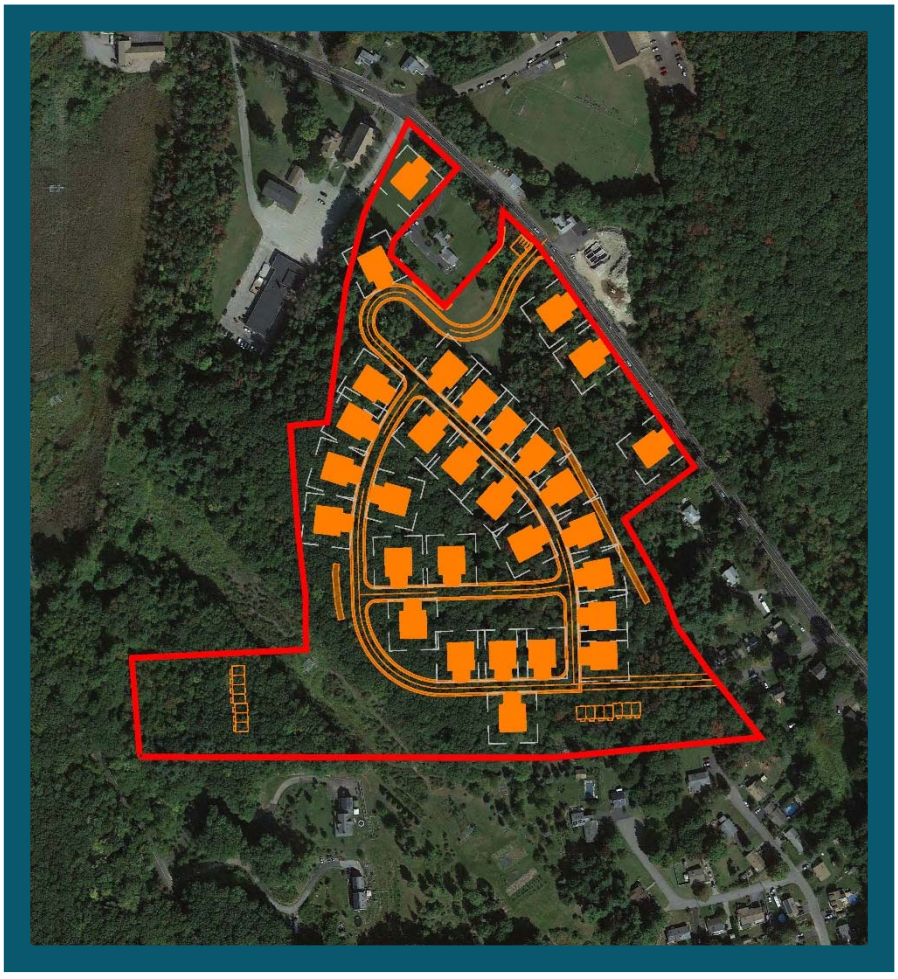
DRAINAGE REPORT

ALLEN & MAJOR ASSOCIATES, INC.

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

DRAINAGE REPORT

Skyview Estates
Leicester, Massachusetts

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

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

ISSUED:
07-16-2021

A&M PROJECT NO.:
2889-01

TABLE OF CONTENTS

SECTION 1.0 - DRAINAGE REPORT 5
Introduction 6
Site Categorization for Stormwater Regulations 6
Site Location and Access 6
Existing Site Conditions 6
Existing Soil Conditions 7
FEMA Floodplain/Environmental Due Diligence 8
Environmentally Sensitive Zones 8
Drainage Analysis Methodology 8
Proposed Conditions – Peak Rate of Runoff 8
MASSDEP Stormwater Performance Standards 11
MASSDEP Stormwater Checklist 16
SECTION 2.0 - OPERATION & MAINTENANCE PLAN 17
Introduction 18
Notification Procedures for Change of Responsibility for O&M 18
Contact Information 19
Demolition & Construction Maintenance Plan 19
Long-Term Pollution Prevention Plan 20
Long-Term Maintenance Plan – Facilities Description 25
Inspection and Maintenance Frequency and Corrective Measures 27
Supplemental Information 28
SECTION 3.0 - EXHIBITS 29
USGS Site Locus Map 30
Aerial Photo 31
FEMA Flood Insurance Rate Map 32
NHESP Map 33
MASSDEP Wetlands Map 34
SECTION 4.0 - EXISTING DRAINAGE ANALYSIS 35
Existing HydroCAD 36
Existing Watershed Plan 37
SECTION 5.0 - PROPOSED DRAINAGE ANALYSIS 38

Proposed HydroCAD 39
Proposed Watershed Plan 40
SECTION 6.0 - APPENDIX 41
Rainfall Data 42
Manning's Number Tables 43
Soils Map 44
Water Quality Flow Calculations 45
WQU Sizing 46
Stormwater Pipe Sizing Calculation 47
MADEP Calculations 48

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 subdivision 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 residential subdivision composed of approximately 32 lots containing a mix of duplex and multi-family housing units (+/- 2,200 SF per unit).

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 35 lots. Each proposed lot contains the minimum 100 feet of frontage on Main Street or the proposed street and meets the minimum dimensional requirements for the town's subdivision regulations. 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 subdivision road 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 will overflow and connect to detention system 1B which overflows and connects to detention system 1C which discharges through an outlet control structure to an existing catch basin within Main Street (Study Point 1).

Detention pipe 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). Detention system 2B overflows through an outlet control structure that discharges to existing catch basin within the municipal system (Study Point 2).

Detention pipe system 3 overflows to gabion wall 1, 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 (Study Point 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)	3.85	10.12	15.69	27.09
Decrease (CFS)	**0.10**	**0.03**	**0.03**	**0.93**
Existing Volume (AF)	0.439	1.014	1.537	2.714
Proposed Volume (AF)	0.812	1.719	2.492	4.163
Change (AF)	**0.373**	**0.705**	**0.955**	**1.449**

STUDY POINT #2 (Existing Catch Basin 2)				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	2.88	8.52	13.96	26.52
Proposed Flow (CFS)	2.84	8.10	13.28	26.52
Decrease (CFS)	**0.04**	**0.42**	**0.68**	**0.00**
Existing Volume (AF)	0.752	1.714	2.583	4.532
Proposed Volume (AF)	1.363	2.618	3.674	5.935
Change (AF)	**0.611**	**0.904**	**1.091**	**1.403**

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)	3.91	10.85	16.84	30.33
Decrease (CFS)	**0.03**	**0.06**	**0.57**	**1.84**
Existing Volume (AF)	0.644	1.482	2.243	3.954
Proposed Volume (AF)	0.823	1.670	2.403	4.006
Change (AF)	**0.179**	**0.188**	**0.160**	**0.052**

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)	1.45	2.90	4.10	6.62
Decrease (CFS)	**0.12**	**1.01**	**1.88**	**3.93**
Existing Volume (AF)	0.144	0.329	0.495	0.869
Proposed Volume (AF)	0.137	0.269	0.380	0.621
Change (AF)	**0.007**	**0.06**	**0.115**	**0.248**

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)	0.12	0.25	0.36	0.58
Decrease (CFS)	**0.34**	**0.87**	**1.34**	**2.40**
Existing Volume (AF)	0.050	0.112	0.168	0.292
Proposed Volume (AF)	0.009	0.018	0.026	0.043
Change (AF)	**0.041**	**0.094**	**0.142**	**0.249**

TOTAL				
	2-Year	10-Year	25-Year	100-Year
Existing Flow (CFS)	12.80	34.61	54.77	100.24
Proposed Flow (CFS)	12.17	32.22	50.27	91.14
Decrease (CFS)	**0.63**	**2.39**	**4.50**	**9.10**
Existing Volume (AF)	2.029	4.651	7.026	12.361
Proposed Volume (AF)	3.144	6.294	8.975	14.768
Change (AF)	**1.115**	**1.643**	**1.949**	**2.407**

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 (Pipe & 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.

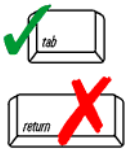
MASSDEP Stormwater Checklist

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.

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

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 for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

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 for Stormwater Report

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 for 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

OPERATION AND MAINTENANCE PLAN SCHEDULE **Date: 07-16-2021**

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	ESTIMATED ANNUAL MAINTENANCE COST	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.	$1,000		
	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.	$2,000		
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.).	$500		
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.	$250		
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.	$1,000		
	OUTLET STRUCTURES	Periodic cleaning of Outlet Control Structures as needed.	Clear trash and debris as necessary.	$500		
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.	$500		
	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	$2,000		

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.

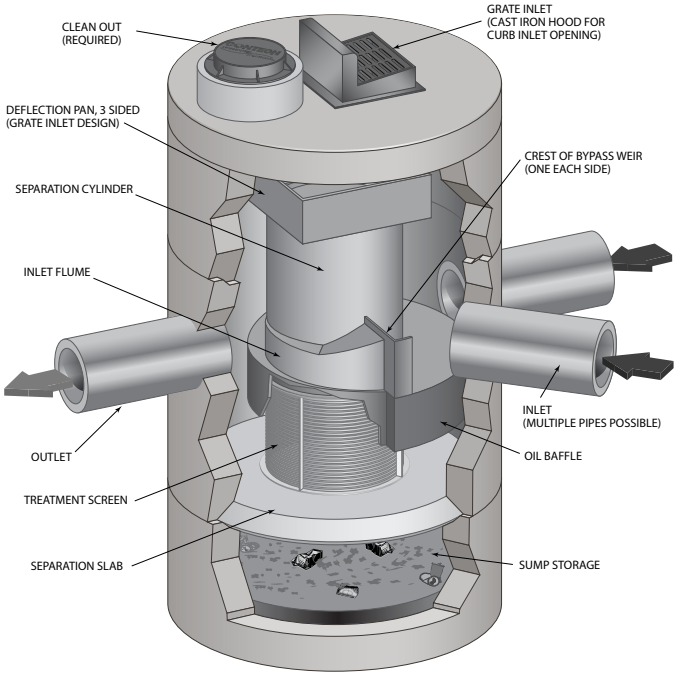
Operation Overview

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.

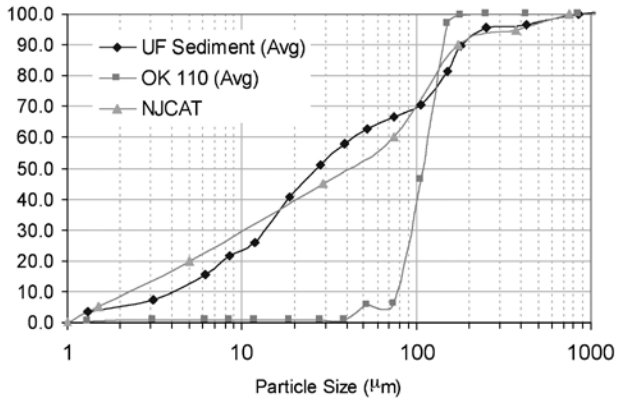


Figure 1. Particle size distributions

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.

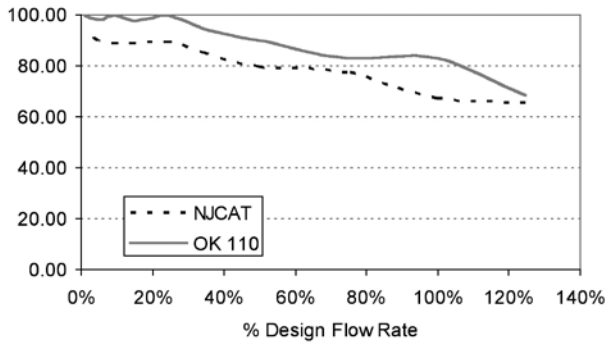


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

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).

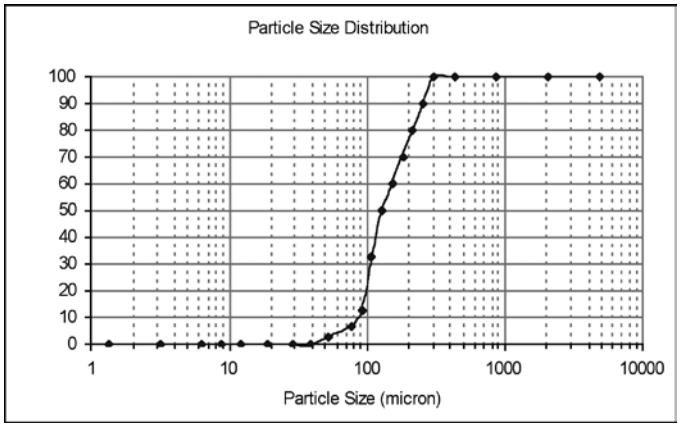


Figure 3. WASDOE PSD

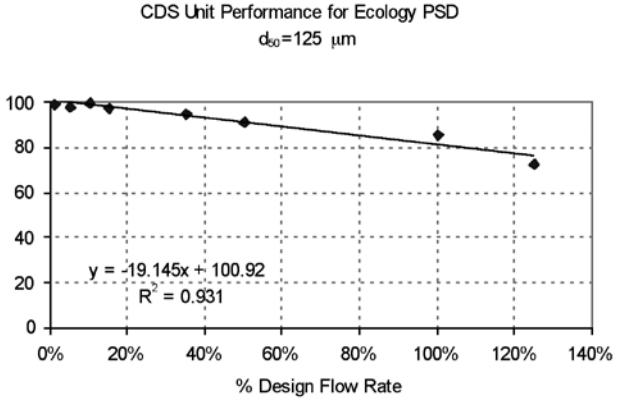


Figure 4. Modeled performance for WASDOE PSD.

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.

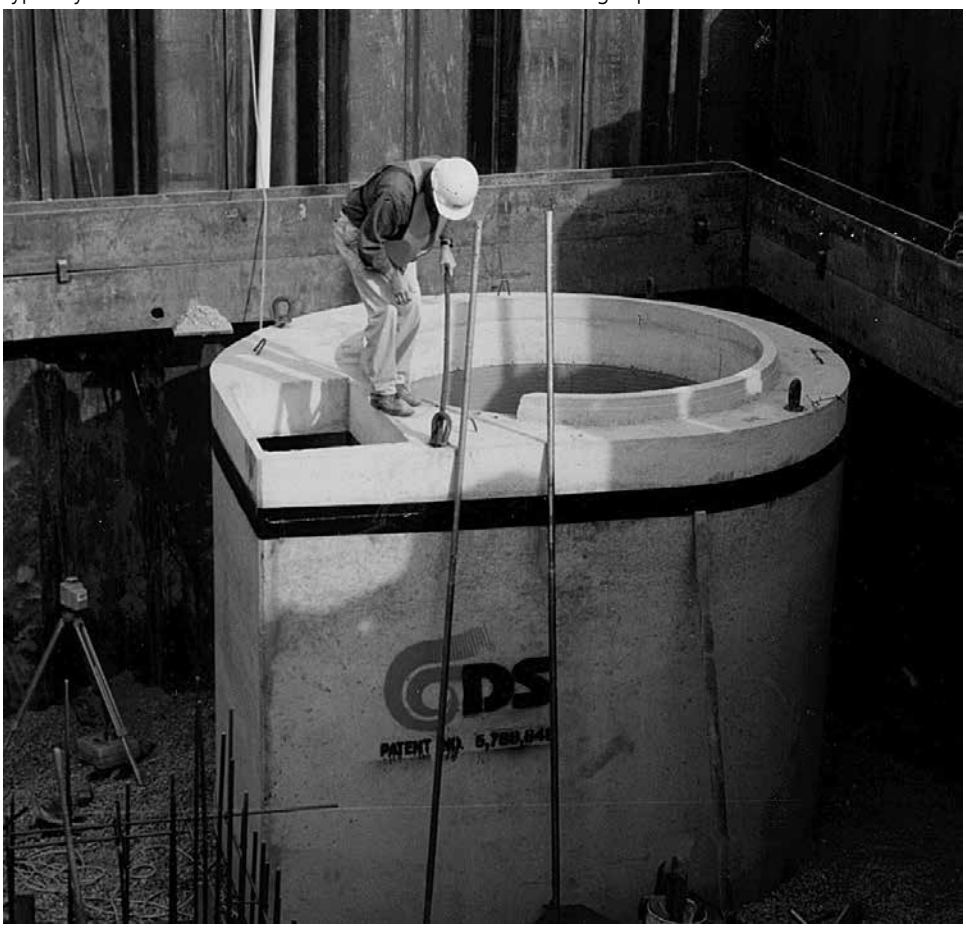
Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material 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.

