland/swale

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 879.43' @ 12.29 hrs Surf.Area= 2 sf Storage= 443 cf
Flood Elev= 880.00' Surf.Area= 2 sf Storage= 444 cf

Plug-Flow detention time= 1.8 min calculated for 2.985 af (100% of inflow)
Center-of-Mass det. time= 1.4 min (897.5 - 896.1)

Volume	Invert	Avail.Storage	Storage Description
#1	877.50'	442 cf	**18.0" Round Pipe Storage** L= 250.0'
#2	879.00'	2 cf	**1.50'D x 1.00'H Vertical Cone/Cylinder**
		444 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	877.50'	**2.0" Horiz. invert orifices X 125.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	878.25'	**2.0" Vert. spring line orifices X 125.00** C= 0.600 Limited to weir flow at low heads
#3	Primary	880.00'	**18.0" Horiz. overflow grates X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=19.57 cfs @ 12.29 hrs HW=879.37' TW=878.81' (Dynamic Tailwater)
├─**1=invert orifices** (Orifice Controls 9.78 cfs @ 3.59 fps)
├─**2=spring line orifices** (Orifice Controls 9.78 cfs @ 3.59 fps)
└─**3=overflow grates** (Controls 0.00 cfs)

Summary for Pond G2: gabion

Inflow Area = 9.959 ac, 34.20% Impervious, Inflow Depth > 5.67" for 100-year event
Inflow = 15.12 cfs @ 12.48 hrs, Volume= 4.704 af
Outflow = 15.13 cfs @ 12.49 hrs, Volume= 4.704 af, Atten= 0%, Lag= 0.5 min
Primary = 15.13 cfs @ 12.49 hrs, Volume= 4.704 af
Routed to Link SP3 : STUDY POINT #3

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 811.58' @ 12.49 hrs Surf.Area= 85 sf Storage= 129 cf
Flood Elev= 811.80' Storage= 141 cf

Plug-Flow detention time= 0.1 min calculated for 4.704 af (100% of inflow)
Center-of-Mass det. time= 0.1 min (888.3 - 888.2)

Volume	Invert	Avail.Storage	Storage Description
#1	810.30'	141 cf	**18.0" Round Pipe Storage** L= 80.0'

Device	Routing	Invert	Outlet Devices
#1	Primary	810.30'	**2.0" Horiz. invert orifices X 80.00** C= 0.600 Limited to weir flow at low heads
#2	Primary	811.05'	**2.0" Vert. spring line orifices X 80.00** C= 0.600 Limited to weir flow at low heads
#3	Primary	811.80'	**18.0" Horiz. overflow grates X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=15.12 cfs @ 12.49 hrs HW=811.58' TW=0.00' (Dynamic Tailwater)
├─**1=invert orifices** (Orifice Controls 9.51 cfs @ 5.45 fps)
├─**2=spring line orifices** (Orifice Controls 5.61 cfs @ 3.22 fps)
└─**3=overflow grates** (Controls 0.00 cfs)

Summary for Link SP1: STUDY POINT #1

Inflow Area = 6.871 ac, 29.41% Impervious, Inflow Depth = 5.80" for 100-year event
Inflow = 26.84 cfs @ 12.22 hrs, Volume= 3.322 af
Primary = 26.84 cfs @ 12.22 hrs, Volume= 3.322 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP2: STUDY POINT #2

Inflow Area = 10.270 ac, 33.15% Impervious, Inflow Depth > 6.00" for 100-year event
Inflow = 23.37 cfs @ 12.48 hrs, Volume= 5.138 af
Primary = 23.37 cfs @ 12.48 hrs, Volume= 5.138 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP3: STUDY POINT #3

Inflow Area = 11.281 ac, 30.19% Impervious, Inflow Depth > 5.88" for 100-year event
Inflow = 26.15 cfs @ 12.47 hrs, Volume= 5.532 af
Primary = 26.15 cfs @ 12.47 hrs, Volume= 5.532 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP4: STUDY POINT #4

Inflow Area = 0.605 ac, 10.67% Impervious, Inflow Depth = 5.70" for 100-year event
Inflow = 3.93 cfs @ 12.09 hrs, Volume= 0.287 af
Primary = 3.93 cfs @ 12.09 hrs, Volume= 0.287 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Summary for Link SP5: STUDY POINT #5

Inflow Area = 0.158 ac, 0.00% Impervious, Inflow Depth = 5.45" for 100-year event
Inflow = 0.98 cfs @ 12.09 hrs, Volume= 0.072 af
Primary = 0.98 cfs @ 12.09 hrs, Volume= 0.072 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs

Proposed Watershed Plan

R:\PROJECTS\2889-01\CIVIL\DRAWINGS\CURRENT\C-2889-01_WATERSHED-PROPOSED_REV1.DWG

REV	DATE	DESCRIPTION

APPLICANT:

MKEP 770 LLC
265 SUNRISE HIGHWAY, SUITE 1368
ROCKVILLE CENTER, NY 11570

PROJECT:

SKYVIEW ESTATES RESIDENTIAL DEVELOPMENT
MAIN STREET
LEICESTER, MA

PROJECT NO.	2889-01	DATE:	09-06-23-21
SCALE:	1" = 80'	DWG.:	C-2889-01_Watershed-Proposed_rev1
DESIGNED BY:	SM	CHECKED BY:	MAM

PREPARED BY:

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DRAWING TITLE:	SHEET No.
PROPOSED WATERSHED PLAN	WS-2

SECTION 6.0 - APPENDIX

Rainfall Data

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	Massachusetts
Location	
Longitude	71.892 degrees West
Latitude	42.243 degrees North
Elevation	0 feet
Date/Time	Tue, 22 Jun 2021 15:07:34 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.27	0.42	0.52	0.69	0.86	1.08	**1yr**	0.74	1.06	1.26	1.60	2.05	2.63	2.89	**1yr**	2.33	2.78	3.18	3.86	4.48	**1yr**
2yr	0.35	0.53	0.66	0.87	1.10	1.39	**2yr**	0.95	1.26	1.61	2.03	2.55	3.23	3.49	**2yr**	2.86	3.35	3.86	4.57	5.20	**2yr**
5yr	0.41	0.63	0.80	1.06	1.36	1.74	**5yr**	1.18	1.57	2.02	2.56	3.22	4.07	4.44	**5yr**	3.60	4.27	4.89	5.72	6.44	**5yr**
10yr	0.46	0.72	0.91	1.23	1.60	2.06	**10yr**	1.38	1.85	2.41	3.06	3.85	4.85	5.34	**10yr**	4.29	5.13	5.85	6.79	7.57	**10yr**
25yr	0.54	0.85	1.09	1.50	1.98	2.58	**25yr**	1.71	2.29	3.03	3.85	4.87	6.12	6.81	**25yr**	5.42	6.55	7.42	8.52	9.38	**25yr**
50yr	0.60	0.96	1.23	1.73	2.34	3.07	**50yr**	2.02	2.70	3.62	4.62	5.83	7.30	8.20	**50yr**	6.46	7.89	8.89	10.12	11.03	**50yr**
100yr	0.69	1.11	1.43	2.02	2.75	3.64	**100yr**	2.38	3.18	4.30	5.51	6.96	8.72	9.89	**100yr**	7.72	9.51	10.66	12.02	12.98	**100yr**
200yr	0.77	1.26	1.64	2.35	3.25	4.33	**200yr**	2.80	3.75	5.13	6.58	8.32	10.42	11.93	**200yr**	9.23	11.47	12.77	14.29	15.28	**200yr**
500yr	0.92	1.52	1.98	2.88	4.04	5.44	**500yr**	3.49	4.66	6.47	8.32	10.54	13.20	15.31	**500yr**	11.69	14.72	16.24	17.97	18.96	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.21	0.32	0.39	0.52	0.64	0.97	**1yr**	0.55	0.95	1.11	1.47	1.90	2.35	2.50	**1yr**	2.08	2.40	2.63	3.26	4.07	**1yr**
2yr	0.34	0.52	0.64	0.87	1.07	1.25	**2yr**	0.93	1.23	1.43	1.89	2.43	3.13	3.38	**2yr**	2.77	3.25	3.74	4.42	5.02	**2yr**
5yr	0.38	0.59	0.73	1.01	1.28	1.49	**5yr**	1.10	1.46	1.71	2.23	2.85	3.79	4.11	**5yr**	3.35	3.95	4.52	5.26	5.90	**5yr**
10yr	0.42	0.65	0.81	1.13	1.46	1.70	**10yr**	1.26	1.67	1.93	2.53	3.21	4.37	4.75	**10yr**	3.87	4.57	5.21	5.99	6.63	**10yr**
25yr	0.49	0.75	0.93	1.33	1.75	2.03	**25yr**	1.51	1.99	2.29	3.00	3.78	5.30	5.93	**25yr**	4.69	5.71	6.30	7.22	7.81	**25yr**
50yr	0.55	0.83	1.04	1.49	2.01	2.32	**50yr**	1.73	2.27	2.61	3.40	4.27	6.16	6.95	**50yr**	5.45	6.68	7.27	8.28	8.82	**50yr**
100yr	0.62	0.93	1.17	1.68	2.31	2.65	**100yr**	1.99	2.59	2.98	3.87	4.83	7.14	8.18	**100yr**	6.32	7.87	8.41	9.51	9.94	**100yr**
200yr	0.69	1.04	1.32	1.91	2.66	3.03	**200yr**	2.30	2.96	3.39	4.42	5.48	8.31	9.69	**200yr**	7.35	9.32	9.73	10.91	11.21	**200yr**
500yr	0.82	1.22	1.56	2.27	3.23	3.63	**500yr**	2.79	3.55	4.04	5.28	6.49	10.15	12.12	**500yr**	8.98	11.65	12.49	13.16	13.12	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.47	0.58	0.78	0.96	1.18	**1yr**	0.83	1.15	1.37	1.75	2.31	2.87	3.16	**1yr**	2.54	3.04	3.47	4.16	4.84	**1yr**
2yr	0.36	0.55	0.68	0.92	1.14	1.33	**2yr**	0.98	1.30	1.53	2.00	2.57	3.34	3.62	**2yr**	2.96	3.49	4.00	4.75	5.44	**2yr**
5yr	0.43	0.67	0.83	1.14	1.44	1.73	**5yr**	1.25	1.69	1.99	2.55	3.22	4.38	4.82	**5yr**	3.88	4.64	5.29	6.23	7.05	**5yr**
10yr	0.50	0.77	0.96	1.34	1.73	2.10	**10yr**	1.49	2.05	2.42	3.07	3.83	5.39	5.96	**10yr**	4.77	5.73	6.52	7.65	8.59	**10yr**
25yr	0.62	0.94	1.17	1.68	2.21	2.73	**25yr**	1.90	2.66	3.14	3.90	4.82	7.07	7.87	**25yr**	6.26	7.57	8.63	9.92	11.06	**25yr**
50yr	0.72	1.10	1.37	1.97	2.65	3.32	**50yr**	2.29	3.24	3.83	4.69	5.73	8.70	9.73	**50yr**	7.70	9.36	10.66	12.16	13.48	**50yr**
100yr	0.85	1.29	1.61	2.33	3.19	4.04	**100yr**	2.75	3.95	4.67	5.64	6.82	10.68	12.04	**100yr**	9.45	11.58	13.17	14.89	16.44	**100yr**
200yr	1.00	1.50	1.90	2.75	3.84	4.92	**200yr**	3.32	4.81	5.70	6.77	8.11	13.14	14.90	**200yr**	11.63	14.33	16.27	18.23	20.04	**200yr**
500yr	1.25	1.85	2.38	3.46	4.93	6.39	**500yr**	4.25	6.25	7.42	8.63	10.19	17.25	19.70	**500yr**	15.26	18.95	20.84	23.81	26.04	**500yr**

Manning's Number Tables

Manning's Roughness Coefficients ("n")

Conduit	Manning's Coefficients
Closed Conduits	
Asbestos-Cement Pipe	0.011 to 0.015
Brick	0.013 to 0.017
Cast Iron Pipe	
Cement-lined and seal-coated	0.011 to 0.015
Concrete (Monolithic)	
Smooth forms	0.012 to 0.014
Rough forms	0.015 to 0.017
Concrete Pipe	0.011 to 0.015
Corrugated-Metal Pipe (1/2 - STUL 34470 2 1/2-inch corrgtn.)	
Plain	0.022 to 0.026
Paved invert	0.018 to 0.022
Spun asphalt-lined	0.011 to 0.015
Plastic Pipe (Smooth)	0.011 to 0.015
Vitrified Clay	
Pipes	0.011 to 0.015
Liner channels	0.013 to 0.017
Open Channels	
Lined Channels	
Asphalt	0.013 to 0.017
Brick	0.012 to 0.018
Concrete	0.011 to 0.020
Rubble or riprap	0.020 to 0.035
Vegetal	0.030 to 0.040
Excavated or Dredged	
Earth, straight and uniform	0.020 to 0.030
Earth, winding, fairly uniform	0.025 to 0.040
Rock	0.030 to 0.045
Unmaintained	0.050 to 0.140
Natural Channels (minor streams, top width at flood state < 100 feet)	
Fairly regular section	0.030 to 0.070
Irregular section with pools	0.040 to 0.100

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers and the Water Pollution Control Federation, 1969.

Soils Map

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 Worcester County, Massachusetts, Southern Part

June 21, 2021

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

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

Soil Map


71° 54' 1" W
71° 53' 5" W
42° 14' 47" N
42° 14' 20" N
260800
260900
261000
261100
261200
261300
261400
261500
261600
261700
261800
261900
260700
4681200
4681100
4681000
4680900
4680800
4680700
4680600
4680500
4680400
Main
Main St
Henshaw St
Michael Ave
9
70B
305D
305B
305C
651
420B
312B
73A
407C
71B
Soil Map may not be valid at this scale.
Map Scale: 1:5,880 if printed on A landscape (11" x 8.5") sheet.
Meters
0
50
100
200
300
Feet
0
250
500
1000
1500
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: Apr 8, 2011—Jul 9, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	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
70B	Ridgebury fine sandy loam, 3 to 8 percent slopes	14.9	15.2%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	0.5	0.5%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	0.6	0.6%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	10.6	10.8%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	16.6	16.9%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	30.1	30.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	8.6	8.7%
407C	Charlton fine sandy loam, 8 to 15 percent slopes, extremely stony	2.9	3.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	12.9	13.2%
651	Udorthents, smoothed	0.2	0.2%
Totals for Area of Interest		**97.9**	**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.

Worcester County, Massachusetts, Southern Part

70B—Ridgebury fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2xffw
Elevation: 0 to 1,030 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ridgebury

Setting

Landform: Ground moraines, depressions, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

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

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge

Percent of map unit: 8 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Scituate

Percent of map unit: 4 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Summit, footslope, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Whitman

Percent of map unit: 3 percent
Landform: Depressions, drainageways, hills, ground moraines, drumlins
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

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

Map Unit Setting

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

Map Unit Composition

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

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, drumlins, drainageways, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope

Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

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

Properties and qualities

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

Interpretive groups

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

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

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

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex

Across-slope shape: Convex, linear
Hydric soil rating: No

73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w695
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Whitman, extremely stony, and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitman, Extremely Stony

Setting

Landform: Depressions, drainageways, hills, ground moraines, drumlins
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 1 inches: peat
A - 1 to 10 inches: fine sandy loam
Bg - 10 to 17 inches: gravelly fine sandy loam
Cdg - 17 to 61 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 7 to 38 inches to densic material
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY041MA - Very Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Ridgebury, extremely stony

Percent of map unit: 10 percent
Landform: Drainageways, hills, ground moraines, depressions, drumlins
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, depressions, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea

Percent of map unit: 3 percent
Landform: Swamps, bogs, marshes
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony

Percent of map unit: 1 percent
Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Paxton

Setting

Landform: Ground moraines, hills, drumlins
Landform position (two-dimensional): Backslope, summit, shoulder
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge

Percent of map unit: 9 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 6 percent
Landform: Drainageways, hills, ground moraines, depressions

Landform position (two-dimensional): Backslope, footslope, toeslope
Landform position (three-dimensional): Head slope, base slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton

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

305C—Paxton fine sandy loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2w66y
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Paxton

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium

Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 7 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 2 percent
Landform: Depressions, drainageways, drumlins, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

305D—Paxton fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2w67j
Elevation: 0 to 1,450 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F

Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Paxton

Setting

Landform: Hills, ground moraines, drumlins
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Woodbridge

Percent of map unit: 6 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury

Percent of map unit: 1 percent
Landform: Drumlins, drainageways, hills, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Hydric soil rating: Yes

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

Map Unit Setting

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

Map Unit Composition

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

Description of Woodbridge, Extremely Stony

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

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

Cd - 32 to 67 inches: gravelly fine sandy loam

Properties and qualities

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

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 8 percent
Landform: Ground moraines, depressions, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