CONTECH®
ENGINEERED SOLUTIONS
800-338-1122
www.ContechES.com

©2017 Contech Engineered Solutions LLC, a QUIKRETE Company

Contech Engineered Solutions provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, earth stabilization and stormwater treatment products. For information on other Contech division offerings, visit www.ContechES.com or call 800.338.1122

NOTHING IN THIS CATALOG SHOULD BE CONSTRUED AS A WARRANTY. APPLICATIONS SUGGESTED HEREIN ARE DESCRIBED ONLY TO HELP READERS MAKE THEIR OWN EVALUATIONS AND DECISIONS, AND ARE NEITHER GUARANTEES NOR WARRANTIES OF SUITABILITY FOR ANY APPLICATION. CONTECH MAKES NO WARRANTY WHATSOEVER, EXPRESS OR IMPLIED, RELATED TO THE APPLICATIONS, MATERIALS, COATINGS, OR PRODUCTS DISCUSSED HEREIN. ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND ALL IMPLIED WARRANTIES OF FITNESS FOR ANY PARTICULAR PURPOSE ARE DISCLAIMED BY CONTECH. SEE CONTECH'S CONDITIONS OF SALE (AVAILABLE AT WWW.CONTECHES.COM/COS) FOR MORE INFORMATION.

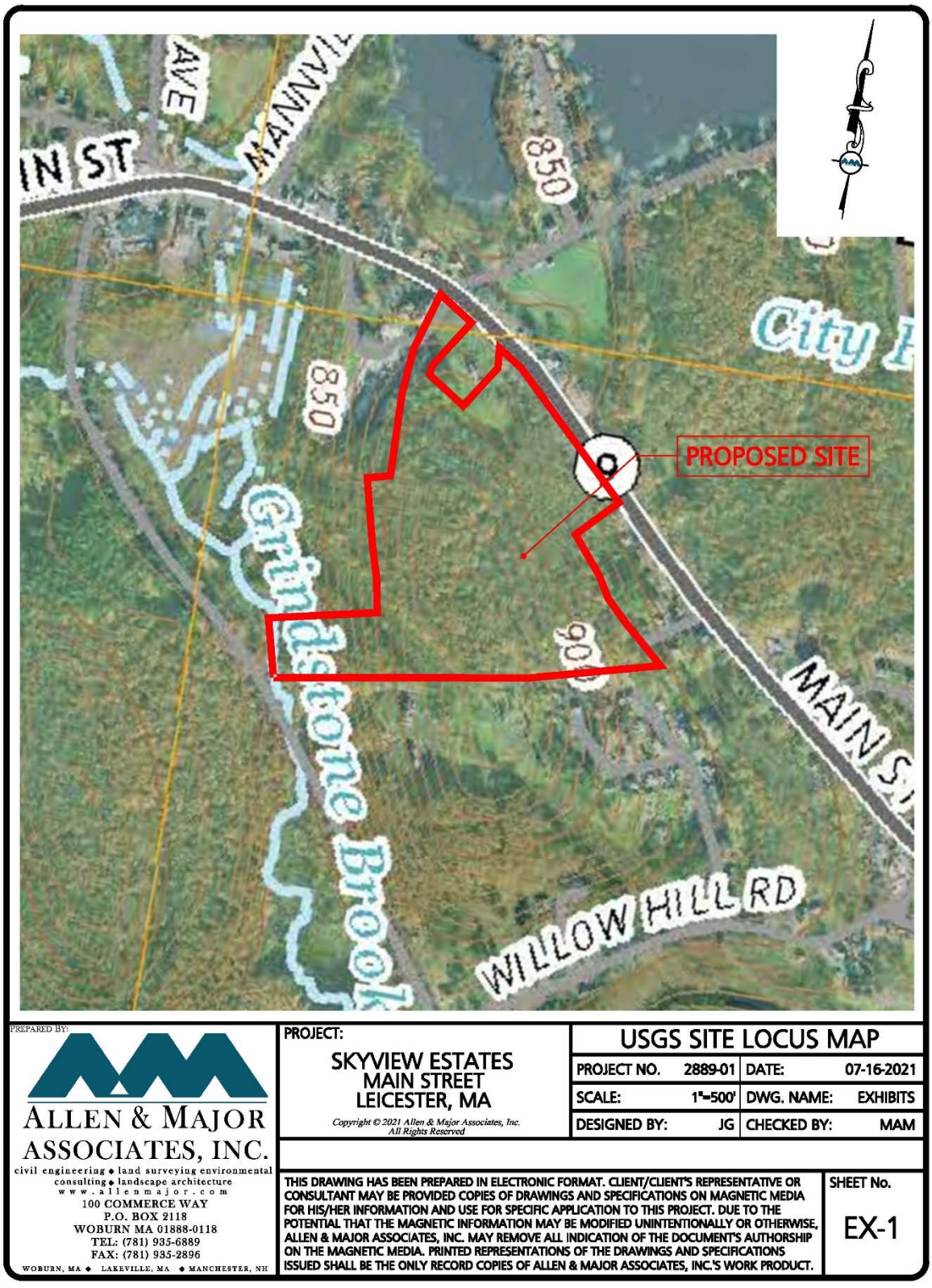
The product(s) described may be protected by one or more of the following US patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 7,296,692; 7,297,266; related foreign patents or other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

cds_manual 3/17 PDF

RECYCLED PAPER

SECTION 3.0 -
EXHIBITS

USGS Site Locus Map



PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:
SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

Copyright © 2021 Allen & Major Associates, Inc.
All Rights Reserved

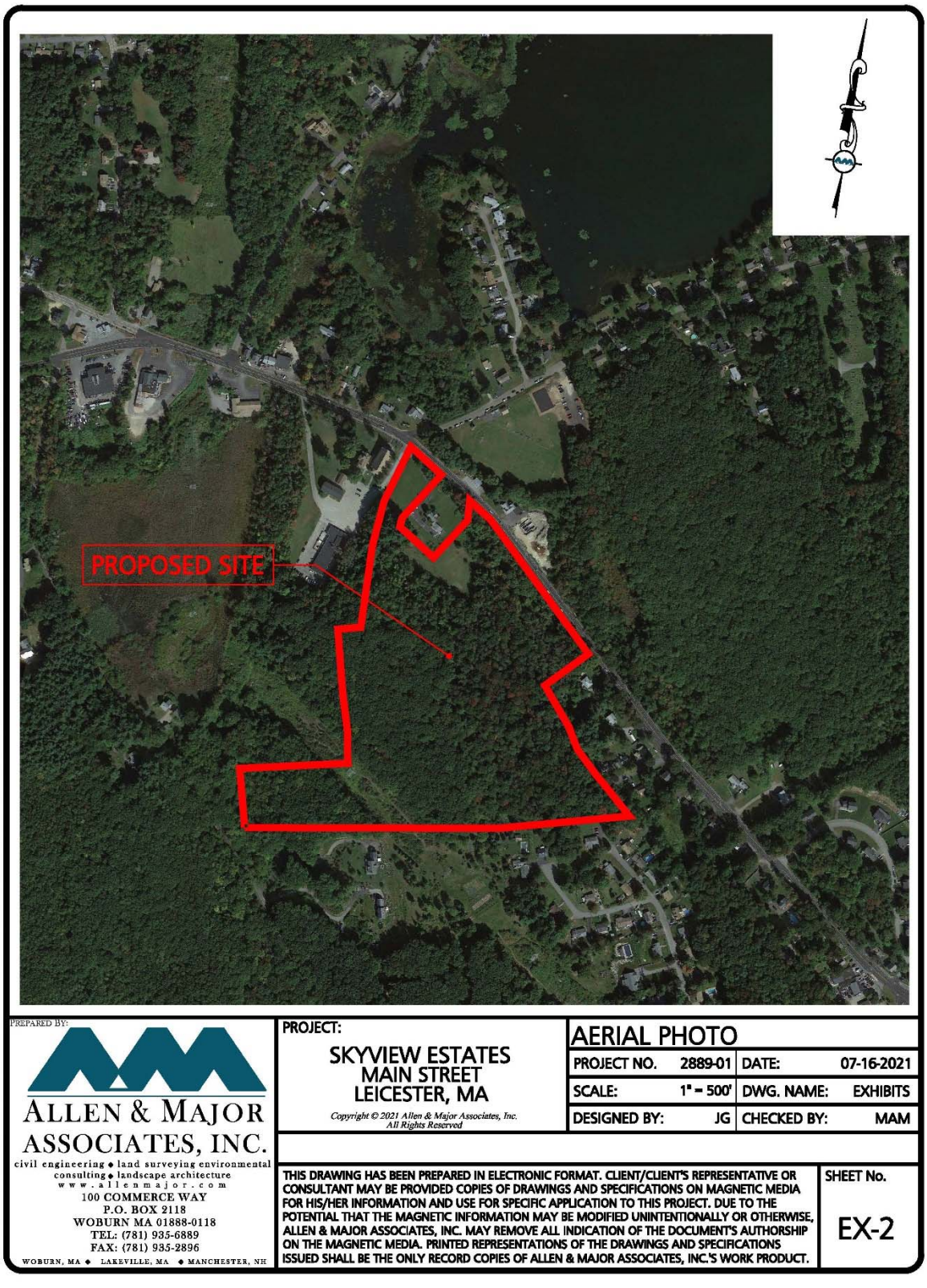
USGS SITE LOCUS MAP

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

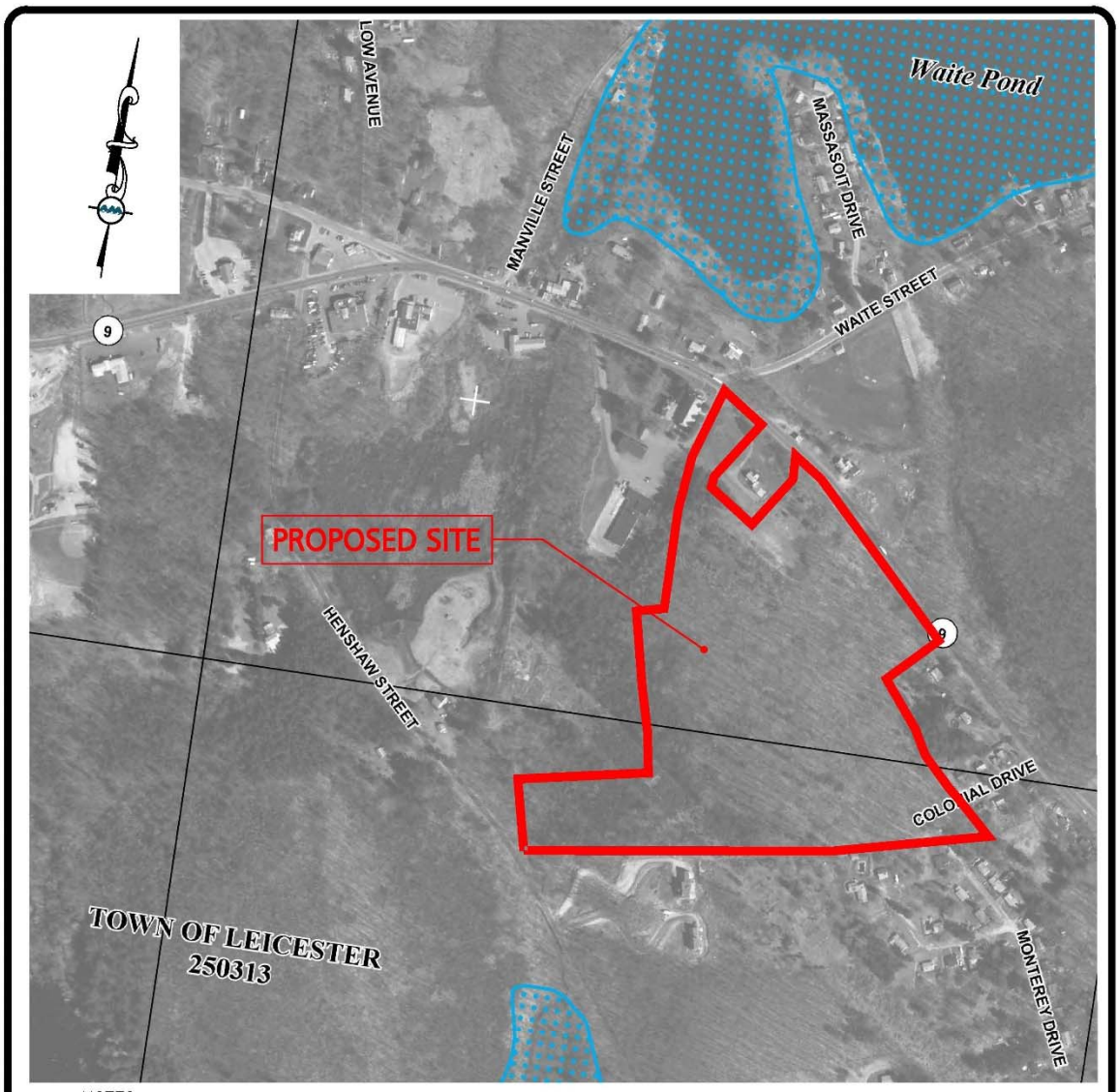
THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANT MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS ON MAGNETIC MEDIA FOR HIS/HER INFORMATION AND USE FOR SPECIFIC APPLICATION TO THIS PROJECT. DUE TO THE POTENTIAL THAT THE MAGNETIC INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE MAGNETIC MEDIA. PRINTED REPRESENTATIONS OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.

SHEET No.
EX-1

Aerial Photo



FEMA Flood Insurance Rate Map



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

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:
SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