407C—Charlton fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 9bd8
Elevation: 280 to 920 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F

Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Charlton and similar soils: 75 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Charlton

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over friable coarse-loamy basal till derived from granite and gneiss

Typical profile

H1 - 0 to 8 inches: fine sandy loam
H2 - 8 to 34 inches: fine sandy loam
H3 - 34 to 65 inches: sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 10 percent
Hydric soil rating: No

Canton

Percent of map unit: 10 percent
Hydric soil rating: No

Woodbridge

Percent of map unit: 5 percent
Hydric soil rating: No

420B—Canton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2w81b
Elevation: 0 to 1,180 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Canton

Setting

Landform: Moraines, hills, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, nose slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Coarse-loamy over sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: gravelly fine sandy loam
2C - 26 to 65 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 19 to 39 inches to strongly contrasting textural stratification
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands

Hydric soil rating: No

Minor Components

Scituate

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Montauk

Percent of map unit: 5 percent
Landform: Drumlins, hills, ground moraines, moraines
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Charlton

Percent of map unit: 4 percent
Landform: Hills, ground moraines, ridges
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Swansea

Percent of map unit: 1 percent
Landform: Marshes, kettles, swamps, bogs, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

651—Udorthents, smoothed

Map Unit Setting

National map unit symbol: 9bfc
Elevation: 0 to 3,000 feet
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 80 percent
Urban land: 20 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Setting

Parent material: Made land over firm coarse-loamy basal till and/or dense coarse-loamy lodgment till

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

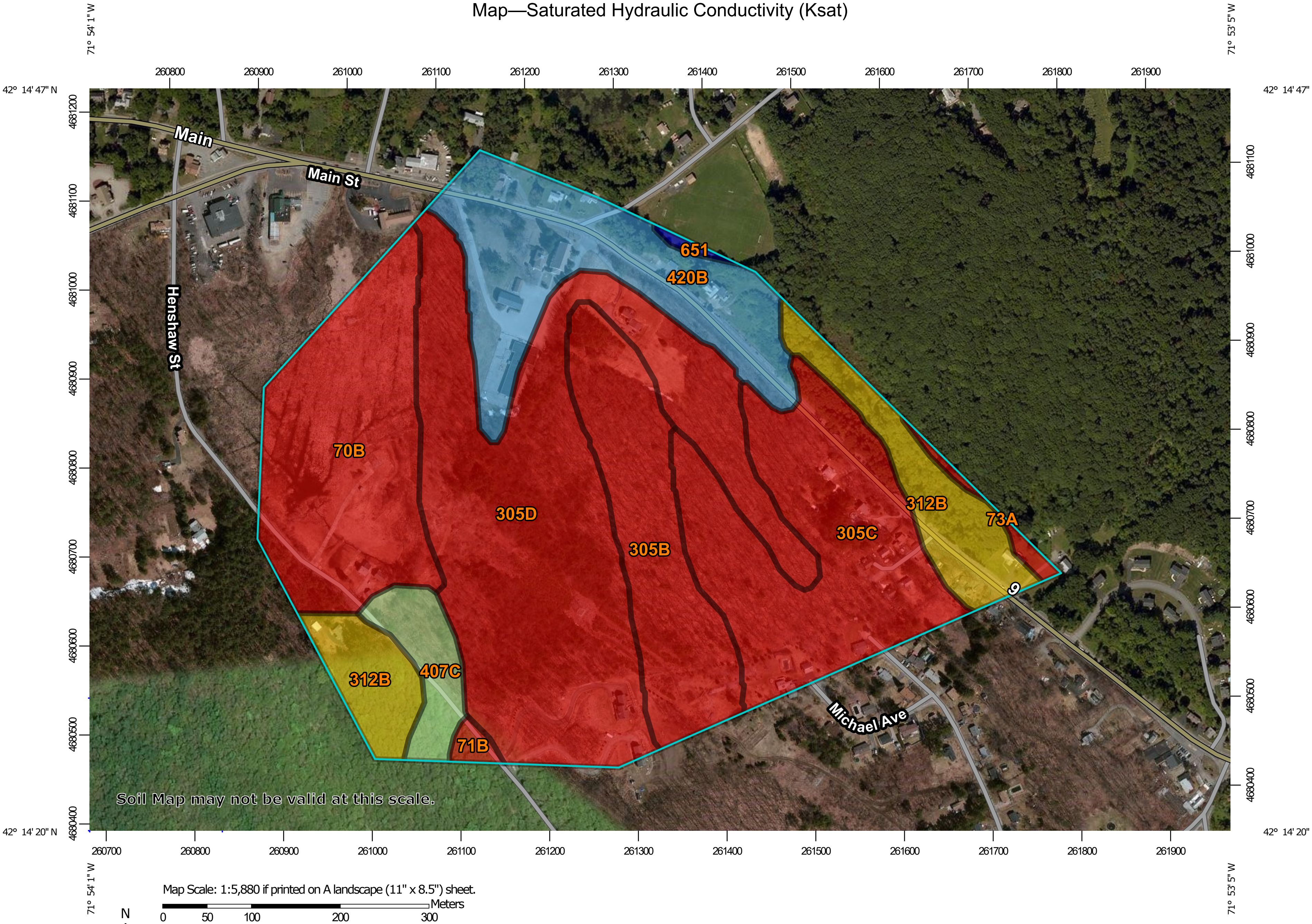
Saturated Hydraulic Conductivity (Ksat)

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.

Map—Saturated Hydraulic Conductivity (Ksat)



Map Scale: 1:5,880 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

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 Rating Polygons

<= 4.5628

> 4.5628 and <= 7.4641

> 7.4641 and <= 23.2900

> 23.2900 and <= 46.0000

> 46.0000 and <= 70.7800

Not rated or not available

Soil Rating Lines

<= 4.5628

> 4.5628 and <= 7.4641

> 7.4641 and <= 23.2900

> 23.2900 and <= 46.0000

> 46.0000 and <= 70.7800

Not rated or not available

Soil Rating Points

<= 4.5628

> 4.5628 and <= 7.4641

> 7.4641 and <= 23.2900

> 23.2900 and <= 46.0000

> 46.0000 and <= 70.7800

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 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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: Apr 8, 2011—Jul 9, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Saturated Hydraulic Conductivity (Ksat)

Map unit symbol	Map unit name	Rating (micrometers per second)	Acres in AOI	Percent of AOI
70B	Ridgebury fine sandy loam, 3 to 8 percent slopes	4.5628	14.9	15.2%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	4.5628	0.5	0.5%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	4.5559	0.6	0.6%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	4.0600	10.6	10.8%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	4.0600	16.6	16.9%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	4.0600	30.1	30.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	7.4641	8.6	8.7%
407C	Charlton fine sandy loam, 8 to 15 percent slopes, extremely stony	23.2900	2.9	3.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	46.0000	12.9	13.2%
651	Udorthents, smoothed	70.7800	0.2	0.2%
Totals for Area of Interest			**97.9**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

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): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 100

Units of Measure: Inches

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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.