Copyright © 2021 Allen & Major Associates, Inc.
All Rights Reserved

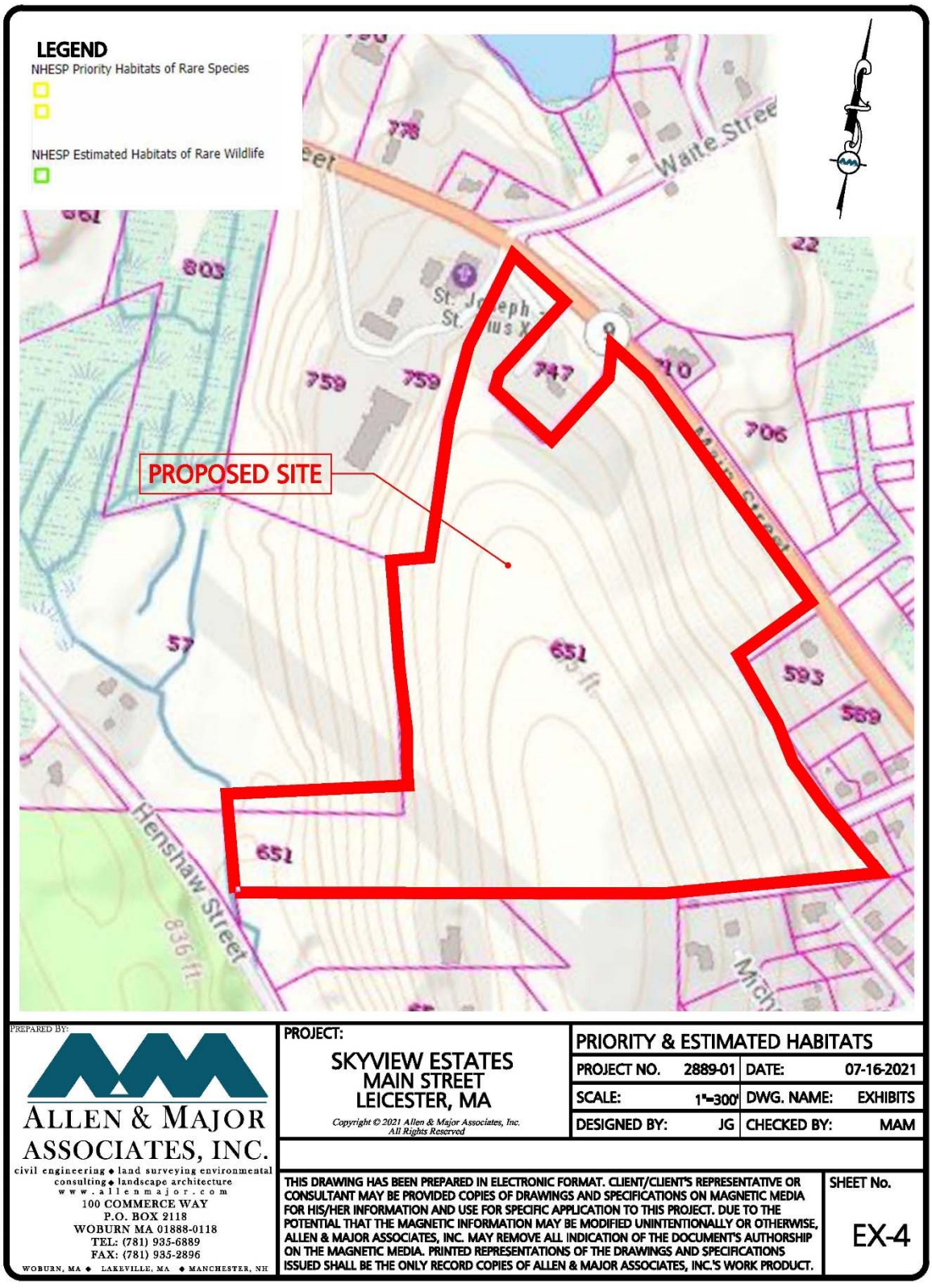
FEMA FIRM MAP

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

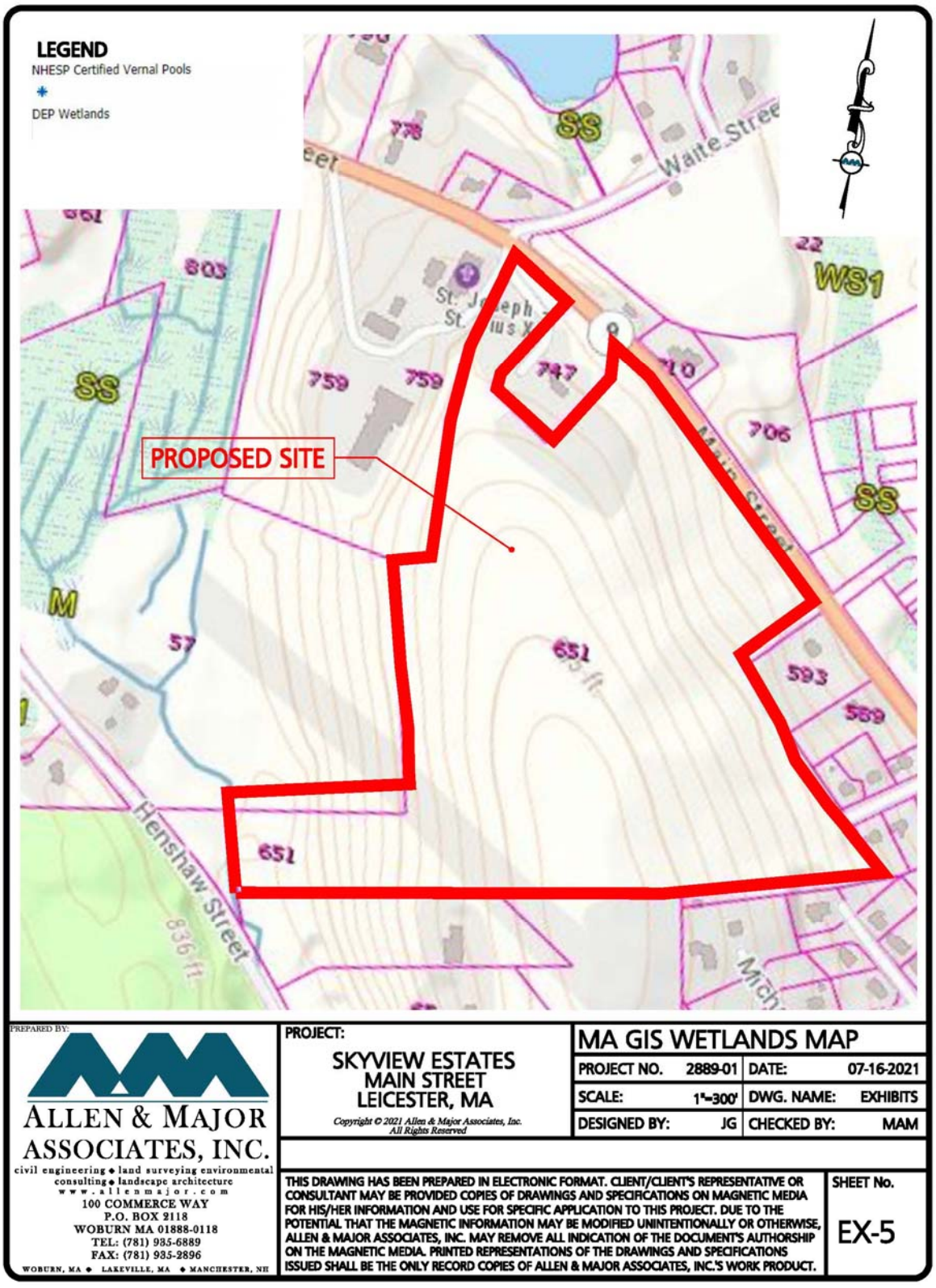
THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANT MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS ON MAGNETIC MEDIA FOR HIS/HER INFORMATION AND USE FOR SPECIFIC APPLICATION TO THIS PROJECT. DUE TO THE POTENTIAL THAT THE MAGNETIC INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE MAGNETIC MEDIA. PRINTED REPRESENTATIONS OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.

SHEET No.
EX-3

NHESP Map


LEGEND
NHESP Priority Habitats of Rare Species
NHESP Estimated Habitats of Rare Wildlife
PROPOSED SITE
Waite Stree
St. Joseph
St. Louis X
803
759
759
747
706
57
651
651
593
589
Henshaw Street
836 ft
PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH
PROJECT:
SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA
Copyright © 2021 Allen & Major Associates, Inc. All Rights Reserved
PRIORITY & ESTIMATED HABITATS
PROJECT NO. 2889-01
DATE: 07-16-2021
SCALE: 1"=300'
DWG. NAME: EXHIBITS
DESIGNED BY: JG
CHECKED BY: MAM
THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANT MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS ON MAGNETIC MEDIA FOR HIS/HER INFORMATION AND USE FOR SPECIFIC APPLICATION TO THIS PROJECT. DUE TO THE POTENTIAL THAT THE MAGNETIC INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE MAGNETIC MEDIA. PRINTED REPRESENTATIONS OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.
SHEET No.
EX-4

MASSDEP Wetlands Map



PREPARED BY:
ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY
P.O. BOX 2118
WOBURN MA 01888-0118
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

PROJECT:
SKYVIEW ESTATES
MAIN STREET
LEICESTER, MA

Copyright © 2021 Allen & Major Associates, Inc.
All Rights Reserved

MA GIS WETLANDS MAP

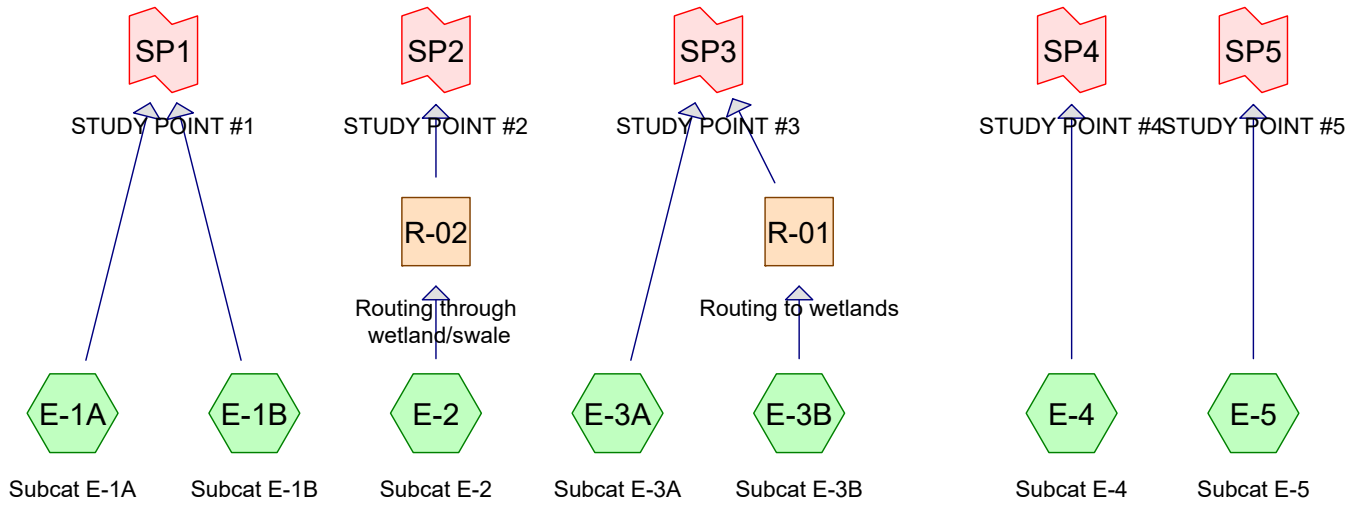
PROJECT NO.	2889-01	DATE:	07-16-2021
SCALE:	1"=300'	DWG. NAME:	EXHIBITS
DESIGNED BY:	JG	CHECKED BY:	MAM

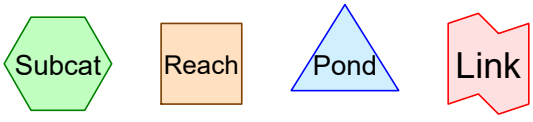
THIS DRAWING HAS BEEN PREPARED IN ELECTRONIC FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANT MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS ON MAGNETIC MEDIA FOR HIS/HER INFORMATION AND USE FOR SPECIFIC APPLICATION TO THIS PROJECT. DUE TO THE POTENTIAL THAT THE MAGNETIC INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE MAGNETIC MEDIA. PRINTED REPRESENTATIONS OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.

SHEET No.
EX-5

SECTION 4.0 -
EXISTING DRAINAGE ANALYSIS

Existing HydroCAD





Routing Diagram for 2899-01 - Existing HydroCAD
Prepared by Allen & Major Associates Inc., Printed 7/13/2021
HydroCAD® 10.10-5a s/n 02947 © 2020 HydroCAD Software Solutions LLC

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
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	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)
1.524	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)
24.669	70	Woods, Good, HSG C (E-1A, E-1B, E-2, E-3A, E-3B, E-4, E-5)
29.385	**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
28.359	HSG C	E-1A, E-1B, E-2, E-3A, E-3B, E-4, E-5
0.000	HSG D	
0.000	Other	
29.385		**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	1.524	0.000	0.000	1.734	>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	24.669	0.000	0.000	25.417	Woods, Good	E-1A, E-1B, E-2, E-3A, E-3B, E-4, E-5
0.000	**1.026**	**28.359**	**0.000**	**0.000**	**29.385**	**TOTAL AREA**	

Notes Listing (all nodes)

Line#	Node Number	Notes
1	R-01	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.
2		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".
3	R-02	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.
4		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".

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 E-1A: Subcat E-1A Runoff Area=262,134 sf 0.00% Impervious Runoff Depth=0.80"
Flow Length=799' Tc=15.7 min CN=69 Runoff=3.62 cfs 0.399 af

Subcatchment E-1B: Subcat E-1B Runoff Area=21,857 sf 12.35% Impervious Runoff Depth=0.95"
Flow Length=315' Tc=8.2 min CN=72 Runoff=0.47 cfs 0.040 af

Subcatchment E-2: Subcat E-2 Runoff Area=465,719 sf 0.00% Impervious Runoff Depth=0.85"
Flow Length=612' Tc=26.3 min CN=70 Runoff=5.69 cfs 0.753 af

Subcatchment E-3A: Subcat E-3A Runoff Area=5.378 ac 0.00% Impervious Runoff Depth=0.80"
Flow Length=890' Tc=19.2 min CN=69 Runoff=3.00 cfs 0.357 af

Subcatchment E-3B: Subcat E-3B Runoff Area=4.074 ac 0.00% Impervious Runoff Depth=0.85"
Flow Length=567' Tc=14.8 min CN=70 Runoff=2.70 cfs 0.287 af

Subcatchment E-4: Subcat E-4 Runoff Area=2.049 ac 0.35% Impervious Runoff Depth=0.85"
Flow Length=258' Tc=10.0 min CN=70 Runoff=1.57 cfs 0.144 af

Subcatchment E-5: Subcat E-5 Runoff Area=29,304 sf 0.00% Impervious Runoff Depth=0.90"
Flow Length=568' Tc=16.5 min CN=71 Runoff=0.46 cfs 0.050 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.24' Max Vel=0.33 fps Inflow=2.70 cfs 0.287 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=1.32 cfs 0.287 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=0.56' Max Vel=0.27 fps Inflow=5.69 cfs 0.753 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=2.88 cfs 0.752 af

Link SP1: STUDY POINT #1 Inflow=3.95 cfs 0.439 af
Primary=3.95 cfs 0.439 af

Link SP2: STUDY POINT #2 Inflow=2.88 cfs 0.752 af
Primary=2.88 cfs 0.752 af

Link SP3: STUDY POINT #3 Inflow=3.94 cfs 0.644 af
Primary=3.94 cfs 0.644 af

Link SP4: STUDY POINT #4 Inflow=1.57 cfs 0.144 af
Primary=1.57 cfs 0.144 af

Link SP5: STUDY POINT #5 Inflow=0.46 cfs 0.050 af
Primary=0.46 cfs 0.050 af

Total Runoff Area = 29.385 ac Runoff Volume = 2.031 af Average Runoff Depth = 0.83"
99.76% Pervious = 29.316 ac 0.24% Impervious = 0.069 ac

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 E-1A: Subcat E-1A Runoff Area=262,134 sf 0.00% Impervious Runoff Depth=1.85"
Flow Length=799' Tc=15.7 min CN=69 Runoff=9.32 cfs 0.927 af

Subcatchment E-1B: Subcat E-1B Runoff Area=21,857 sf 12.35% Impervious Runoff Depth=2.08"
Flow Length=315' Tc=8.2 min CN=72 Runoff=1.10 cfs 0.087 af

Subcatchment E-2: Subcat E-2 Runoff Area=465,719 sf 0.00% Impervious Runoff Depth=1.93"
Flow Length=612' Tc=26.3 min CN=70 Runoff=14.10 cfs 1.716 af

Subcatchment E-3A: Subcat E-3A Runoff Area=5.378 ac 0.00% Impervious Runoff Depth=1.85"
Flow Length=890' Tc=19.2 min CN=69 Runoff=7.71 cfs 0.829 af

Subcatchment E-3B: Subcat E-3B Runoff Area=4.074 ac 0.00% Impervious Runoff Depth=1.93"
Flow Length=567' Tc=14.8 min CN=70 Runoff=6.79 cfs 0.654 af

Subcatchment E-4: Subcat E-4 Runoff Area=2.049 ac 0.35% Impervious Runoff Depth=1.93"
Flow Length=258' Tc=10.0 min CN=70 Runoff=3.91 cfs 0.329 af

Subcatchment E-5: Subcat E-5 Runoff Area=29,304 sf 0.00% Impervious Runoff Depth=2.00"
Flow Length=568' Tc=16.5 min CN=71 Runoff=1.12 cfs 0.112 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.37' Max Vel=0.43 fps Inflow=6.79 cfs 0.654 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=3.84 cfs 0.654 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=0.94' Max Vel=0.35 fps Inflow=14.10 cfs 1.716 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=8.52 cfs 1.714 af

Link SP1: STUDY POINT #1 Inflow=10.15 cfs 1.014 af
Primary=10.15 cfs 1.014 af

Link SP2: STUDY POINT #2 Inflow=8.52 cfs 1.714 af
Primary=8.52 cfs 1.714 af

Link SP3: STUDY POINT #3 Inflow=10.91 cfs 1.482 af
Primary=10.91 cfs 1.482 af

Link SP4: STUDY POINT #4 Inflow=3.91 cfs 0.329 af
Primary=3.91 cfs 0.329 af

Link SP5: STUDY POINT #5 Inflow=1.12 cfs 0.112 af
Primary=1.12 cfs 0.112 af

Total Runoff Area = 29.385 ac Runoff Volume = 4.654 af Average Runoff Depth = 1.90"
99.76% Pervious = 29.316 ac 0.24% Impervious = 0.069 ac

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 E-1A: Subcat E-1A Runoff Area=262,134 sf 0.00% Impervious Runoff Depth=2.81"
Flow Length=799' Tc=15.7 min CN=69 Runoff=14.52 cfs 1.407 af

Subcatchment E-1B: Subcat E-1B Runoff Area=21,857 sf 12.35% Impervious Runoff Depth=3.09"
Flow Length=315' Tc=8.2 min CN=72 Runoff=1.66 cfs 0.129 af

Subcatchment E-2: Subcat E-2 Runoff Area=465,719 sf 0.00% Impervious Runoff Depth=2.90"
Flow Length=612' Tc=26.3 min CN=70 Runoff=21.64 cfs 2.584 af

Subcatchment E-3A: Subcat E-3A Runoff Area=5.378 ac 0.00% Impervious Runoff Depth=2.81"
Flow Length=890' Tc=19.2 min CN=69 Runoff=11.99 cfs 1.258 af

Subcatchment E-3B: Subcat E-3B Runoff Area=4.074 ac 0.00% Impervious Runoff Depth=2.90"
Flow Length=567' Tc=14.8 min CN=70 Runoff=10.42 cfs 0.985 af

Subcatchment E-4: Subcat E-4 Runoff Area=2.049 ac 0.35% Impervious Runoff Depth=2.90"
Flow Length=258' Tc=10.0 min CN=70 Runoff=5.98 cfs 0.495 af

Subcatchment E-5: Subcat E-5 Runoff Area=29,304 sf 0.00% Impervious Runoff Depth=3.00"
Flow Length=568' Tc=16.5 min CN=71 Runoff=1.70 cfs 0.168 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.46' Max Vel=0.49 fps Inflow=10.42 cfs 0.985 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=6.28 cfs 0.985 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=1.17' Max Vel=0.40 fps Inflow=21.64 cfs 2.584 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=13.96 cfs 2.583 af

Link SP1: STUDY POINT #1 Inflow=15.72 cfs 1.537 af
Primary=15.72 cfs 1.537 af

Link SP2: STUDY POINT #2 Inflow=13.96 cfs 2.583 af
Primary=13.96 cfs 2.583 af

Link SP3: STUDY POINT #3 Inflow=17.41 cfs 2.243 af
Primary=17.41 cfs 2.243 af

Link SP4: STUDY POINT #4 Inflow=5.98 cfs 0.495 af
Primary=5.98 cfs 0.495 af

Link SP5: STUDY POINT #5 Inflow=1.70 cfs 0.168 af
Primary=1.70 cfs 0.168 af

Total Runoff Area = 29.385 ac Runoff Volume = 7.027 af Average Runoff Depth = 2.87"
99.76% Pervious = 29.316 ac 0.24% Impervious = 0.069 ac

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 E-1A: Subcat E-1A Runoff Area=262,134 sf 0.00% Impervious Runoff Depth=4.97"
Flow Length=799' Tc=15.7 min CN=69 Runoff=25.97 cfs 2.491 af

Subcatchment E-1B: Subcat E-1B Runoff Area=21,857 sf 12.35% Impervious Runoff Depth=5.33"
Flow Length=315' Tc=8.2 min CN=72 Runoff=2.86 cfs 0.223 af

Subcatchment E-2: Subcat E-2 Runoff Area=465,719 sf 0.00% Impervious Runoff Depth=5.09"
Flow Length=612' Tc=26.3 min CN=70 Runoff=38.23 cfs 4.534 af

Subcatchment E-3A: Subcat E-3A Runoff Area=5.378 ac 0.00% Impervious Runoff Depth=4.97"
Flow Length=890' Tc=19.2 min CN=69 Runoff=21.44 cfs 2.226 af

Subcatchment E-3B: Subcat E-3B Runoff Area=4.074 ac 0.00% Impervious Runoff Depth=5.09"
Flow Length=567' Tc=14.8 min CN=70 Runoff=18.41 cfs 1.728 af

Subcatchment E-4: Subcat E-4 Runoff Area=2.049 ac 0.35% Impervious Runoff Depth=5.09"
Flow Length=258' Tc=10.0 min CN=70 Runoff=10.55 cfs 0.869 af

Subcatchment E-5: Subcat E-5 Runoff Area=29,304 sf 0.00% Impervious Runoff Depth=5.21"
Flow Length=568' Tc=16.5 min CN=71 Runoff=2.98 cfs 0.292 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.60' Max Vel=0.57 fps Inflow=18.41 cfs 1.728 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=11.93 cfs 1.728 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=1.55' Max Vel=0.47 fps Inflow=38.23 cfs 4.534 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=26.52 cfs 4.532 af

Link SP1: STUDY POINT #1 Inflow=28.02 cfs 2.714 af
Primary=28.02 cfs 2.714 af

Link SP2: STUDY POINT #2 Inflow=26.52 cfs 4.532 af
Primary=26.52 cfs 4.532 af

Link SP3: STUDY POINT #3 Inflow=32.17 cfs 3.954 af
Primary=32.17 cfs 3.954 af

Link SP4: STUDY POINT #4 Inflow=10.55 cfs 0.869 af
Primary=10.55 cfs 0.869 af

Link SP5: STUDY POINT #5 Inflow=2.98 cfs 0.292 af
Primary=2.98 cfs 0.292 af

Total Runoff Area = 29.385 ac Runoff Volume = 12.364 af Average Runoff Depth = 5.05"
99.76% Pervious = 29.316 ac 0.24% Impervious = 0.069 ac

Existing Watershed Plan



LEGEND

- SUBCATCHMENT BOUNDARY
- SCS SOILS BOUNDARY
- Tc FLOW PATH (A — B)
- SUBCATCHMENT LABEL (E-1)

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT:

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

PROJECT:

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION

MAIN STREET
LEICESTER, MA

PROJECT NO.	2889-01	DATE:	06-23-21
SCALE:	1" = 80'	DWG. :	C2889-01_Watershed-Existing
DESIGNED BY:	SM	CHECKED BY:	MAM

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY, SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

THIS DRAWING HAS BEEN PREPARED IN DIGITAL FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANTS MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS FOR HIS/HER INFORMATION AND/OR SPECIFIC USE ON THIS PROJECT. DUE TO THE POTENTIAL THAT THE PROVIDED INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE DIGITAL MEDIA. PRINTED REPRESENTATIONS OR PORTABLE DOCUMENT FORMAT OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.

DRAWING TITLE:

EXISTING WATERSHED PLAN

SHEET No.

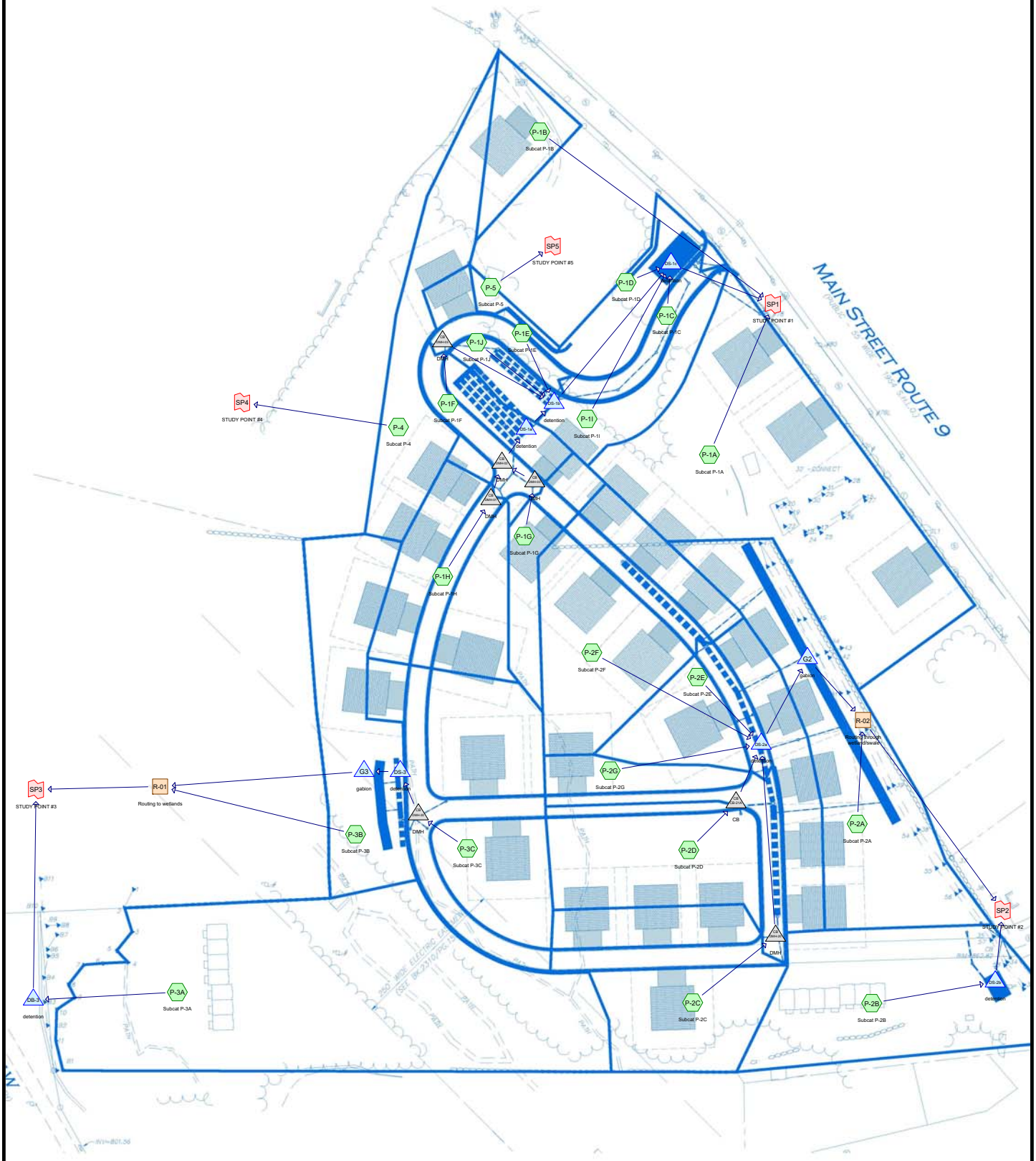
WS-1

Copyright©2021 Allen & Major Associates, Inc.
All Rights Reserved

R:\PROJECTS\2889-01\CIVIL\DRAWINGS\CURRENT\C-2889-01_WATERSHED-EXISTING.DWG

SECTION 5.0 -
PROPOSED DRAINAGE ANALYSIS

Proposed HydroCAD



Subcat Reach Pond Link

Routing Diagram for 2899-01 - Proposed HydroCAD
Prepared by Allen & Major Associates Inc., Printed 7/15/2021
HydroCAD® 10.10-5a s/n 02947 © 2020 HydroCAD Software Solutions LLC

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
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	100-year	Type III 24-hr		Default	24.00	1	8.72	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.505	70	1/2 acre lots, 25% imp, HSG B (P-1A, P-1B, P-4)
15.272	80	1/2 acre lots, 25% imp, HSG C (P-1A, P-1B, P-1D, P-1E, P-1F, P-1G, P-1H, P-1I, P-2A, P-2B, P-2C, P-2D, P-2E, P-2F, P-2G, P-3A, P-3B, P-3C, P-4, P-5)
0.250	61	>75% Grass cover, Good, HSG B (P-1A, P-1B, P-1D, P-1I)
2.251	74	>75% Grass cover, Good, HSG C (P-1A, P-1B, P-1D, P-1E, P-1F, P-1I, P-1J, P-2B, P-3A, P-3B, P-4, P-5)
2.164	65	Brush, Good, HSG C (P-2B, P-2C, P-3A, P-3B)
0.137	98	Paved parking, HSG B (P-1A, P-1B, P-1C, P-1D, P-4)
3.466	98	Paved parking, HSG C (P-1A, P-1B, P-1C, P-1E, P-1F, P-1G, P-1H, P-1J, P-2B, P-2C, P-2D, P-2E, P-2F, P-2G, P-3B, P-3C)
0.133	55	Woods, Good, HSG B (P-1A)
5.206	70	Woods, Good, HSG C (P-1A, P-2A, P-2B, P-2C, P-3A, P-3B)
29.385	**78**	**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-1I, P-4
28.359	HSG C	P-1A, P-1B, P-1C, P-1D, P-1E, P-1F, P-1G, P-1H, P-1I, P-1J, P-2A, P-2B, P-2C, P-2D, P-2E, P-2F, P-2G, P-3A, P-3B, P-3C, P-4, P-5
0.000	HSG D	
0.000	Other	
29.385		**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	0.505	15.272	0.000	0.000	15.777	1/2 acre lots, 25% imp	P-1A, P-1B, P-1D, P-1E, P-1F, P-1G, P-1H, P-1I, P-2A, P-2B, P-2C, P-2D, P-2E, P-2F, P-2G, P-3A, P-3B, P-3C, P-4, P-5
0.000	0.250	2.251	0.000	0.000	2.502	>75% Grass cover, Good	P-1A, P-1B, P-1D, P-1E, P-1F, P-1I, P-1J, P-2B, P-3A, P-3B, P-4, P-5
0.000	0.000	2.164	0.000	0.000	2.164	Brush, Good	P-2B, P-2C, P-3A, P-3B
0.000	0.137	3.466	0.000	0.000	3.603	Paved parking	P-1A, P-1B, P-1C, P-1D, P-1E, P-1F, P-1G, P-1H, P-1J, P-2B, P-2C, P-2D, P-2E, P-2F, P-2G, P-3B, P-3C, P-4
0.000	0.133	5.206	0.000	0.000	5.339	Woods, Good	P-1A, P-2A, P-2B, P-2C, P-3A, P-3B
0.000	**1.026**	**28.359**	**0.000**	**0.000**	**29.385**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)
1	CB-21A	903.04	902.20	54.0	0.0156	0.013	0.0	24.0	0.0
2	DMH-01	911.00	910.66	34.0	0.0100	0.013	0.0	15.0	0.0
3	DMH-02	910.56	909.27	40.0	0.0322	0.013	0.0	18.0	0.0
4	DMH-03	911.90	910.66	38.0	0.0326	0.013	0.0	15.0	0.0
5	DMH-05	900.59	895.90	84.0	0.0558	0.013	0.0	12.0	0.0
6	DMH-20	911.39	910.08	33.0	0.0397	0.013	0.0	18.0	0.0
7	DMH-30	914.07	913.50	22.0	0.0259	0.013	0.0	18.0	0.0
8	DS-1a	907.00	906.00	13.0	0.0769	0.013	0.0	12.0	0.0
9	DS-1b	880.00	879.50	10.0	0.0500	0.013	0.0	12.0	0.0
10	DS-1c	847.64	847.27	37.0	0.0100	0.013	0.0	15.0	0.0
11	DS-2a	893.80	890.00	54.0	0.0704	0.013	0.0	12.0	0.0
12	DS-2a	893.80	878.50	178.0	0.0860	0.013	0.0	12.0	0.0
13	DS-2b	859.20	858.70	45.0	0.0111	0.013	0.0	8.0	0.0
14	DS-3	907.00	906.80	30.0	0.0067	0.013	0.0	12.0	0.0

Notes Listing (all nodes)

Line#	Node Number	Notes
1	R-01	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.
2		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".
3	R-02	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.
4		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".