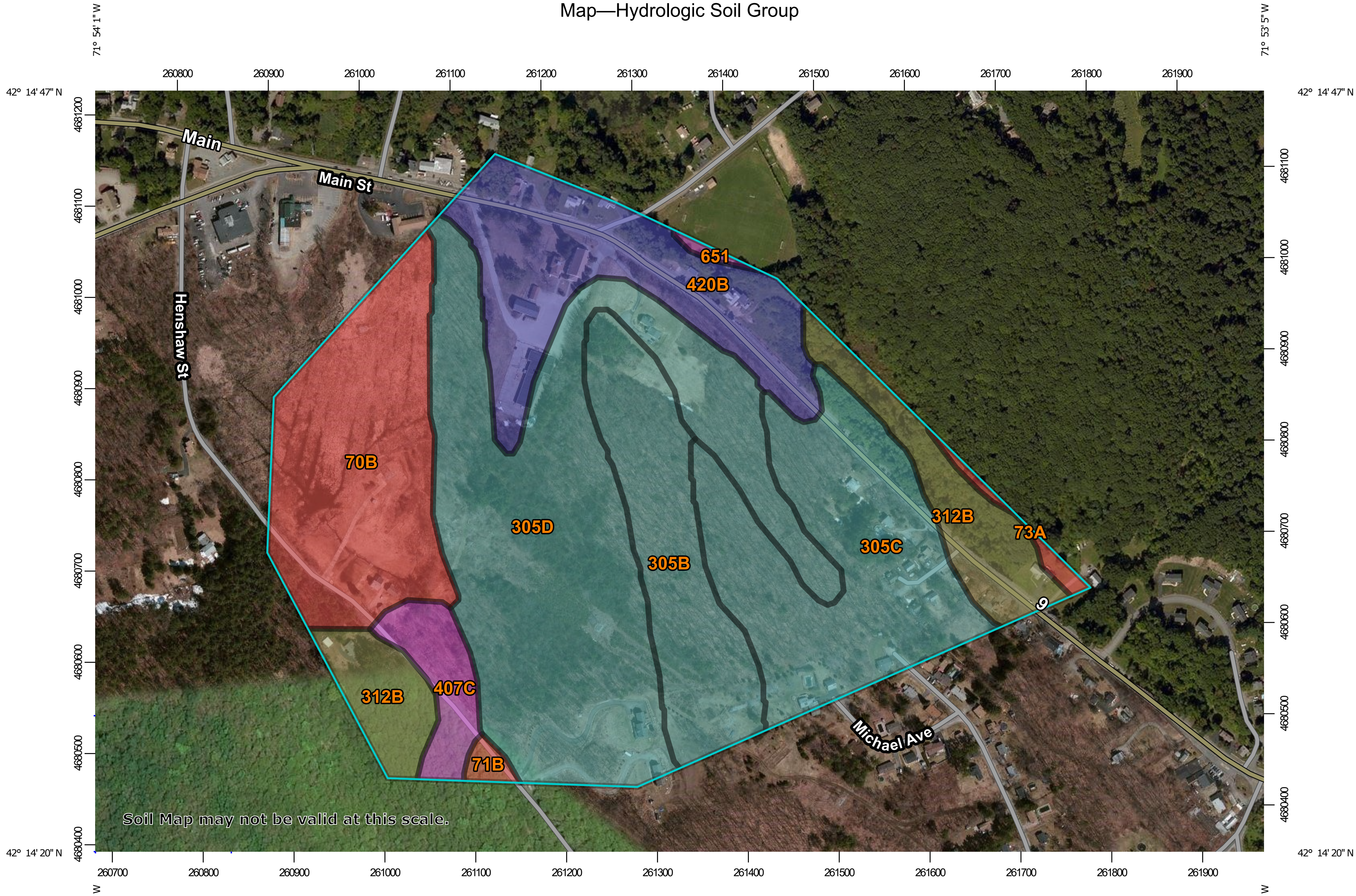
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Map—Hydrologic Soil Group



Map Scale: 1:5,880 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 50, 100, 200, 300

Feet: 0, 250, 500, 1000, 1500

N

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

MAP LEGEND

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

Soils

Soil 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 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: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 13, Jun 11, 2020

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

Date(s) aerial images were photographed: Apr 8, 2011—Jul 9, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND	MAP INFORMATION
	imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
70B	Ridgebury fine sandy loam, 3 to 8 percent slopes	D	14.9	15.2%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	D	0.5	0.5%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	D	0.6	0.6%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	10.6	10.8%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	16.6	16.9%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	C	30.1	30.7%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	C/D	8.6	8.7%
407C	Charlton fine sandy loam, 8 to 15 percent slopes, extremely stony	A	2.9	3.0%
420B	Canton fine sandy loam, 3 to 8 percent slopes	B	12.9	13.2%
651	Udorthents, smoothed	A	0.2	0.2%
Totals for Area of Interest			**97.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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Water Quality Flow Calculations

WQU Sizing

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION
LEICESTER, MA

Area	1.02 ac	Unit Site Designation	DMH-50
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	2015-4	CDS Treatment Capacity	1.4 cfs

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.04	15.1%	15.1%	0.04	0.04	14.5
0.08	24.6%	39.7%	0.07	0.07	23.0
0.12	13.7%	53.4%	0.11	0.11	12.6
0.16	9.4%	62.8%	0.15	0.15	8.5
0.20	6.6%	69.5%	0.18	0.18	5.9
0.24	5.2%	74.7%	0.22	0.22	4.5
0.28	4.8%	79.5%	0.26	0.26	4.0
0.32	3.1%	82.6%	0.29	0.29	2.6
0.36	2.7%	85.3%	0.33	0.33	2.2
0.40	2.1%	87.4%	0.37	0.37	1.7
0.48	2.5%	89.9%	0.44	0.44	1.9
0.56	2.0%	91.9%	0.51	0.51	1.5
0.64	1.4%	93.3%	0.59	0.59	1.0
0.72	1.0%	94.3%	0.66	0.66	0.7
0.80	1.1%	95.4%	0.73	0.73	0.7
1.00	1.6%	97.1%	0.92	0.92	0.9
1.20	0.9%	98.0%	1.10	1.10	0.4
1.40	0.6%	98.6%	1.28	1.28	0.2
1.60	0.5%	99.1%	1.46	1.40	0.1
1.80	0.5%	99.6%	1.65	1.40	0.1
0.00	0.0%	99.6%	0.00	0.00	0.0
					86.8

Removal Efficiency Adjustment[2] = 0.0%

Predicted % Annual Rainfall Treated = 99.5%

Predicted Net Annual Load Removal Efficiency = 86.8%

1 - Based on 14 years of 15-minute rainfall data from NCDC Station 2107, East Brimfield Lake, Worcester County, M

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Estimated Net Annual Solids Load Reduction
Based on the Rational Rainfall Method

CONTECH ENGINEERED SOLUTIONS

CASCADE separator™

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION

LEICESTER, MA

DMH-57

AREA	2.59	acres	**CASCADE MODEL**	CS-5	
WEIGHTED C	0.90		**PARTICLE SIZE**	110	microns
TC	6.00	minutes	**RAINFALL STATION**	70	

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Hydraulic Loading Rate (gpm/ft2)	Removal Efficiency (%)	Incremental Removal (%)
0.04	15.1%	2.13	100.0	15.1
0.08	24.6%	4.26	100.0	24.6
0.12	13.7%	6.39	100.0	13.7
0.16	9.4%	8.53	100.0	9.4
0.20	6.6%	10.66	100.0	6.6
0.24	5.2%	12.79	99.9	5.2
0.28	4.8%	14.92	97.9	4.7
0.32	3.1%	17.05	95.9	3.0
0.36	2.7%	19.18	93.9	2.5
0.40	2.1%	21.31	91.9	1.9
0.48	2.5%	25.58	87.9	2.2
0.56	2.0%	29.84	83.9	1.7
0.64	1.4%	34.10	79.8	1.1
0.72	1.0%	38.36	75.8	0.8
0.80	1.1%	42.63	71.8	0.8
1.00	1.6%	53.28	61.8	1.0
1.20	0.9%	63.94	51.8	0.5
1.40	0.6%	74.60	41.8	0.3
1.60	0.5%	80.01	34.4	0.2
1.80	0.5%	80.01	30.6	0.1
				95.5
			Removal Efficiency Adjustment[2] =	0.0%
			Predicted % Annual Rainfall Treated =	99.5%
			Predicted Net Annual Load Removal Efficiency =	**95.5%**

1 - Based on 14 years of 15-minute rainfall data from NCDC Station 2107, East Brimfield Lake, Worcester County, MA

2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Stormwater Pipe Sizing Calculation

DRAINAGE PIPE DESIGN ANALYSIS

ALLEN & MAJOR ASSOCIATES, INC.

A&M Job No.	2889-01
Date:	2/4/2022

Project Location:
Skyview Estates
Main Street
Leicester, MA

Prepared For:
MKEP 770 LLC
265 Sunrise Highway, Suite 1368
Rockville Center, NY 11570

Manning's Formula

$V=1.486/n*R^{2/3}*S^{1/2}$
Q = V*A
(25-Year storm)

Where: V is the velocity in Ft/sec.
n is Manning's coefficient of friction
R is the Hydraulic Radius
S is the slope of the pipe