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=154,716 sf 12.37% Impervious Runoff Depth=1.00"
Flow Length=344' Tc=14.4 min CN=73 Runoff=2.98 cfs 0.297 af

Subcatchment P-1B: Subcat P-1B Runoff Area=21,857 sf 28.45% Impervious Runoff Depth=1.23"
Flow Length=315' Tc=8.2 min CN=77 Runoff=0.64 cfs 0.052 af

Subcatchment P-1C: Subcat P-1C Runoff Area=0.306 ac 100.00% Impervious Runoff Depth=3.00"
Tc=6.0 min CN=98 Runoff=0.94 cfs 0.076 af

Subcatchment P-1D: Subcat P-1D Runoff Area=0.599 ac 4.42% Impervious Runoff Depth=0.95"
Flow Length=310' Tc=7.0 min CN=72 Runoff=0.59 cfs 0.047 af

Subcatchment P-1E: Subcat P-1E Runoff Area=0.351 ac 73.21% Impervious Runoff Depth=2.38"
Tc=6.0 min CN=92 Runoff=0.93 cfs 0.070 af

Subcatchment P-1F: Subcat P-1F Runoff Area=0.670 ac 51.82% Impervious Runoff Depth=1.86"
Tc=6.0 min CN=86 Runoff=1.43 cfs 0.104 af

Subcatchment P-1G: Subcat P-1G Runoff Area=0.522 ac 34.26% Impervious Runoff Depth=1.56"
Flow Length=321' Slope=0.0600 '/' Tc=10.6 min CN=82 Runoff=0.81 cfs 0.068 af

Subcatchment P-1H: Subcat P-1H Runoff Area=1.260 ac 41.56% Impervious Runoff Depth=1.71"
Flow Length=241' Tc=10.3 min CN=84 Runoff=2.16 cfs 0.179 af

Subcatchment P-1I: Subcat P-1I Runoff Area=22,426 sf 6.38% Impervious Runoff Depth=1.11"
Tc=6.0 min CN=75 Runoff=0.63 cfs 0.048 af

Subcatchment P-1J: Subcat P-1J Runoff Area=10,290 sf 0.02% Impervious Runoff Depth=1.06"
Tc=6.0 min CN=74 Runoff=0.27 cfs 0.021 af

Subcatchment P-2A: Subcat P-2A Runoff Area=2.171 ac 12.55% Impervious Runoff Depth=1.11"
Flow Length=175' Tc=9.8 min CN=75 Runoff=2.36 cfs 0.202 af

Subcatchment P-2B: Subcat P-2B Runoff Area=2.009 ac 22.10% Impervious Runoff Depth=1.23"
Flow Length=334' Tc=7.6 min CN=77 Runoff=2.64 cfs 0.207 af

Subcatchment P-2C: Subcat P-2C Runoff Area=1.694 ac 35.54% Impervious Runoff Depth=1.49"
Flow Length=281' Tc=13.3 min CN=81 Runoff=2.31 cfs 0.211 af

Subcatchment P-2D: Subcat P-2D Runoff Area=1.254 ac 33.11% Impervious Runoff Depth=1.56"
Flow Length=290' Tc=10.1 min CN=82 Runoff=1.97 cfs 0.163 af

Subcatchment P-2E: Subcat P-2E Runoff Area=1.456 ac 35.83% Impervious Runoff Depth=1.63"
Flow Length=310' Tc=8.6 min CN=83 Runoff=2.49 cfs 0.198 af

Subcatchment P-2F: Subcat P-2F Runoff Area=1.888 ac 35.41% Impervious Runoff Depth=1.56"
Flow Length=370' Tc=9.2 min CN=82 Runoff=3.03 cfs 0.246 af

Subcatchment P-2G: Subcat P-2G Runoff Area=0.778 ac 67.80% Impervious Runoff Depth=2.20"
Tc=6.0 min CN=90 Runoff=1.94 cfs 0.142 af

Subcatchment P-3A: Subcat P-3A Runoff Area=4.549 ac 6.74% Impervious Runoff Depth=0.90"
Flow Length=802' Tc=18.3 min CN=71 Runoff=3.01 cfs 0.340 af

Subcatchment P-3B: Subcat P-3B Runoff Area=1.514 ac 10.37% Impervious Runoff Depth=1.06"
Flow Length=94' Tc=9.2 min CN=74 Runoff=1.57 cfs 0.133 af

Subcatchment P-3C: Subcat P-3C Runoff Area=2.272 ac 48.35% Impervious Runoff Depth=1.86"
Flow Length=499' Tc=11.6 min CN=86 Runoff=4.10 cfs 0.352 af

Subcatchment P-4: Subcat P-4 Runoff Area=52,519 sf 22.18% Impervious Runoff Depth=1.36"
Flow Length=272' Tc=14.2 min CN=79 Runoff=1.45 cfs 0.137 af

Subcatchment P-5: Subcat P-5 Runoff Area=3,673 sf 15.86% Impervious Runoff Depth=1.30"
Tc=6.0 min CN=78 Runoff=0.12 cfs 0.009 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.28' Max Vel=0.36 fps Inflow=2.83 cfs 0.486 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=1.87 cfs 0.486 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=0.50' Max Vel=0.25 fps Inflow=3.75 cfs 1.162 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=2.30 cfs 1.160 af

Pond CB-21A: CB Peak Elev=903.62' Inflow=1.97 cfs 0.163 af
24.0" Round Culvert n=0.013 L=54.0' S=0.0156 '/' Outflow=1.97 cfs 0.163 af

Pond DB-3: detention Peak Elev=812.73' Storage=2,782 cf Inflow=3.01 cfs 0.340 af
Outflow=2.08 cfs 0.337 af

Pond DMH-01: DMH Peak Elev=911.81' Inflow=2.16 cfs 0.179 af
15.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=2.16 cfs 0.179 af

Pond DMH-02: DMH Peak Elev=911.37' Inflow=2.97 cfs 0.247 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0322 '/' Outflow=2.97 cfs 0.247 af

Pond DMH-03: DMH Peak Elev=912.32' Inflow=0.81 cfs 0.068 af
15.0" Round Culvert n=0.013 L=38.0' S=0.0326 '/' Outflow=0.81 cfs 0.068 af

Pond DMH-05: DMH Peak Elev=901.23' Inflow=1.43 cfs 0.104 af
12.0" Round Culvert n=0.013 L=84.0' S=0.0558 '/' Outflow=1.43 cfs 0.104 af

Pond DMH-20: DMH Peak Elev=912.09' Inflow=2.31 cfs 0.211 af
18.0" Round Culvert n=0.013 L=33.0' S=0.0397 '/' Outflow=2.31 cfs 0.211 af

Pond DMH-30: DMH Peak Elev=915.05' Inflow=4.10 cfs 0.352 af
18.0" Round Culvert n=0.013 L=22.0' S=0.0259 '/' Outflow=4.10 cfs 0.352 af

Pond DS-1a: detention Peak Elev=907.29' Storage=0.176 af Inflow=2.97 cfs 0.247 af
Outflow=0.15 cfs 0.098 af

Pond DS-1b: detention Peak Elev=881.00' Storage=0.023 af Inflow=2.64 cfs 0.292 af
Outflow=1.68 cfs 0.292 af

Pond DS-1c: detention Peak Elev=849.88' Storage=5,357 cf Inflow=3.66 cfs 0.464 af
Outflow=1.33 cfs 0.464 af

Pond DS-2a: detention Peak Elev=897.41' Storage=15,476 cf Inflow=11.25 cfs 0.960 af
Outflow=2.27 cfs 0.960 af

Pond DS-2b: detention Peak Elev=859.81' Storage=3,332 cf Inflow=2.64 cfs 0.207 af
Outflow=0.57 cfs 0.203 af

Pond DS-3: detention Peak Elev=910.85' Storage=0.077 af Inflow=4.10 cfs 0.352 af
Outflow=1.63 cfs 0.352 af

Pond G2: gabion Peak Elev=878.54' Storage=6 cf Inflow=2.27 cfs 0.960 af
Outflow=2.27 cfs 0.960 af

Pond G3: gabion Peak Elev=906.86' Storage=0.000 af Inflow=1.63 cfs 0.352 af
Outflow=1.63 cfs 0.352 af

Link SP1: STUDY POINT #1 Inflow=3.85 cfs 0.812 af
Primary=3.85 cfs 0.812 af

Link SP2: STUDY POINT #2 Inflow=2.84 cfs 1.363 af
Primary=2.84 cfs 1.363 af

Link SP3: STUDY POINT #3 Inflow=3.91 cfs 0.823 af
Primary=3.91 cfs 0.823 af

Link SP4: STUDY POINT #4 Inflow=1.45 cfs 0.137 af
Primary=1.45 cfs 0.137 af

Link SP5: STUDY POINT #5 Inflow=0.12 cfs 0.009 af
Primary=0.12 cfs 0.009 af

Total Runoff Area = 29.385 ac Runoff Volume = 3.301 af Average Runoff Depth = 1.35"
74.32% Pervious = 21.837 ac 25.68% Impervious = 7.547 ac

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=154,716 sf 12.37% Impervious Runoff Depth=2.16"
Flow Length=344' Tc=14.4 min CN=73 Runoff=6.81 cfs 0.640 af

Subcatchment P-1B: Subcat P-1B Runoff Area=21,857 sf 28.45% Impervious Runoff Depth=2.50"
Flow Length=315' Tc=8.2 min CN=77 Runoff=1.34 cfs 0.104 af

Subcatchment P-1C: Subcat P-1C Runoff Area=0.306 ac 100.00% Impervious Runoff Depth=4.61"
Tc=6.0 min CN=98 Runoff=1.42 cfs 0.118 af

Subcatchment P-1D: Subcat P-1D Runoff Area=0.599 ac 4.42% Impervious Runoff Depth=2.08"
Flow Length=310' Tc=7.0 min CN=72 Runoff=1.38 cfs 0.104 af

Subcatchment P-1E: Subcat P-1E Runoff Area=0.351 ac 73.21% Impervious Runoff Depth=3.94"
Tc=6.0 min CN=92 Runoff=1.51 cfs 0.115 af

Subcatchment P-1F: Subcat P-1F Runoff Area=0.670 ac 51.82% Impervious Runoff Depth=3.33"
Tc=6.0 min CN=86 Runoff=2.52 cfs 0.186 af

Subcatchment P-1G: Subcat P-1G Runoff Area=0.522 ac 34.26% Impervious Runoff Depth=2.95"
Flow Length=321' Slope=0.0600 '/' Tc=10.6 min CN=82 Runoff=1.53 cfs 0.128 af

Subcatchment P-1H: Subcat P-1H Runoff Area=1.260 ac 41.56% Impervious Runoff Depth=3.13"
Flow Length=241' Tc=10.3 min CN=84 Runoff=3.94 cfs 0.329 af

Subcatchment P-1I: Subcat P-1I Runoff Area=22,426 sf 6.38% Impervious Runoff Depth=2.33"
Tc=6.0 min CN=75 Runoff=1.37 cfs 0.100 af

Subcatchment P-1J: Subcat P-1J Runoff Area=10,290 sf 0.02% Impervious Runoff Depth=2.25"
Tc=6.0 min CN=74 Runoff=0.61 cfs 0.044 af

Subcatchment P-2A: Subcat P-2A Runoff Area=2.171 ac 12.55% Impervious Runoff Depth=2.33"
Flow Length=175' Tc=9.8 min CN=75 Runoff=5.12 cfs 0.421 af

Subcatchment P-2B: Subcat P-2B Runoff Area=2.009 ac 22.10% Impervious Runoff Depth=2.50"
Flow Length=334' Tc=7.6 min CN=77 Runoff=5.49 cfs 0.418 af

Subcatchment P-2C: Subcat P-2C Runoff Area=1.694 ac 35.54% Impervious Runoff Depth=2.85"
Flow Length=281' Tc=13.3 min CN=81 Runoff=4.44 cfs 0.403 af

Subcatchment P-2D: Subcat P-2D Runoff Area=1.254 ac 33.11% Impervious Runoff Depth=2.95"
Flow Length=290' Tc=10.1 min CN=82 Runoff=3.72 cfs 0.308 af

Subcatchment P-2E: Subcat P-2E Runoff Area=1.456 ac 35.83% Impervious Runoff Depth=3.04"
Flow Length=310' Tc=8.6 min CN=83 Runoff=4.66 cfs 0.369 af

Subcatchment P-2F: Subcat P-2F Runoff Area=1.888 ac 35.41% Impervious Runoff Depth=2.95"
Flow Length=370' Tc=9.2 min CN=82 Runoff=5.73 cfs 0.463 af

Subcatchment P-2G: Subcat P-2G Runoff Area=0.778 ac 67.80% Impervious Runoff Depth=3.73"
Tc=6.0 min CN=90 Runoff=3.21 cfs 0.242 af

Subcatchment P-3A: Subcat P-3A Runoff Area=4.549 ac 6.74% Impervious Runoff Depth=2.00"
Flow Length=802' Tc=18.3 min CN=71 Runoff=7.30 cfs 0.760 af

Subcatchment P-3B: Subcat P-3B Runoff Area=1.514 ac 10.37% Impervious Runoff Depth=2.25"
Flow Length=94' Tc=9.2 min CN=74 Runoff=3.49 cfs 0.283 af

Subcatchment P-3C: Subcat P-3C Runoff Area=2.272 ac 48.35% Impervious Runoff Depth=3.33"
Flow Length=499' Tc=11.6 min CN=86 Runoff=7.25 cfs 0.630 af

Subcatchment P-4: Subcat P-4 Runoff Area=52,519 sf 22.18% Impervious Runoff Depth=2.67"
Flow Length=272' Tc=14.2 min CN=79 Runoff=2.90 cfs 0.269 af

Subcatchment P-5: Subcat P-5 Runoff Area=3,673 sf 15.86% Impervious Runoff Depth=2.58"
Tc=6.0 min CN=78 Runoff=0.25 cfs 0.018 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.42' Max Vel=0.46 fps Inflow=7.95 cfs 0.913 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=4.98 cfs 0.913 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=0.86' Max Vel=0.34 fps Inflow=10.18 cfs 2.205 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=7.11 cfs 2.204 af

Pond CB-21A: CB Peak Elev=903.86' Inflow=3.72 cfs 0.308 af
24.0" Round Culvert n=0.013 L=54.0' S=0.0156 '/' Outflow=3.72 cfs 0.308 af

Pond DB-3: detention Peak Elev=813.64' Storage=4,956 cf Inflow=7.30 cfs 0.760 af
Outflow=5.98 cfs 0.757 af

Pond DMH-01: DMH Peak Elev=912.23' Inflow=3.94 cfs 0.329 af
15.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=3.94 cfs 0.329 af

Pond DMH-02: DMH Peak Elev=911.73' Inflow=5.47 cfs 0.457 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0322 '/' Outflow=5.47 cfs 0.457 af

Pond DMH-03: DMH Peak Elev=912.50' Inflow=1.53 cfs 0.128 af
15.0" Round Culvert n=0.013 L=38.0' S=0.0326 '/' Outflow=1.53 cfs 0.128 af

Pond DMH-05: DMH Peak Elev=901.53' Inflow=2.52 cfs 0.186 af
12.0" Round Culvert n=0.013 L=84.0' S=0.0558 '/' Outflow=2.52 cfs 0.186 af

Pond DMH-20: DMH Peak Elev=912.42' Inflow=4.44 cfs 0.403 af
18.0" Round Culvert n=0.013 L=33.0' S=0.0397 '/' Outflow=4.44 cfs 0.403 af

Pond DMH-30: DMH Peak Elev=915.54' Inflow=7.25 cfs 0.630 af
18.0" Round Culvert n=0.013 L=22.0' S=0.0259 '/' Outflow=7.25 cfs 0.630 af

Pond DS-1a: detention Peak Elev=908.18' Storage=0.273 af Inflow=5.47 cfs 0.457 af
Outflow=0.42 cfs 0.307 af

Pond DS-1b: detention Peak Elev=881.73' Storage=0.050 af Inflow=4.64 cfs 0.653 af
Outflow=2.48 cfs 0.653 af

Pond DS-1c: detention Peak Elev=850.91' Storage=8,291 cf Inflow=6.32 cfs 0.974 af
Outflow=3.35 cfs 0.974 af

Pond DS-2a: detention Peak Elev=899.13' Storage=25,427 cf Inflow=20.92 cfs 1.784 af
Outflow=8.05 cfs 1.784 af

Pond DS-2b: detention Peak Elev=860.56' Storage=7,421 cf Inflow=5.49 cfs 0.418 af
Outflow=1.00 cfs 0.414 af

Pond DS-3: detention Peak Elev=911.94' Storage=0.105 af Inflow=7.25 cfs 0.630 af
Outflow=5.53 cfs 0.630 af

Pond G2: gabion Peak Elev=878.80' Storage=123 cf Inflow=8.05 cfs 1.784 af
Outflow=8.05 cfs 1.784 af

Pond G3: gabion Peak Elev=907.37' Storage=0.002 af Inflow=5.53 cfs 0.630 af
Outflow=5.58 cfs 0.630 af

Link SP1: STUDY POINT #1 Inflow=10.12 cfs 1.719 af
Primary=10.12 cfs 1.719 af

Link SP2: STUDY POINT #2 Inflow=8.10 cfs 2.618 af
Primary=8.10 cfs 2.618 af

Link SP3: STUDY POINT #3 Inflow=10.85 cfs 1.670 af
Primary=10.85 cfs 1.670 af

Link SP4: STUDY POINT #4 Inflow=2.90 cfs 0.269 af
Primary=2.90 cfs 0.269 af

Link SP5: STUDY POINT #5 Inflow=0.25 cfs 0.018 af
Primary=0.25 cfs 0.018 af

Total Runoff Area = 29.385 ac Runoff Volume = 6.452 af Average Runoff Depth = 2.63"
74.32% Pervious = 21.837 ac 25.68% Impervious = 7.547 ac

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=154,716 sf 12.37% Impervious Runoff Depth=3.19"
Flow Length=344' Tc=14.4 min CN=73 Runoff=10.14 cfs 0.944 af

Subcatchment P-1B: Subcat P-1B Runoff Area=21,857 sf 28.45% Impervious Runoff Depth=3.58"
Flow Length=315' Tc=8.2 min CN=77 Runoff=1.93 cfs 0.150 af

Subcatchment P-1C: Subcat P-1C Runoff Area=0.306 ac 100.00% Impervious Runoff Depth=5.88"
Tc=6.0 min CN=98 Runoff=1.79 cfs 0.150 af

Subcatchment P-1D: Subcat P-1D Runoff Area=0.599 ac 4.42% Impervious Runoff Depth=3.09"
Flow Length=310' Tc=7.0 min CN=72 Runoff=2.07 cfs 0.154 af

Subcatchment P-1E: Subcat P-1E Runoff Area=0.351 ac 73.21% Impervious Runoff Depth=5.19"
Tc=6.0 min CN=92 Runoff=1.95 cfs 0.152 af

Subcatchment P-1F: Subcat P-1F Runoff Area=0.670 ac 51.82% Impervious Runoff Depth=4.52"
Tc=6.0 min CN=86 Runoff=3.39 cfs 0.252 af

Subcatchment P-1G: Subcat P-1G Runoff Area=0.522 ac 34.26% Impervious Runoff Depth=4.10"
Flow Length=321' Slope=0.0600 '/' Tc=10.6 min CN=82 Runoff=2.11 cfs 0.178 af

Subcatchment P-1H: Subcat P-1H Runoff Area=1.260 ac 41.56% Impervious Runoff Depth=4.31"
Flow Length=241' Tc=10.3 min CN=84 Runoff=5.37 cfs 0.452 af

Subcatchment P-1I: Subcat P-1I Runoff Area=22,426 sf 6.38% Impervious Runoff Depth=3.38"
Tc=6.0 min CN=75 Runoff=2.00 cfs 0.145 af

Subcatchment P-1J: Subcat P-1J Runoff Area=10,290 sf 0.02% Impervious Runoff Depth=3.29"
Tc=6.0 min CN=74 Runoff=0.89 cfs 0.065 af

Subcatchment P-2A: Subcat P-2A Runoff Area=2.171 ac 12.55% Impervious Runoff Depth=3.38"
Flow Length=175' Tc=9.8 min CN=75 Runoff=7.47 cfs 0.612 af

Subcatchment P-2B: Subcat P-2B Runoff Area=2.009 ac 22.10% Impervious Runoff Depth=3.58"
Flow Length=334' Tc=7.6 min CN=77 Runoff=7.89 cfs 0.600 af

Subcatchment P-2C: Subcat P-2C Runoff Area=1.694 ac 35.54% Impervious Runoff Depth=3.99"
Flow Length=281' Tc=13.3 min CN=81 Runoff=6.19 cfs 0.564 af

Subcatchment P-2D: Subcat P-2D Runoff Area=1.254 ac 33.11% Impervious Runoff Depth=4.10"
Flow Length=290' Tc=10.1 min CN=82 Runoff=5.14 cfs 0.428 af

Subcatchment P-2E: Subcat P-2E Runoff Area=1.456 ac 35.83% Impervious Runoff Depth=4.20"
Flow Length=310' Tc=8.6 min CN=83 Runoff=6.39 cfs 0.510 af

Subcatchment P-2F: Subcat P-2F Runoff Area=1.888 ac 35.41% Impervious Runoff Depth=4.10"
Flow Length=370' Tc=9.2 min CN=82 Runoff=7.91 cfs 0.645 af

Subcatchment P-2G: Subcat P-2G Runoff Area=0.778 ac 67.80% Impervious Runoff Depth=4.96"
Tc=6.0 min CN=90 Runoff=4.21 cfs 0.322 af

Subcatchment P-3A: Subcat P-3A Runoff Area=4.549 ac 6.74% Impervious Runoff Depth=3.00"
Flow Length=802' Tc=18.3 min CN=71 Runoff=11.08 cfs 1.136 af

Subcatchment P-3B: Subcat P-3B Runoff Area=1.514 ac 10.37% Impervious Runoff Depth=3.29"
Flow Length=94' Tc=9.2 min CN=74 Runoff=5.13 cfs 0.415 af

Subcatchment P-3C: Subcat P-3C Runoff Area=2.272 ac 48.35% Impervious Runoff Depth=4.52"
Flow Length=499' Tc=11.6 min CN=86 Runoff=9.74 cfs 0.856 af

Subcatchment P-4: Subcat P-4 Runoff Area=52,519 sf 22.18% Impervious Runoff Depth=3.79"
Flow Length=272' Tc=14.2 min CN=79 Runoff=4.10 cfs 0.380 af

Subcatchment P-5: Subcat P-5 Runoff Area=3,673 sf 15.86% Impervious Runoff Depth=3.69"
Tc=6.0 min CN=78 Runoff=0.36 cfs 0.026 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.50' Max Vel=0.51 fps Inflow=11.49 cfs 1.271 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=7.58 cfs 1.271 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=1.09' Max Vel=0.39 fps Inflow=17.75 cfs 3.080 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=12.02 cfs 3.078 af

Pond CB-21A: CB Peak Elev=904.02' Inflow=5.14 cfs 0.428 af
24.0" Round Culvert n=0.013 L=54.0' S=0.0156 '/' Outflow=5.14 cfs 0.428 af

Pond DB-3: detention Peak Elev=814.17' Storage=6,481 cf Inflow=11.08 cfs 1.136 af
Outflow=9.47 cfs 1.133 af

Pond DMH-01: DMH Peak Elev=912.81' Inflow=5.37 cfs 0.452 af
15.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=5.37 cfs 0.452 af

Pond DMH-02: DMH Peak Elev=912.08' Inflow=7.48 cfs 0.630 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0322 '/' Outflow=7.48 cfs 0.630 af

Pond DMH-03: DMH Peak Elev=912.63' Inflow=2.11 cfs 0.178 af
15.0" Round Culvert n=0.013 L=38.0' S=0.0326 '/' Outflow=2.11 cfs 0.178 af

Pond DMH-05: DMH Peak Elev=901.89' Inflow=3.39 cfs 0.252 af
12.0" Round Culvert n=0.013 L=84.0' S=0.0558 '/' Outflow=3.39 cfs 0.252 af

Pond DMH-20: DMH Peak Elev=912.67' Inflow=6.19 cfs 0.564 af
18.0" Round Culvert n=0.013 L=33.0' S=0.0397 '/' Outflow=6.19 cfs 0.564 af

Pond DMH-30: DMH Peak Elev=916.13' Inflow=9.74 cfs 0.856 af
18.0" Round Culvert n=0.013 L=22.0' S=0.0259 '/' Outflow=9.74 cfs 0.856 af

Pond DS-1a: detention Peak Elev=909.13' Storage=0.379 af Inflow=7.48 cfs 0.630 af
Outflow=0.59 cfs 0.480 af

Pond DS-1b: detention Peak Elev=882.47' Storage=0.080 af Inflow=6.44 cfs 0.949 af
Outflow=3.08 cfs 0.949 af

Pond DS-1c: detention Peak Elev=851.54' Storage=10,102 cf Inflow=8.46 cfs 1.399 af
Outflow=4.95 cfs 1.399 af

Pond DS-2a: detention Peak Elev=900.40' Storage=32,413 cf Inflow=28.72 cfs 2.468 af
Outflow=13.80 cfs 2.468 af

Pond DS-2b: detention Peak Elev=861.24' Storage=11,087 cf Inflow=7.89 cfs 0.600 af
Outflow=1.26 cfs 0.596 af

Pond DS-3: detention Peak Elev=912.92' Storage=0.128 af Inflow=9.74 cfs 0.856 af
Outflow=7.56 cfs 0.856 af

Pond G2: gabion Peak Elev=879.32' Storage=493 cf Inflow=13.80 cfs 2.468 af
Outflow=13.92 cfs 2.468 af

Pond G3: gabion Peak Elev=907.64' Storage=0.003 af Inflow=7.56 cfs 0.856 af
Outflow=7.56 cfs 0.856 af

Link SP1: STUDY POINT #1 Inflow=15.69 cfs 2.492 af
Primary=15.69 cfs 2.492 af

Link SP2: STUDY POINT #2 Inflow=13.28 cfs 3.674 af
Primary=13.28 cfs 3.674 af

Link SP3: STUDY POINT #3 Inflow=16.84 cfs 2.403 af
Primary=16.84 cfs 2.403 af

Link SP4: STUDY POINT #4 Inflow=4.10 cfs 0.380 af
Primary=4.10 cfs 0.380 af

Link SP5: STUDY POINT #5 Inflow=0.36 cfs 0.026 af
Primary=0.36 cfs 0.026 af

Total Runoff Area = 29.385 ac Runoff Volume = 9.136 af Average Runoff Depth = 3.73"
74.32% Pervious = 21.837 ac 25.68% Impervious = 7.547 ac

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=154,716 sf 12.37% Impervious Runoff Depth=5.45"
Flow Length=344' Tc=14.4 min CN=73 Runoff=17.32 cfs 1.614 af

Subcatchment P-1B: Subcat P-1B Runoff Area=21,857 sf 28.45% Impervious Runoff Depth=5.94"
Flow Length=315' Tc=8.2 min CN=77 Runoff=3.16 cfs 0.248 af

Subcatchment P-1C: Subcat P-1C Runoff Area=0.306 ac 100.00% Impervious Runoff Depth=8.48"
Tc=6.0 min CN=98 Runoff=2.56 cfs 0.216 af

Subcatchment P-1D: Subcat P-1D Runoff Area=0.599 ac 4.42% Impervious Runoff Depth=5.33"
Flow Length=310' Tc=7.0 min CN=72 Runoff=3.56 cfs 0.266 af

Subcatchment P-1E: Subcat P-1E Runoff Area=0.351 ac 73.21% Impervious Runoff Depth=7.76"
Tc=6.0 min CN=92 Runoff=2.85 cfs 0.227 af

Subcatchment P-1F: Subcat P-1F Runoff Area=0.670 ac 51.82% Impervious Runoff Depth=7.03"
Tc=6.0 min CN=86 Runoff=5.15 cfs 0.392 af

Subcatchment P-1G: Subcat P-1G Runoff Area=0.522 ac 34.26% Impervious Runoff Depth=6.55"
Flow Length=321' Slope=0.0600 '/' Tc=10.6 min CN=82 Runoff=3.32 cfs 0.285 af

Subcatchment P-1H: Subcat P-1H Runoff Area=1.260 ac 41.56% Impervious Runoff Depth=6.79"
Flow Length=241' Tc=10.3 min CN=84 Runoff=8.29 cfs 0.713 af

Subcatchment P-1I: Subcat P-1I Runoff Area=22,426 sf 6.38% Impervious Runoff Depth=5.70"
Tc=6.0 min CN=75 Runoff=3.34 cfs 0.244 af

Subcatchment P-1J: Subcat P-1J Runoff Area=10,290 sf 0.02% Impervious Runoff Depth=5.57"
Tc=6.0 min CN=74 Runoff=1.50 cfs 0.110 af

Subcatchment P-2A: Subcat P-2A Runoff Area=2.171 ac 12.55% Impervious Runoff Depth=5.70"
Flow Length=175' Tc=9.8 min CN=75 Runoff=12.49 cfs 1.030 af

Subcatchment P-2B: Subcat P-2B Runoff Area=2.009 ac 22.10% Impervious Runoff Depth=5.94"
Flow Length=334' Tc=7.6 min CN=77 Runoff=12.93 cfs 0.994 af

Subcatchment P-2C: Subcat P-2C Runoff Area=1.694 ac 35.54% Impervious Runoff Depth=6.42"
Flow Length=281' Tc=13.3 min CN=81 Runoff=9.80 cfs 0.907 af

Subcatchment P-2D: Subcat P-2D Runoff Area=1.254 ac 33.11% Impervious Runoff Depth=6.55"
Flow Length=290' Tc=10.1 min CN=82 Runoff=8.07 cfs 0.684 af

Subcatchment P-2E: Subcat P-2E Runoff Area=1.456 ac 35.83% Impervious Runoff Depth=6.67"
Flow Length=310' Tc=8.6 min CN=83 Runoff=9.95 cfs 0.809 af

Subcatchment P-2F: Subcat P-2F Runoff Area=1.888 ac 35.41% Impervious Runoff Depth=6.55"
Flow Length=370' Tc=9.2 min CN=82 Runoff=12.41 cfs 1.030 af

Subcatchment P-2G: Subcat P-2G Runoff Area=0.778 ac 67.80% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=90 Runoff=6.22 cfs 0.487 af

Subcatchment P-3A: Subcat P-3A Runoff Area=4.549 ac 6.74% Impervious Runoff Depth=5.21"
Flow Length=802' Tc=18.3 min CN=71 Runoff=19.36 cfs 1.975 af

Subcatchment P-3B: Subcat P-3B Runoff Area=1.514 ac 10.37% Impervious Runoff Depth=5.57"
Flow Length=94' Tc=9.2 min CN=74 Runoff=8.67 cfs 0.703 af

Subcatchment P-3C: Subcat P-3C Runoff Area=2.272 ac 48.35% Impervious Runoff Depth=7.03"
Flow Length=499' Tc=11.6 min CN=86 Runoff=14.82 cfs 1.331 af

Subcatchment P-4: Subcat P-4 Runoff Area=52,519 sf 22.18% Impervious Runoff Depth=6.18"
Flow Length=272' Tc=14.2 min CN=79 Runoff=6.62 cfs 0.621 af

Subcatchment P-5: Subcat P-5 Runoff Area=3,673 sf 15.86% Impervious Runoff Depth=6.06"
Tc=6.0 min CN=78 Runoff=0.58 cfs 0.043 af

Reach R-01: Routing to wetlands Avg. Flow Depth=0.62' Max Vel=0.59 fps Inflow=22.03 cfs 2.034 af
n=0.400 L=722.0' S=0.1087 '/' Capacity=43.77 cfs Outflow=13.12 cfs 2.034 af

Reach R-02: Routing through wetland/swale Avg. Flow Depth=1.49' Max Vel=0.46 fps Inflow=45.17 cfs 4.947 af
n=0.400 L=735.0' S=0.0189 '/' Capacity=24.55 cfs Outflow=23.99 cfs 4.945 af

Pond CB-21A: CB Peak Elev=905.17' Inflow=8.07 cfs 0.684 af
24.0" Round Culvert n=0.013 L=54.0' S=0.0156 '/' Outflow=8.07 cfs 0.684 af

Pond DB-3: detention Peak Elev=815.03' Storage=9,352 cf Inflow=19.36 cfs 1.975 af
Outflow=17.21 cfs 1.972 af

Pond DMH-01: DMH Peak Elev=914.94' Inflow=8.29 cfs 0.713 af
15.0" Round Culvert n=0.013 L=34.0' S=0.0100 '/' Outflow=8.29 cfs 0.713 af

Pond DMH-02: DMH Peak Elev=913.17' Inflow=11.60 cfs 0.997 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0322 '/' Outflow=11.60 cfs 0.997 af

Pond DMH-03: DMH Peak Elev=913.43' Inflow=3.32 cfs 0.285 af
15.0" Round Culvert n=0.013 L=38.0' S=0.0326 '/' Outflow=3.32 cfs 0.285 af

Pond DMH-05: DMH Peak Elev=902.94' Inflow=5.15 cfs 0.392 af
12.0" Round Culvert n=0.013 L=84.0' S=0.0558 '/' Outflow=5.15 cfs 0.392 af

Pond DMH-20: DMH Peak Elev=913.46' Inflow=9.80 cfs 0.907 af
18.0" Round Culvert n=0.013 L=33.0' S=0.0397 '/' Outflow=9.80 cfs 0.907 af

Pond DMH-30: DMH Peak Elev=917.85' Inflow=14.82 cfs 1.331 af
18.0" Round Culvert n=0.013 L=22.0' S=0.0259 '/' Outflow=14.82 cfs 1.331 af

Pond DS-1a: detention Peak Elev=911.73' Storage=0.610 af Inflow=11.60 cfs 0.997 af
Outflow=0.90 cfs 0.845 af

Pond DS-1b: detention Peak Elev=884.36' Storage=0.150 af Inflow=10.00 cfs 1.574 af
Outflow=4.25 cfs 1.574 af

Pond DS-1c: detention Peak Elev=852.63' Storage=13,190 cf Inflow=12.92 cfs 2.301 af
Outflow=8.27 cfs 2.301 af

Pond DS-2a: detention Peak Elev=905.06' Storage=42,973 cf Inflow=44.78 cfs 3.916 af
Outflow=37.38 cfs 3.916 af

Pond DS-2b: detention Peak Elev=862.56' Storage=18,274 cf Inflow=12.93 cfs 0.994 af
Outflow=2.53 cfs 0.990 af

Pond DS-3: detention Peak Elev=913.98' Storage=0.150 af Inflow=14.82 cfs 1.331 af
Outflow=14.44 cfs 1.331 af

Pond G2: gabion Peak Elev=879.97' Storage=878 cf Inflow=37.38 cfs 3.916 af
Outflow=36.48 cfs 3.916 af

Pond G3: gabion Peak Elev=908.26' Storage=0.006 af Inflow=14.44 cfs 1.331 af
Outflow=14.67 cfs 1.331 af