Where: Area=Pi*(R/12)2
Wetted Perimeter=2*Pi*R/12

Start	Q_{design} (cfs)	n	Diameter (inches)	A (ft^2)	Wp (ft)	R (ft)	S (feet/foot)	Q_{full} (cfs)	$Q_{full} \geq Q_{design}$	V_{full} (ft/s)	Q_d/Q_f	Results Fig. 4-4A	V_{design} (ft/s)	2 ft/s ≤ V_{design} ≤ 10 ft/s
DMH-01	1.88	0.013	12	0.79	3.14	0.25	0.012	3.90	OK	4.97	0.48	0.98	4.87	OK
DMH-05	8.53	0.013	15	1.23	3.93	0.31	0.070	17.09	OK	13.93	0.50	0.99	13.79	WAIVER REQUESTED
DMH-20	7.02	0.013	18	1.77	4.71	0.38	0.008	9.10	OK	5.15	0.77	1.11	5.71	OK
DMH-21	18.72	0.013	24	3.14	6.28	0.50	0.009	21.93	OK	6.98	0.85	1.12	7.82	OK
DMH-23	23.97	0.013	30	4.91	7.85	0.63	0.013	46.77	OK	9.53	0.51	1.00	9.53	OK
DMH-25	3.00	0.013	12	0.79	3.14	0.25	0.070	9.43	OK	12.00	0.32	0.86	10.32	WAIVER REQUESTED
DMH-31	6.83	0.013	12	0.79	3.14	0.25	0.045	7.56	OK	9.62	0.90	1.13	10.87	WAIVER REQUESTED
DMH-50 (CDS)	7.40	0.013	15	1.23	3.93	0.31	0.080	18.27	OK	14.89	0.41	0.94	14.00	WAIVER REQUESTED
DMH-51	7.40	0.013	15	1.23	3.93	0.31	0.078	18.01	OK	14.67	0.41	0.94	13.79	WAIVER REQUESTED
DMH-52	7.40	0.013	15	1.23	3.93	0.31	0.080	18.27	OK	14.89	0.41	0.94	14.00	WAIVER REQUESTED
DMH-53	7.46	0.013	18	1.77	4.71	0.38	0.047	22.82	OK	12.91	0.33	0.87	11.24	WAIVER REQUESTED
DMH-55	16.39	0.013	24	3.14	6.28	0.50	0.046	48.26	OK	15.36	0.34	0.88	13.52	WAIVER REQUESTED
DMH-56	18.45	0.013	30	4.91	7.85	0.63	0.010	41.02	OK	8.36	0.45	0.95	7.94	OK
DMH-57 (CDS)	18.45	0.013	30	4.91	7.85	0.63	0.008	36.69	OK	7.47	0.50	0.99	7.40	OK
DMH-58	18.45	0.013	30	4.91	7.85	0.63	0.008	36.69	OK	7.47	0.50	0.99	7.40	OK
DMH-59	18.45	0.013	30	4.91	7.85	0.63	0.009	39.13	OK	7.97	0.47	0.97	7.73	OK
DMH-60	18.45	0.013	30	4.91	7.85	0.63	0.012	43.99	OK	8.96	0.42	0.94	8.42	OK
DMH-61	18.45	0.013	30	4.91	7.85	0.63	0.010	41.02	OK	8.36	0.45	0.95	7.94	OK
DMH-62	25.85	0.013	30	4.91	7.85	0.63	0.033	74.51	OK	15.18	0.35	0.89	13.51	WAIVER REQUESTED
DMH-69	25.85	0.013	30	4.91	7.85	0.63	0.034	75.63	OK	15.41	0.34	0.88	13.56	WAIVER REQUESTED
OCS-01	5.35	0.013	15	1.23	3.93	0.31	0.007	5.48	OK	4.47	0.98	1.15	5.14	OK
OCS-02	6.93	0.013	24	3.14	6.28	0.50	0.028	38.12	OK	12.14	0.18	0.73	8.86	OK
OCS-04	11.76	0.013	18	1.77	4.71	0.38	0.022	15.62	OK	8.84	0.75	1.10	9.72	OK
OCS-05	0.56	0.013	12	0.79	3.14	0.25	0.010	3.56	OK	4.54	0.16	0.69	3.13	OK

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2889-01	**Sheet**	1
Project Description	Skyview Estates		
	Leicester, MA		
Calculated By	SM	**Date**	09/28/21
Checked By	MAM		

These calculations provide the TSS removal rate of the stormwater management system for runoff directed to the open detention basin

Stormwater Management BMP	TSS Removal rate
Parking Lot Sweeping	5%
Hooded Catch Basins	25%
Proprietary Device (CDS Unit)	80%

Average Annual Load	=	100%	
Parking Lot Sweeping	=	5%	Removal Rate
		95%	TSS Load Remains

TSS Load Remaining	=	95%	
Hooded Catch Basins	=	25%	Removal Rate
		71.3%	TSS Load Remains

TSS Load Remaining	=	71.3%	
Proprietary Device (CDS Unit)	=	80%	Removal Rate
		14.3%	% TSS Load Remains

Percentage of TSS Remaining - Initial TSS Load = Final TSS Removal Rate

100% - 14.3% = 85.8%

For this drainage area, this system as designed will remove an estimated 86% of the annual TSS load and therefore will meet the TSS removal standard.

Project No.	2889-01	**Sheet**	2
Project Description	Skyview Estates		
	Leicester, MA		
Calculated By	SM	**Date**	09/28/21
Checked By	MAM		

These calculations provide the TSS removal rate of the stormwater management system for runoff directed to the retain-it detention systems

Stormwater Management BMP	TSS Removal rate
Parking Lot Sweeping	5%
Hooded Catch Basins	25%
Retain-It Advanced Sedimentation	80%

Average Annual Load	=	100%	
Parking Lot Sweeping	=	5%	Removal Rate
		95%	TSS Load Remains
TSS Load Remaining	=	95%	
Hooded Catch Basins	=	25%	Removal Rate
		71.3%	TSS Load Remains
TSS Load Remaining	=	71.3%	
Retain-It Advanced Sedimentation	=	80%	Removal Rate
		14.3%	% TSS Load Remains

Percentage of TSS Remaining - Initial TSS Load = Final TSS Removal Rate

100% - 14.3% = 85.8%

For this drainage area, this system as designed will remove an estimated 86% of the annual TSS load and therefore will meet the TSS removal standard.

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2889-01	**Sheet**	**1 of 1**
Project Description	Skyview Estates		
	Leicester, MA		
Calculated By	JG	**Date**	04/29/22
Checked By	MAM		

TOTAL RECHARGE FOR ENTIRE PROJECT

Standard # 3: Groundwater Recharge

Proposed recharge system: Dry Well

In accordance with *MADEP – Volume 2, Technical Guide for Compliance with Massachusetts Stormwater Management Standards, dated January 2008*

A soils require a Volume to recharge of	**0.60**	**inches**
B soils require a Volume to recharge of	**0.35**	**inches**
C soils require a Volume to recharge of	**0.25**	**inches**
D soils require a Volume to recharge of	**0.10**	**inches**

Impervious area within: A-soils =	0	sf
Impervious area within: B-soils =	14,898	sf
Impervious area within: C-soils =	401,275	sf
Impervious area within: D-soils =	0	sf

Weighted Groundwater Recharge Depth = **0.25** **in**

Total Site Volume required to be recharged =

416,172 sf x 1" / 12 x 0.25 in = **8,794 cf**

Site volume recharge provided by = volume within residential drywells

45 Drywells at each grouping of homes Volume= 196

= **8,820** c.f. Total Volume Recharged > **8,794 cf** (OK)

Unit #01	=	Drywell #01	Unit #28	=	Drywell #26
Unit #01	=	Drywell #02	Unit #28	=	Drywell #27
Unit #02	=	Drywell #03	Unit #32	=	Drywell #28
Unit #02	=	Drywell #04	Unit #32	=	Drywell #29
Unit #03	=	Drywell #05	Unit #33	=	Drywell #30
Unit #04	=	Drywell #06	Unit #33	=	Drywell #31
Unit #05	=	Drywell #07	Unit #33	=	Drywell #32
Unit #06	=	Drywell #08	Unit #34	=	Drywell #33
Unit #07	=	Drywell #09	Unit #34	=	Drywell #34
Unit #08	=	Drywell #10	Unit #35	=	Drywell #35
Unit #09	=	Drywell #11	Unit #35	=	Drywell #36
Unit #10	=	Drywell #12	Unit #36	=	Drywell #37
Unit #11	=	Drywell #13	Unit #36	=	Drywell #38
Unit #12	=	Drywell #14	Unit #37	=	Drywell #39
Unit #12	=	Drywell #15	Unit #37	=	Drywell #40
Unit #13	=	Drywell #16	Unit #38	=	Drywell #41
Unit #13	=	Drywell #17	Unit #39	=	Drywell #42
Unit #14	=	Drywell #18	Unit #39	=	Drywell #43
Unit #15	=	Drywell #19	Unit #39	=	Drywell #44
Unit #15	=	Drywell #20	Unit #39	=	Drywell #45
Unit #16	=	Drywell #21			
Unit #16	=	Drywell #22			
Unit #17	=	Drywell #23			
Unit #18	=	Drywell #24			
Unit #18	=	Drywell #25			

Outlet # FES-01

Q10 = 19.85 cfs T_w = 0.6 feet

D_o = 30 inches

Design Criteria

Apron Dimensions

The dimensions of the apron at the outlet of the pipe shall be determined as follows:

1.) The width of the apron at the outlet of the pipe or channel shall be 3 times the diameter of the pipe of width of the channel.

W= **7.5** feet

2.) The length of the apron shall be determined from the following formula when the tailwater depth at the outlet of the pipe or channel is less than one-half the diameter of the pipe or one-half the width of the channel:

USE THIS ONE ⇒

La=1.8*Q/ Do^3/2+ 7Do

La= **26.54** feet

Where:

La is the length of the apron

Q is the discharge from the pipe or channel

D_o is the diameter of pipe of width of channel

3.) When the depth of the tailwater at the outlet of the pipe or channel is equal to or greater than one-half the diameter of the pipe or the width of the channel. Then the following formula applies:

La=3.0*Qo/ Do^1.5 +7D_o

La= **32.57** feet

4.) Where there is no well defined channel downstream of the outlet, the width of the downstream end of the apron shall be determined as follows:

a. For minimum tailwater conditions where the tailwater depth is less than the elevation of the center of the pipe:

W=3*Do+La

USE THIS ONE ⇒

W= **34.04** feet

b. For maximum tailwater conditions where the tailwater depth is greater than the elevation of the center of the pipe:

W=3*Do+0.4*La

W= **20.53** feet

5.) Where there is a stable well-defined channel downstream of the apron, the bottom of the apron shall be equal to the width of the channel.

6.) The side of the apron in a well-defined channel shall be 2:1 (horizontal to vertical) or flatter. The height of the structural lining along the channel sides shall begin at the elevation equal to the top of conduit and taper down to the channel bottom through the length of the apron.

7.) The bottom grade of the apron shall be level (0% grade). No overfall is allowable at the end of the apron.

8.) The apron shall be located so that there are no bends in the horizontal alignment of the apron.

Rock Riprap

The following criteria shall be used to determine the dimensions of the rock riprap used for the apron:

1.) The median stone diameter shall be determined using the formula:

d_{50}=0.02*Q^4/3/(Tw*D_o)

d_{50}= **8.11** inches **USE 8** inches

d_{50} minimum 3 inches

Where:

d_{50} is the median stone diameter in feet

Tw is the tailwater depth above the invert of the pipe channel in feet

Q is the discharge from the pipe or channel in cubic feet per second

D_o is the diameter of the pipe or width of the channel in feet

2.) Fifty percent by weight of the riprap mixture shall be smaller the than median size stone designated as d_{50}. The largest stone size in the mixture shall be 1.5 times the d_{50} size.

3.) The quality and gradation of the rock, the thickness of the riprap lining, filter material and the quality of the stone shall meet the requirements in the Rock Riprap BMP. The minimum depth shall be 6 inches or 1.5 times the largest stone size in the mixture whichever is larger (d).

Thickness of the riprap

d = 1.5*(1.5*d_{50}(largest stone size))

d = **18** inches*

* must use a minimum of 6"

Rock Rip Rap Gradation

% of weight smaller than the given size	size of stone in inches		
100	**12.2**	to	**16.2**
85	**10.5**	to	**14.6**
50	**8.1**	to	**12.2**
15	**2.4**	to	**4.1**

Formulas Used (Reference NHDES Handbook, Pages 7-114, 7-115)

OPEN CHANNEL FLOW DESIGN/ANALYSIS

Stone Swale 1:

Channel Dimensions

Q_{50} (cfs)	3.63	
Bottom Width (ft)	2	
Side Slopes	4	:1
Channel Slope ('/')	0.1052	
Channel depth (ft)	1	
Area (ft^2)	6.00	
Wetted Perimeter (ft)	10.25	
Hydraulic Radius (ft)	0.59	
P/R	17.50	
d_{50} (in.)	6	(see fig. 7-43)

(R) = Hydraulic Radius = A/P
Where: A=Cross sectional area of waterway
P=Wetted perimeter

Rock Riprap

The following criteria shall be used to determine the dimensions of the rock riprap used for the apron:

1.) The median stone diameter shall be determined using the formula:

d_{50}= **6.00** inches **USE** **6.00** inches

d_{50} minimum 3 inches

2.) Fifty percent by weight of the riprap mixture shall be smaller the than median size stone designated as d_{50}. The largest stone size in the mixture shall be 1.5 times the d_{50} size.

3.) The quality and gradation of the rock, the thickness of the riprap lining, filter material and the quality of the stone shall meet the requirements in the Rock Riprap BMP. The minimum depth shall be 6 inches or 1.5 times the largest stone size in the mixture whichever is larger (d).

Thickness of the riprap
d = 1.5*(1.5*d_{50}(largest stone size))
d = **14** inches*

* must use a minimum of 6"

Rock Rip Rap Gradation

% of weight smaller than the given size	size of stone in inches		
100	**9.0**	to	**12.0**
85	**7.8**	to	**10.8**
50	**6.0**	to	**9.0**
15	**1.8**	to	**3.0**

OPEN CHANNEL FLOW DESIGN/ANALYSIS

Stone Swale 2:

Channel Dimensions

Q_{50}(cfs)	2.4	
Bottom Width (ft)	2	
Side Slopes	4	:1
Channel Slope ('/')	0.111	
Channel depth (ft)	1	
Area (ft^2)	6.00	
Wetted Perimeter (ft)	10.25	
Hydraulic Radius (ft)	0.59	
P/R	17.50	
d_{50} (in.)	5.1	(see fig. 7-43)

(R) = Hydraulic Radius = A/P
Where: A=Cross sectional area of waterway
P=Wetted perimeter

Rock Riprap

The following criteria shall be used to determine the dimensions of the rock riprap used for the apron:

1.) The median stone diameter shall be determined using the formula:

d_{50}= **5.10** inches **USE** **5.10** inches

d_{50} minimum 3 inches

2.) Fifty percent by weight of the riprap mixture shall be smaller the than median size stone designated as d_{50}. The largest stone size in the mixture shall be 1.5 times the d_{50} size.

3.) The quality and gradation of the rock, the thickness of the riprap lining, filter material and the quality of the stone shall meet the requirements in the Rock Riprap BMP. The minimum depth shall be 6 inches or 1.5 times the largest stone size in the mixture whichever is larger (d).

Thickness of the riprap
d = 1.5*(1.5*d_{50}(largest stone size))
d = **11** inches*

* must use a minimum of 6"

Rock Rip Rap Gradation

% of weight smaller than the given size	size of stone in inches		
100	**7.7**	to	**10.2**
85	**6.6**	to	**9.2**
50	**5.1**	to	**7.7**
15	**1.5**	to	**2.6**