Link SP1: STUDY POINT #1 Inflow=27.09 cfs 4.163 af
Primary=27.09 cfs 4.163 af

Link SP2: STUDY POINT #2 Inflow=26.52 cfs 5.935 af
Primary=26.52 cfs 5.935 af

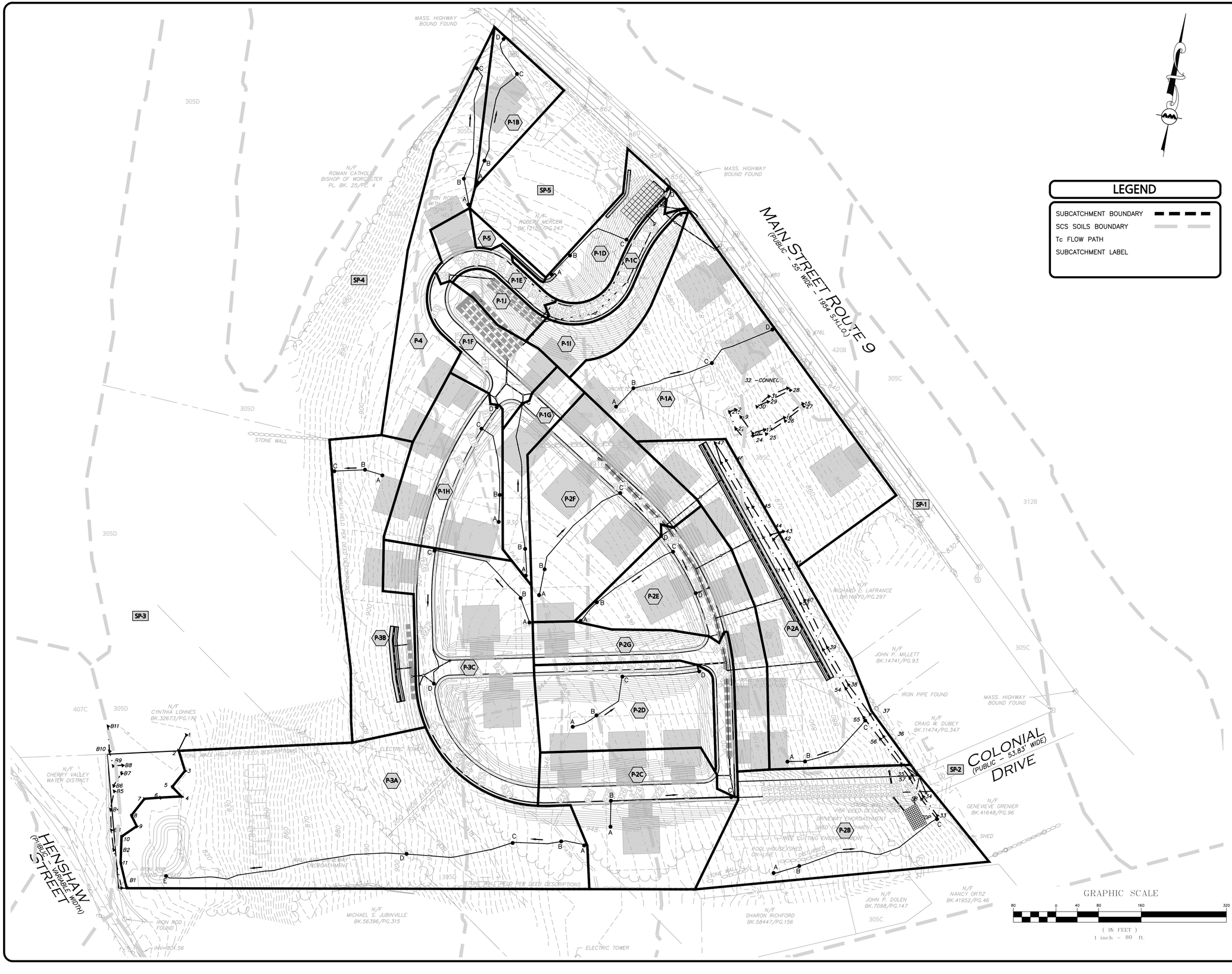
Link SP3: STUDY POINT #3 Inflow=30.33 cfs 4.006 af
Primary=30.33 cfs 4.006 af

Link SP4: STUDY POINT #4 Inflow=6.62 cfs 0.621 af
Primary=6.62 cfs 0.621 af

Link SP5: STUDY POINT #5 Inflow=0.58 cfs 0.043 af
Primary=0.58 cfs 0.043 af

Total Runoff Area = 29.385 ac Runoff Volume = 14.929 af Average Runoff Depth = 6.10"
74.32% Pervious = 21.837 ac 25.68% Impervious = 7.547 ac

Proposed Watershed Plan



LEGEND

- SUBCATCHMENT BOUNDARY
- SCS SOILS BOUNDARY
- Tc FLOW PATH
- SUBCATCHMENT LABEL

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION

APPLICANT:

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

PROJECT:

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION

MAIN STREET
LEICESTER, MA

PROJECT NO.	2889-01	DATE:	06-23-21
SCALE:	1" = 80'	DWG. :	C2889-01_Watershed-Proposed
DESIGNED BY:	SM	CHECKED BY:	MAM

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil engineering ◆ land surveying
environmental consulting ◆ landscape architecture
www.allenmajor.com
100 COMMERCE WAY, SUITE 5
WOBURN MA 01801
TEL: (781) 935-6889
FAX: (781) 935-2896
WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

THIS DRAWING HAS BEEN PREPARED IN DIGITAL FORMAT. CLIENT/CLIENT'S REPRESENTATIVE OR CONSULTANTS MAY BE PROVIDED COPIES OF DRAWINGS AND SPECIFICATIONS FOR HIS/HER INFORMATION AND/OR SPECIFIC USE ON THIS PROJECT. DUE TO THE POTENTIAL THAT THE PROVIDED INFORMATION MAY BE MODIFIED UNINTENTIONALLY OR OTHERWISE, ALLEN & MAJOR ASSOCIATES, INC. MAY REMOVE ALL INDICATION OF THE DOCUMENT'S AUTHORSHIP ON THE DIGITAL MEDIA. PRINTED REPRESENTATIONS OR PORTABLE DOCUMENT FORMAT OF THE DRAWINGS AND SPECIFICATIONS ISSUED SHALL BE THE ONLY RECORD COPIES OF ALLEN & MAJOR ASSOCIATES, INC.'S WORK PRODUCT.

DRAWING TITLE:

PROPOSED WATERSHED PLAN

SHEET No.

WS-2

Copyright©2021 Allen & Major Associates, Inc.
All Rights Reserved

R:\PROJECTS\2889-01\CIVIL\DRAWINGS\CURRENT\C-2889-01_WATERSHED-PROPOSED.DWG

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**

Powered by ACIS
Northeast Regional Climate Center

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.

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

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

Contents

Preface.....2
How Soil Surveys Are Made.....5
Soil Map.....8
Soil Map.....9
Legend.....10
Map Unit Legend.....12
Map Unit Descriptions.....12
Worcester County, Massachusetts, Southern Part.....15
70B—Ridgebury fine sandy loam, 3 to 8 percent slopes.....15
71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony.....16
73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony.....18
305B—Paxton fine sandy loam, 3 to 8 percent slopes.....19
305C—Paxton fine sandy loam, 8 to 15 percent slopes.....21
305D—Paxton fine sandy loam, 15 to 25 percent slopes.....22
312B—Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony.....24
407C—Charlton fine sandy loam, 8 to 15 percent slopes, extremely stony.....25
420B—Canton fine sandy loam, 3 to 8 percent slopes.....27
651—Udorthents, smoothed.....28
Soil Information for All Uses.....30
Soil Properties and Qualities.....30
Soil Physical Properties.....30
Saturated Hydraulic Conductivity (Ksat).....30
Soil Qualities and Features.....35
Hydrologic Soil Group.....35
References.....40

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.

Custom Soil Resource Report
Soil Map



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 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.

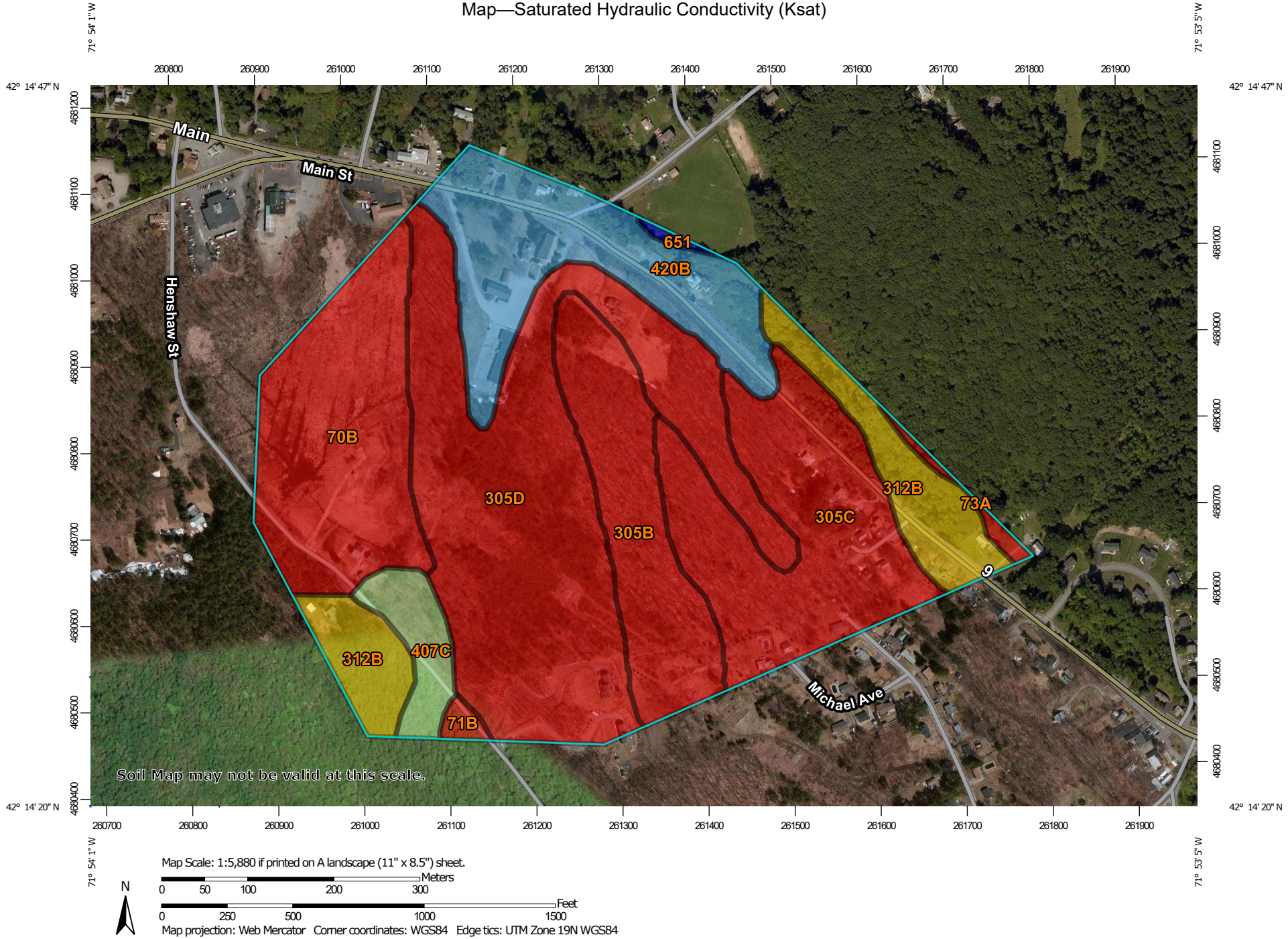
Saturated Hydraulic Conductivity (Ksat)

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.

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat)



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:

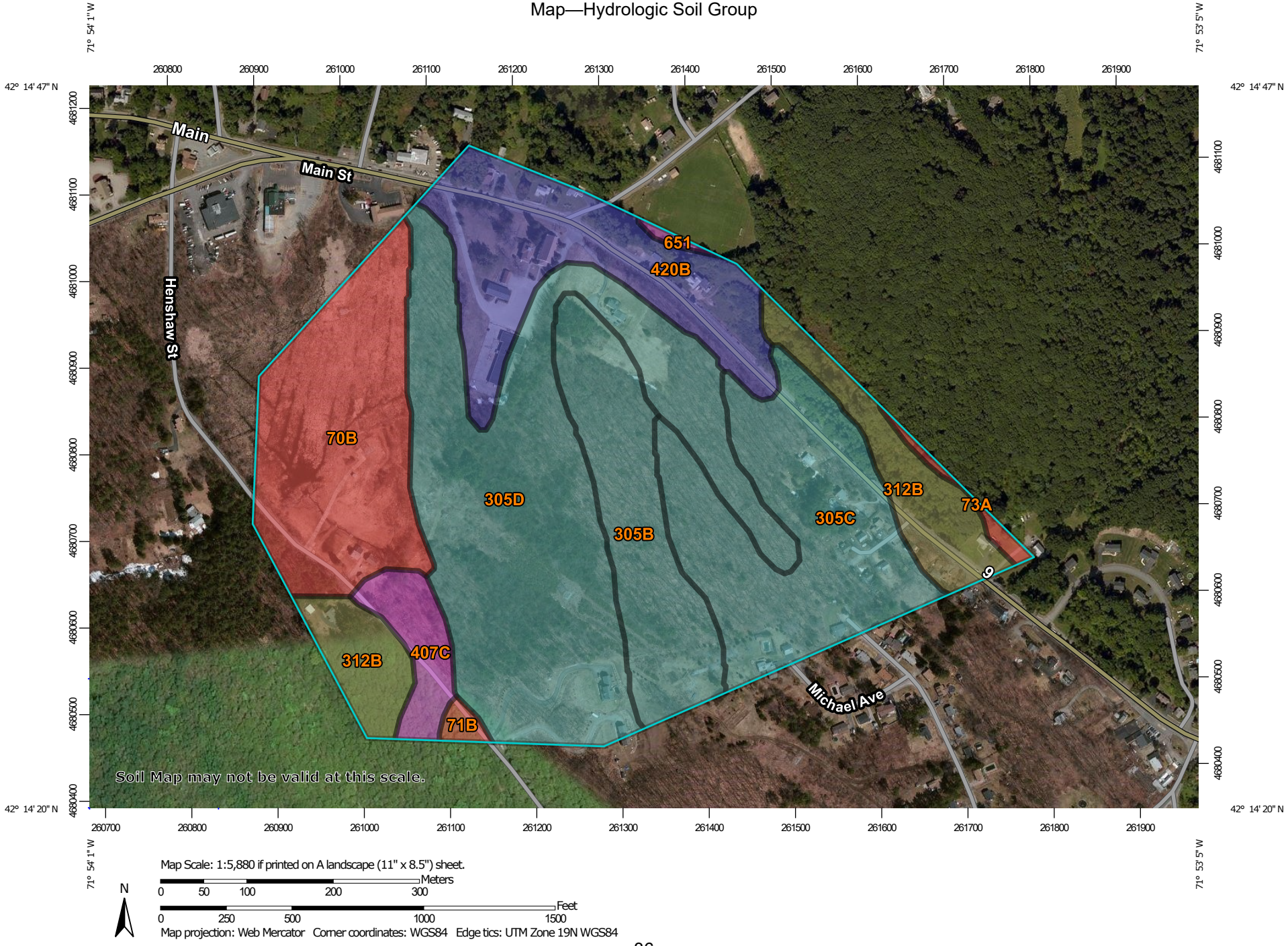
Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

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.