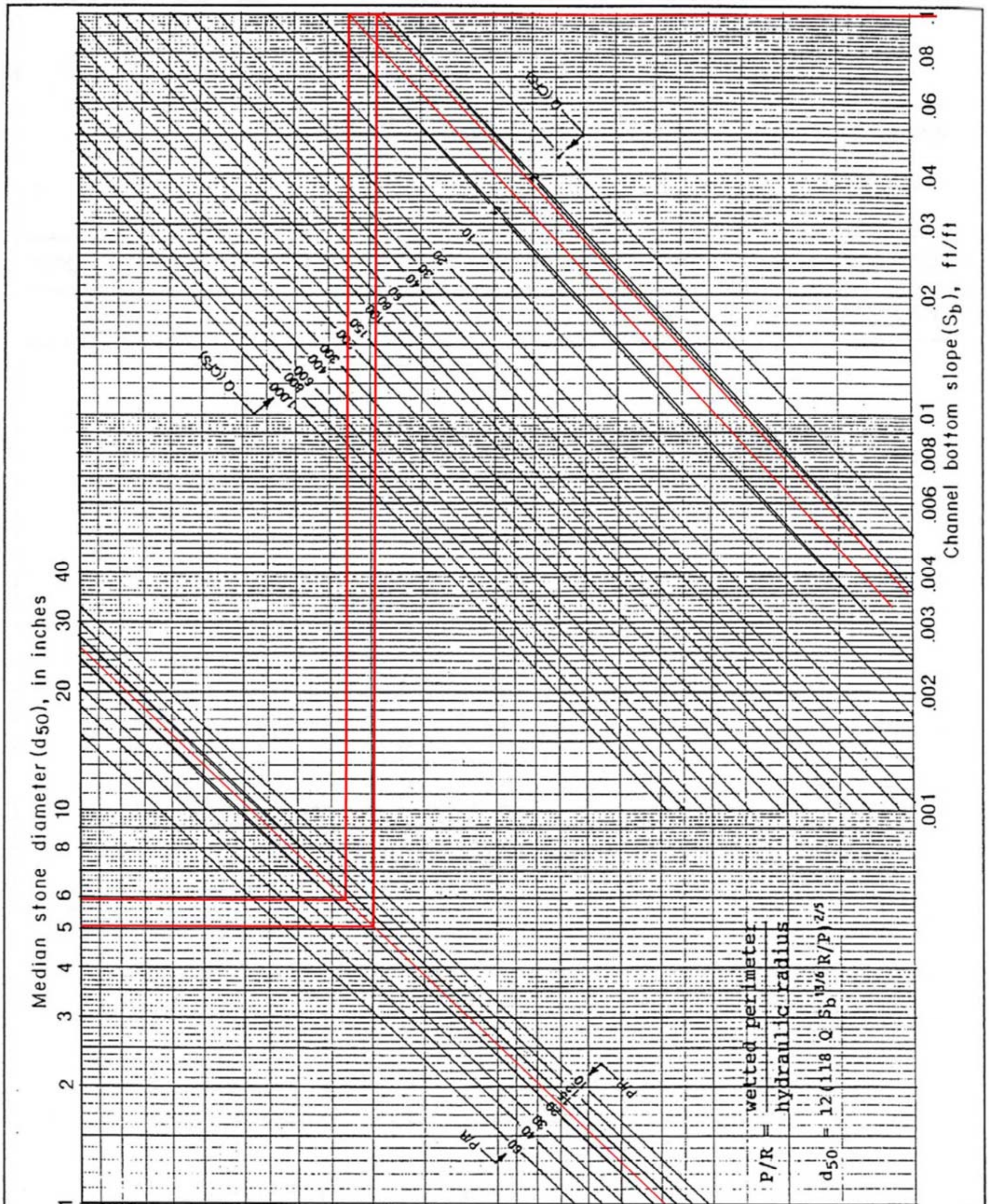

FIGURE 7-43 -- MEDIAN RIPRAP DIAMETER FOR STRAIGHT TRAPEZOIDAL CHANNELS

Skyview Estates - Leicester, MA
Allen & Major Associates, Inc.

Computation Sheet

By	mm
Chk'd	MAM
Apprv'd	MAM

Title *Inlet Grate Capacity*

Project Skyview Estates - Leicester, MA
Date March 7, 2019
A&M Project: 2889-01
Rainfall Intensity (in/hr): 4.85 10 year storm

GUTTER FLOW INLET GRATE CAPACITY

Structure I.D.	Contributing Area (Acres)	Runoff Coefficient (C)	Q10 Year Storm (Q=CiA)	Q10 + bypass	Longitudinal Cross Slope (SL)	Transverse Cross Slope (ST)	Width of Grate Perpendicular to Flow (GW)	Depth of Flow (d)	Top Width of Flow (Zd)	Velocity (V), fps	Gutter Flow Ratio (Eo)	Site Flow Ratio (Rs)	Grate Efficiency (%)	Intercepted Flow	Bypass Flow	Bypass Flow to
CB-01	0.191	0.85	0.79	0.79	0.0200	0.117	2.00	0.22	1.88	3.82	1.00	0.25	100%	0.79	0.00	-
CB-02	0.191	0.85	0.79	0.79	0.0200	0.117	2.00	0.22	1.88	3.82	1.00	0.25	100%	0.79	0.00	-
CB-03	0.191	0.85	0.79	0.79	0.0200	0.117	2.00	0.22	1.88	3.82	1.00	0.25	100%	0.79	0.00	CB-03
CB-04	0.250	0.88	1.06	1.06	0.0200	0.117	2.00	0.25	2.11	4.12	1.00	0.23	100%	1.06	0.00	CB-01
CB-05	0.250	0.88	1.06	1.07	0.0200	0.117	2.00	0.25	2.11	4.12	1.00	0.23	100%	1.06	0.00	CB-02
CB-09	0.715	0.77	2.67	2.67	0.0200	0.117	2.00	0.35	2.98	5.20	0.95	0.16	96%	2.53	0.14	CB-08
CB-20	0.755	0.84	3.07	3.21	0.0200	0.120	2.00	0.38	3.13	5.48	0.93	0.16	94%	3.00	0.21	CB-04
CB-21	0.755	0.84	3.07	3.29	0.0200	0.120	2.00	0.38	3.16	5.52	0.93	0.15	94%	3.06	0.23	CB-05
CB-26	0.278	0.93	1.25	4.61	0.0200	0.100	2.00	0.40	4.02	5.74	0.84	0.12	86%	3.87	0.74	CB-25
CB-27	0.278	0.93	1.25	1.99	0.0200	0.100	2.00	0.29	2.94	4.65	0.95	0.17	96%	1.90	0.10	CB-24
CB-50	0.703	0.91	3.10	3.20	0.0200	0.080	2.00	0.32	4.03	4.95	0.84	0.13	86%	2.68	0.52	CB-52
CB-51	0.703	0.91	3.10	3.62	0.0200	0.080	2.00	0.34	4.22	5.10	0.82	0.12	84%	2.96	0.66	CB-53
CB-55	0.829	0.93	3.74	8.84	0.0200	0.063	2.00	0.43	6.88	6.00	0.60	0.08	63%	5.30	3.55	CB-57
CB-56	0.829	0.93	3.74	7.28	0.0200	0.063	2.00	0.40	6.40	5.72	0.63	0.08	66%	4.60	2.69	CB-58
CB-57	0.188	0.93	0.85	3.53	0.0200	0.063	2.00	0.31	4.88	4.77	0.76	0.11	78%	2.66	0.87	-
CB-58	0.188	0.93	0.85	1.71	0.0200	0.063	2.00	0.23	3.72	3.98	0.87	0.15	89%	1.49	0.22	-

**Bypass flow to sump catch basin. See separate sheet.

GUTTER FLOW EQUATIONS

Depth of Flow (d): = [Q * St / 37*(SL)^.5]^.375
Top Width of Flow (Zd): = (d / ST)
Velocity of Flow (V): = (Kc / n)* (SL^0.5 * St^0.67 * Zd^0.67)
Gutter Flow Ratio (Eo): = 1-(1-GW/Zd)^2.67
Site Flow Ratio (Rs): = 1/[1 + (0.15V^1.8) / (SxL* L^2.3)]
Grate Efficiency: = Rf * Eo + Rs(1 - Eo)
Intercepted Flow (Qi): = (Q - Qb)
Bypass Flow (Qb): = Q[Zd - GW / Zd]^2.66

Skyview Estates - Leicester, MA
Allen & Major Associates, Inc.

Computation Sheet

By	mm
Chk'd	MAM
Apprv'd	MAM

Title ***Inlet Grate Capacity***
Project Skyview Estates - Leicester, MA
Date 2/4/2022
A&M Project Number: 2889-01

Rainfall Intensity (in/hr):	4.85	10 year storm
Single Grate Open Area (s.f.):	2.55	
Orifice Coefficient:	0.6	
gravitational constant (fps^2):	32.2	
Perimeter of single CB (ft):	8	(unless along a curb)

SUMP CATCH BASINS (at a low point, not gutter flow)

Structure I.D.	Contributing Area (acres)	Average CN value	C*A	Q10 Year Storm	Orifice Flow Ponding depth (ft)	Perimeter of grate for weir flow	Weir Flow Ponding Depth (ft)	Total depth of ponding (ft)	CB Rim Elevation	Peak Elevation
CB-22	1.184	0.87	1.030	5.0	0.17	8.0	0.33	0.33	904.73	905.06
CB-23	1.184	0.87	1.030	5.0	0.17	8.0	0.33	0.33	904.73	905.06
CB-24	0.523	0.88	0.460	2.2	0.03	8.0	0.19	0.19	910.51	910.70
CB-25	0.523	0.88	0.460	2.2	0.03	8.0	0.19	0.19	910.61	910.80
CB-52	0.709	0.91	0.645	3.1	0.06	8.0	0.24	0.24	921.29	921.53
CB-53	0.709	0.91	0.645	3.1	0.06	8.0	0.24	0.24	921.27	921.51
CB-54	0.709	0.91	0.645	3.1	0.06	8.0	0.24	0.24	920.60	920.84

**Includes bypass flow from upstream strucutres

Orifice Equation: Q = C*A*(2*g*h)^.5

Solve for h yields: $(Q/(C*A))^2/(2*g)$

Weir Flow Equation: $Q=3.3*P(h)^{1.5}$

Solve for h yields: $(Q/(3.3*P))^{0.667}$

Watershed Overlay District Calculations

100 Commerce Way, Suite 5, Woburn, MA 01801 | T (781) 935-6889 | F (781) 935-2896
allenmajor.com

ALLEN & MAJOR ASSOCIATES, INC.

May 26, 2022

To:
Alaa M. Abusalah , Director of Development & Inspectional Services/Town Planner
Leicester Development and Inspectional Services
3 Washburn Square
Leicester, Massachusetts 01524

Copy:

A&M Project #: 2889-01

Re: ZBA Special Permit
Area Summary Letter
651 Main Street
Map 21/Parcel B5.1

Dear Ms. Abusalah

On behalf of our client, MKEP 770, LLC, the Applicant, Allen & Major Associates, Inc. has filled for a Special Permit Application with the Board of Appeals to support the construction of a proposed subdivision/site plan off Main Street in Leicester, Massachusetts as portion of the project area lies within the Water Resources Protection Overlay District (Section 7.1.04.2.a). The project includes land depicted on the Assessor's Map #21 as Parcel B5.1 (651 Main Street), owned by MKEP 770, LLC. The plans submitted intend to depict the land encompassing the subdivision & site plan based on the Existing Conditions Plan created by Allen & Major Associates, Inc. Dated: July 16, 2021, latest revision 02-07-2022

We wish to provide this clarification letter which may help better explain how our project is conforming with Section 7.1.04.2. As stated in Section 7.1.04. a special permit is required when:

"the rendering impervious of more than 15% or 2500 square feet of any lot, but not greater than 30% of any lot; for uses with impervious areas greater than that specified by the By-Law, appropriate measures must be taken to insure that the increase in storm-water runoff (over that amount generated by a lot with the specified impervious area) must be artificially recharged into the ground water."

Based upon the calculation for the project, the area specifically within the Water Resources Protection Overlay District is 27.96% impervious. The total impervious cover is further broken down into either paved parking which encompasses driveways, sidewalks & streets or building roof areas.

Summary for Subcatchment WRPOD: Subcat WRPOD

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

Runoff = 24.03 cfs @ 12.01 hrs, Volume= 1.506 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
76,243	98	Paved parking, HSG C
555	98	Paved parking, HSG B
1,130	61	>75% Grass cover, Good, HSG B
275,580	74	>75% Grass cover, Good, HSG C
62,470	70	Woods, Good, HSG C
78,003	65	Brush, Good, HSG C
85,144	98	Roofs, HSG C
579,126	79	Weighted Average
417,183		72.04% Pervious Area
161,942		27.96% Impervious Area

Per Section 7.01.03 – Definitions: *"Impervious Area" - A surface covered by materials or structures on or above the ground that severely limits the amount of precipitation that infiltrates the underlying soil, including, but not limited to, asphalt, roofed buildings, etc.* As the project proposes to install gutters at approximately 18 of the residential buildings within the overlay district to capture 100% of the roof water for recharge, by definition, these areas would not "*severely limit the amount of precipitation that infiltrates the underlying soil*".

As stated in the Massachusetts Stormwater Policy, LID site design credit is obtained by directing runoff from non-metal roofs to a qualifying pervious area (Disconnected roof runoff). In accordance with the Massachusetts Stormwater Policy, dry wells area classified as a "qualifying pervious area".

Based on this principle of disconnecting roof runoff, the area of impervious cover associated with the roofs could be re-evaluated in terms of the impervious percentage within the district. Below is a summary of the updated impervious calculations utilizing only "connected" impervious areas within the watershed district.

Summary for Subcatchment WRPOD: Subcat WRPOD

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

Runoff = 19.17 cfs @ 12.01 hrs, Volume= 1.235 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
76,243	98	Paved parking, HSG C
555	98	Paved parking, HSG B
1,130	61	>75% Grass cover, Good, HSG B
275,580	74	>75% Grass cover, Good, HSG C
62,470	70	Woods, Good, HSG C
155,545	65	Brush, Good, HSG C
7,603	98	Roofs, HSG C
579,126	75	Weighted Average
494,725		85.43% Pervious Area
84,401		14.57% Impervious Area

Based on this principles and explanations, the project would not meet the requirements of requiring a Special Permit. However, the project proposes to still pursue the Special Permit for the project as well as implementing the complete stormwater management design for the project include the comprehensive Operation & Maintenance protocols submitted both for this permit as well as the site plan approval.

We thank you in advance for your anticipated cooperation regarding this project and look forward to meeting to discuss the plans.

Very Truly Yours,
ALLEN & MAJOR ASSOCIATES, INC.

Michael Malynowski

Michael Malynowski, PE
Senior Project Manager

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	3.23	2

Summary for Subcatchment WRPOD: Subcat WRPOD

Runoff = 24.03 cfs @ 12.01 hrs, Volume= 1.506 af, Depth= 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-year Rainfall=3.23"

Area (sf)	CN	Description
76,243	98	Paved parking, HSG C
555	98	Paved parking, HSG B
1,130	61	>75% Grass cover, Good, HSG B
275,580	74	>75% Grass cover, Good, HSG C
62,470	70	Woods, Good, HSG C
78,003	65	Brush, Good, HSG C
85,144	98	Roofs, HSG C
579,126	79	Weighted Average
417,183		72.04% Pervious Area
161,942		27.96% Impervious Area

Project No.	2889-01	**Sheet**	1 of 1
Project Description	Skyview Estates		
	Leicester, MA		
Calculated By	JG	**Date**	04/29/22
Checked By	MAM		

RECHARGE CALCULATION FOR AREA WITHin WATERSHED OVERLAY PROTECTION DISTRICT ONLY

Standard # 3: Groundwater Recharge

Proposed recharge system: Dry Well

In accordance with *MADEP – Volume 2, Technical Guide for Compliance with Massachusetts Stormwater Management Standards, dated January 2008*

A soils require a Volume to recharge of	**0.60**	**inches**
B soils require a Volume to recharge of	**0.35**	**inches**
C soils require a Volume to recharge of	**0.25**	**inches**
D soils require a Volume to recharge of	**0.10**	**inches**

Impervious area within: A-soils =	0	sf
Impervious area within: B-soils =	566	sf
Impervious area within: C-soils =	171,496	sf
Impervious area within: D-soils =	0	sf

Weighted Groundwater Recharge Depth = **0.25** **in**

Total Site Volume required to be recharged =

172,062 sf x 1" / 12 x 0.25 in = **3,589 cf**

Site volume recharge provided by = volume within residential drywells

House Drywell = 196 cf

Unit #28	Drywell #26	=	196	cf
Unit #28	Drywell #27	=	196	cf
Unit #32	Drywell #28	=	196	cf
Unit #32	Drywell #29	=	196	cf
Unit #33	Drywell #30	=	196	cf
Unit #33	Drywell #31	=	196	cf
Unit #33	Drywell #32	=	196	cf
Unit #34	Drywell #33	=	196	cf
Unit #34	Drywell #34	=	196	cf
Unit #35	Drywell #35	=	196	cf
Unit #35	Drywell #36	=	196	cf
Unit #36	Drywell #37	=	196	cf
Unit #36	Drywell #38	=	196	cf
Unit #37	Drywell #39	=	196	cf
Unit #37	Drywell #40	=	196	cf
Unit #38	Drywell #41	=	196	cf
Unit #39	Drywell #42	=	196	cf
Unit #39	Drywell #43	=	196	cf
Unit #39	Drywell #44	=	196	cf
Unit #39	Drywell #45	=	196	cf
	Total	=	*3920*	*cf*

= **3,920** c.f. Total Volume Recharged > **3,589 cf** (OK)

R:\PROJECTS\2889-01\CIVIL\DRAWINGS\CURRENT\C-2889-01_WATERSHED-PROPOSED.DWG

REV	DATE	DESCRIPTION

APPLICANT:

MKEP 770 LLC
265 SUNRISE HIGHWAY, SUITE 1368
ROCKVILLE CENTER, NY 11570

PROJECT:

SKYVIEW ESTATES
RESIDENTIAL DEVELOPMENT
MAIN STREET
LEICESTER, MA

PROJECT NO.	2889-01	DATE:	06-23-21
SCALE:	1" = 80'	DWG.:	C-2889-01_Watershed-Proposed
DESIGNED BY:	SM	CHECKED BY:	MAM

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
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environmental consulting ♦ landscape architecture
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WOBURN, MA ♦ LAKEVILLE, MA ♦ MANCHESTER, NH

DRAWING TITLE:	SHEET No.
PROPOSED WATERSHED PLAN	WS-2