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
4681200
4681100
4681000
4680900
4680800
4680700
4680600
4680500
4680400
Main
Main St
Henshaw St
651
420B
70B
305D
305B
305C
312B
73A
9
312B
407C
71B
Michael Ave
Soil Map may not be valid at this scale.
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

- 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

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Water Quality Flow Calculations

Project:	**Skyview Estates Residential Subdivision**
Location:	**Leicester, MA**
Prepared For:	**Allen & Major Associates**

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
CB-21A	0.42	0.0006484	6.0	0.100	1.00	774.00	0.50
CB-22A	0.36	0.0005625	6.0	0.100	1.00	774.00	0.44
CB-22B	0.23	0.0003641	6.0	0.100	1.00	774.00	0.28
CB-23A	0.24	0.0003703	6.0	0.100	1.00	774.00	0.29
CB-23B	0.19	0.0002953	6.0	0.100	1.00	774.00	0.23
CB-24A	0.43	0.0006781	6.0	0.100	1.00	774.00	0.52
CB-24B	0.23	0.0003656	6.0	0.100	1.00	774.00	0.28
CB-26	0.39	0.0006047	6.0	0.100	1.00	774.00	0.47

Project: Skyview Estates Residential Subdivision
Location: Leicester, MA
Prepared For: Allen & Major Associates

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
DMH-02	0.70	0.0010969	6.0	0.100	1.00	774.00	0.85
DMH-05	0.35	0.0005422	6.0	0.100	1.00	774.00	0.42
DMH-06	0.26	0.0004016	6.0	0.100	1.00	774.00	0.31
DMH-11	0.34	0.0005281	6.0	0.100	1.00	774.00	0.41
DMH-20	0.60	0.0009406	6.0	0.100	1.00	774.00	0.73
DMH-30	1.10	0.0017172	6.0	0.100	1.00	774.00	1.33

WQU Sizing

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.42 ac	Unit Site Designation	CB-21A
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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.03	0.03	23.5
0.12	13.7%	53.4%	0.04	0.04	13.0
0.16	9.4%	62.8%	0.06	0.06	8.9
0.20	6.6%	69.5%	0.07	0.07	6.2
0.24	5.2%	74.7%	0.09	0.09	4.9
0.28	4.8%	79.5%	0.10	0.10	4.4
0.32	3.1%	82.6%	0.12	0.12	2.9
0.36	2.7%	85.3%	0.13	0.13	2.5
0.40	2.1%	87.4%	0.15	0.15	1.9
0.48	2.5%	89.9%	0.18	0.18	2.2
0.56	2.0%	91.9%	0.21	0.21	1.8
0.64	1.4%	93.3%	0.24	0.24	1.2
0.72	1.0%	94.3%	0.27	0.27	0.8
0.80	1.1%	95.4%	0.30	0.30	0.9
1.00	1.6%	97.1%	0.37	0.37	1.3
1.20	0.9%	98.0%	0.45	0.45	0.7
1.40	0.6%	98.6%	0.52	0.52	0.4
1.60	0.5%	99.1%	0.60	0.60	0.3
1.80	0.5%	99.6%	0.67	0.67	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					92.7
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**92.7%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.36 ac	Unit Site Designation	CB-22A
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.03	0.03	23.5
0.12	13.7%	53.4%	0.04	0.04	13.0
0.16	9.4%	62.8%	0.05	0.05	8.8
0.20	6.6%	69.5%	0.06	0.06	6.2
0.24	5.2%	74.7%	0.08	0.08	4.8
0.28	4.8%	79.5%	0.09	0.09	4.4
0.32	3.1%	82.6%	0.10	0.10	2.8
0.36	2.7%	85.3%	0.12	0.12	2.4
0.40	2.1%	87.4%	0.13	0.13	1.9
0.48	2.5%	89.9%	0.16	0.16	2.1
0.56	2.0%	91.9%	0.18	0.18	1.7
0.64	1.4%	93.3%	0.21	0.21	1.2
0.72	1.0%	94.3%	0.23	0.23	0.8
0.80	1.1%	95.4%	0.26	0.26	0.9
1.00	1.6%	97.1%	0.32	0.32	1.2
1.20	0.9%	98.0%	0.39	0.39	0.7
1.40	0.6%	98.6%	0.45	0.45	0.4
1.60	0.5%	99.1%	0.52	0.52	0.3
1.80	0.5%	99.6%	0.58	0.58	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					91.8
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**91.8%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.23 ac	Unit Site Designation	CB-22B
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.02	0.02	23.6
0.12	13.7%	53.4%	0.03	0.03	13.1
0.16	9.4%	62.8%	0.03	0.03	8.9
0.20	6.6%	69.5%	0.04	0.04	6.3
0.24	5.2%	74.7%	0.05	0.05	4.9
0.28	4.8%	79.5%	0.06	0.06	4.5
0.32	3.1%	82.6%	0.07	0.07	2.9
0.36	2.7%	85.3%	0.08	0.08	2.5
0.40	2.1%	87.4%	0.08	0.08	1.9
0.48	2.5%	89.9%	0.10	0.10	2.2
0.56	2.0%	91.9%	0.12	0.12	1.8
0.64	1.4%	93.3%	0.13	0.13	1.3
0.72	1.0%	94.3%	0.15	0.15	0.9
0.80	1.1%	95.4%	0.17	0.17	0.9
1.00	1.6%	97.1%	0.21	0.21	1.4
1.20	0.9%	98.0%	0.25	0.25	0.7
1.40	0.6%	98.6%	0.29	0.29	0.5
1.60	0.5%	99.1%	0.34	0.34	0.4
1.80	0.5%	99.6%	0.38	0.38	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					93.6
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**93.6%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.24 ac	Unit Site Designation	CB-23A
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.02	0.02	23.6
0.12	13.7%	53.4%	0.03	0.03	13.1
0.16	9.4%	62.8%	0.03	0.03	8.9
0.20	6.6%	69.5%	0.04	0.04	6.3
0.24	5.2%	74.7%	0.05	0.05	4.9
0.28	4.8%	79.5%	0.06	0.06	4.5
0.32	3.1%	82.6%	0.07	0.07	2.9
0.36	2.7%	85.3%	0.08	0.08	2.5
0.40	2.1%	87.4%	0.09	0.09	1.9
0.48	2.5%	89.9%	0.10	0.10	2.2
0.56	2.0%	91.9%	0.12	0.12	1.8
0.64	1.4%	93.3%	0.14	0.14	1.3
0.72	1.0%	94.3%	0.15	0.15	0.9
0.80	1.1%	95.4%	0.17	0.17	0.9
1.00	1.6%	97.1%	0.21	0.21	1.4
1.20	0.9%	98.0%	0.26	0.26	0.7
1.40	0.6%	98.6%	0.30	0.30	0.5
1.60	0.5%	99.1%	0.34	0.34	0.4
1.80	0.5%	99.6%	0.38	0.38	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					93.5
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**93.5%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.43 ac	Unit Site Designation	CB-24A
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.02	0.02	14.6
0.08	24.6%	39.7%	0.03	0.03	23.4
0.12	13.7%	53.4%	0.05	0.05	12.9
0.16	9.4%	62.8%	0.06	0.06	8.7
0.20	6.6%	69.5%	0.08	0.08	6.1
0.24	5.2%	74.7%	0.09	0.09	4.8
0.28	4.8%	79.5%	0.11	0.11	4.3
0.32	3.1%	82.6%	0.12	0.12	2.8
0.36	2.7%	85.3%	0.14	0.14	2.4
0.40	2.1%	87.4%	0.16	0.16	1.8
0.48	2.5%	89.9%	0.19	0.19	2.1
0.56	2.0%	91.9%	0.22	0.22	1.7
0.64	1.4%	93.3%	0.25	0.25	1.1
0.72	1.0%	94.3%	0.28	0.28	0.8
0.80	1.1%	95.4%	0.31	0.31	0.8
1.00	1.6%	97.1%	0.39	0.39	1.2
1.20	0.9%	98.0%	0.47	0.47	0.6
1.40	0.6%	98.6%	0.55	0.55	0.4
1.60	0.5%	99.1%	0.62	0.62	0.3
1.80	0.5%	99.6%	0.70	0.70	0.2
0.00	0.0%	99.6%	0.00	0.00	0.0
					90.8
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**90.8%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.23 ac	Unit Site Designation	CB-24B
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.02	0.02	23.6
0.12	13.7%	53.4%	0.03	0.03	13.1
0.16	9.4%	62.8%	0.03	0.03	8.9
0.20	6.6%	69.5%	0.04	0.04	6.3
0.24	5.2%	74.7%	0.05	0.05	4.9
0.28	4.8%	79.5%	0.06	0.06	4.5
0.32	3.1%	82.6%	0.07	0.07	2.9
0.36	2.7%	85.3%	0.08	0.08	2.5
0.40	2.1%	87.4%	0.08	0.08	1.9
0.48	2.5%	89.9%	0.10	0.10	2.2
0.56	2.0%	91.9%	0.12	0.12	1.8
0.64	1.4%	93.3%	0.13	0.13	1.3
0.72	1.0%	94.3%	0.15	0.15	0.9
0.80	1.1%	95.4%	0.17	0.17	0.9
1.00	1.6%	97.1%	0.21	0.21	1.4
1.20	0.9%	98.0%	0.25	0.25	0.7
1.40	0.6%	98.6%	0.29	0.29	0.5
1.60	0.5%	99.1%	0.34	0.34	0.4
1.80	0.5%	99.6%	0.38	0.38	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					93.6
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**93.6%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.19 ac	Unit Site Designation	CB-23B
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.7
0.08	24.6%	39.7%	0.01	0.01	23.7
0.12	13.7%	53.4%	0.02	0.02	13.1
0.16	9.4%	62.8%	0.03	0.03	9.0
0.20	6.6%	69.5%	0.03	0.03	6.3
0.24	5.2%	74.7%	0.04	0.04	4.9
0.28	4.8%	79.5%	0.05	0.05	4.5
0.32	3.1%	82.6%	0.05	0.05	2.9
0.36	2.7%	85.3%	0.06	0.06	2.5
0.40	2.1%	87.4%	0.07	0.07	1.9
0.48	2.5%	89.9%	0.08	0.08	2.3
0.56	2.0%	91.9%	0.10	0.10	1.8
0.64	1.4%	93.3%	0.11	0.11	1.3
0.72	1.0%	94.3%	0.12	0.12	0.9
0.80	1.1%	95.4%	0.14	0.14	0.9
1.00	1.6%	97.1%	0.17	0.17	1.4
1.20	0.9%	98.0%	0.20	0.20	0.8
1.40	0.6%	98.6%	0.24	0.24	0.5
1.60	0.5%	99.1%	0.27	0.27	0.4
1.80	0.5%	99.6%	0.31	0.31	0.4
0.00	0.0%	99.6%	0.00	0.00	0.0
					94.2
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**94.2%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.39 ac	Unit Site Designation	CB-26
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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.03	0.03	23.6
0.12	13.7%	53.4%	0.04	0.04	13.0
0.16	9.4%	62.8%	0.06	0.06	8.9
0.20	6.6%	69.5%	0.07	0.07	6.2
0.24	5.2%	74.7%	0.08	0.08	4.9
0.28	4.8%	79.5%	0.10	0.10	4.4
0.32	3.1%	82.6%	0.11	0.11	2.9
0.36	2.7%	85.3%	0.13	0.13	2.5
0.40	2.1%	87.4%	0.14	0.14	1.9
0.48	2.5%	89.9%	0.17	0.17	2.2
0.56	2.0%	91.9%	0.20	0.20	1.8
0.64	1.4%	93.3%	0.22	0.22	1.2
0.72	1.0%	94.3%	0.25	0.25	0.9
0.80	1.1%	95.4%	0.28	0.28	0.9
1.00	1.6%	97.1%	0.35	0.35	1.3
1.20	0.9%	98.0%	0.42	0.42	0.7
1.40	0.6%	98.6%	0.49	0.49	0.4
1.60	0.5%	99.1%	0.56	0.56	0.3
1.80	0.5%	99.6%	0.63	0.63	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					93.0
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**93.0%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.70 ac	Unit Site Designation	DMH-02
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%	0.03	0.03	14.5
0.08	24.6%	39.7%	0.05	0.05	23.3
0.12	13.7%	53.4%	0.08	0.08	12.8
0.16	9.4%	62.8%	0.10	0.10	8.7
0.20	6.6%	69.5%	0.13	0.13	6.0
0.24	5.2%	74.7%	0.15	0.15	4.7
0.28	4.8%	79.5%	0.18	0.18	4.2
0.32	3.1%	82.6%	0.20	0.20	2.7
0.36	2.7%	85.3%	0.23	0.23	2.3
0.40	2.1%	87.4%	0.25	0.25	1.8
0.48	2.5%	89.9%	0.30	0.30	2.0
0.56	2.0%	91.9%	0.35	0.35	1.6
0.64	1.4%	93.3%	0.40	0.40	1.1
0.72	1.0%	94.3%	0.45	0.45	0.8
0.80	1.1%	95.4%	0.51	0.51	0.8
1.00	1.6%	97.1%	0.63	0.63	1.1
1.20	0.9%	98.0%	0.76	0.76	0.6
1.40	0.6%	98.6%	0.88	0.88	0.3
1.60	0.5%	99.1%	1.01	1.01	0.2
1.80	0.5%	99.6%	1.14	1.14	0.2
0.00	0.0%	99.6%	0.00	0.00	0.0
					89.9
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**89.9%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.35 ac	Unit Site Designation	DMH-05
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.02	0.02	23.5
0.12	13.7%	53.4%	0.04	0.04	13.0
0.16	9.4%	62.8%	0.05	0.05	8.8
0.20	6.6%	69.5%	0.06	0.06	6.2
0.24	5.2%	74.7%	0.07	0.07	4.8
0.28	4.8%	79.5%	0.09	0.09	4.4
0.32	3.1%	82.6%	0.10	0.10	2.8
0.36	2.7%	85.3%	0.11	0.11	2.4
0.40	2.1%	87.4%	0.12	0.12	1.9
0.48	2.5%	89.9%	0.15	0.15	2.1
0.56	2.0%	91.9%	0.17	0.17	1.7
0.64	1.4%	93.3%	0.20	0.20	1.2
0.72	1.0%	94.3%	0.22	0.22	0.8
0.80	1.1%	95.4%	0.25	0.25	0.9
1.00	1.6%	97.1%	0.31	0.31	1.3
1.20	0.9%	98.0%	0.37	0.37	0.7
1.40	0.6%	98.6%	0.44	0.44	0.4
1.60	0.5%	99.1%	0.50	0.50	0.3
1.80	0.5%	99.6%	0.56	0.56	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					92.0
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**92.0%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.26 ac	Unit Site Designation	DMH-06
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.02	0.02	23.6
0.12	13.7%	53.4%	0.03	0.03	13.1
0.16	9.4%	62.8%	0.04	0.04	8.9
0.20	6.6%	69.5%	0.05	0.05	6.2
0.24	5.2%	74.7%	0.06	0.06	4.9
0.28	4.8%	79.5%	0.06	0.06	4.4
0.32	3.1%	82.6%	0.07	0.07	2.9
0.36	2.7%	85.3%	0.08	0.08	2.5
0.40	2.1%	87.4%	0.09	0.09	1.9
0.48	2.5%	89.9%	0.11	0.11	2.2
0.56	2.0%	91.9%	0.13	0.13	1.8
0.64	1.4%	93.3%	0.15	0.15	1.2
0.72	1.0%	94.3%	0.17	0.17	0.9
0.80	1.1%	95.4%	0.19	0.19	0.9
1.00	1.6%	97.1%	0.23	0.23	1.3
1.20	0.9%	98.0%	0.28	0.28	0.7
1.40	0.6%	98.6%	0.32	0.32	0.5
1.60	0.5%	99.1%	0.37	0.37	0.4
1.80	0.5%	99.6%	0.42	0.42	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					93.2
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**93.2%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	0.34 ac	Unit Site Designation	DMH-11
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	1515-3	CDS Treatment Capacity	**1.0 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%	0.01	0.01	14.6
0.08	24.6%	39.7%	0.02	0.02	23.5
0.12	13.7%	53.4%	0.04	0.04	13.0
0.16	9.4%	62.8%	0.05	0.05	8.8
0.20	6.6%	69.5%	0.06	0.06	6.2
0.24	5.2%	74.7%	0.07	0.07	4.8
0.28	4.8%	79.5%	0.09	0.09	4.4
0.32	3.1%	82.6%	0.10	0.10	2.8
0.36	2.7%	85.3%	0.11	0.11	2.4
0.40	2.1%	87.4%	0.12	0.12	1.9
0.48	2.5%	89.9%	0.15	0.15	2.2
0.56	2.0%	91.9%	0.17	0.17	1.7
0.64	1.4%	93.3%	0.19	0.19	1.2
0.72	1.0%	94.3%	0.22	0.22	0.8
0.80	1.1%	95.4%	0.24	0.24	0.9
1.00	1.6%	97.1%	0.30	0.30	1.3
1.20	0.9%	98.0%	0.37	0.37	0.7
1.40	0.6%	98.6%	0.43	0.43	0.4
1.60	0.5%	99.1%	0.49	0.49	0.3
1.80	0.5%	99.6%	0.55	0.55	0.3
0.00	0.0%	99.6%	0.00	0.00	0.0
					92.1
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**92.1%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION
BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION
LEICESTER, MA

Area	0.60 ac	Unit Site Designation	DMH-20
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%	0.02	0.02	14.6
0.08	24.6%	39.7%	0.04	0.04	23.4
0.12	13.7%	53.4%	0.07	0.07	12.9
0.16	9.4%	62.8%	0.09	0.09	8.8
0.20	6.6%	69.5%	0.11	0.11	6.1
0.24	5.2%	74.7%	0.13	0.13	4.8
0.28	4.8%	79.5%	0.15	0.15	4.3
0.32	3.1%	82.6%	0.17	0.17	2.8
0.36	2.7%	85.3%	0.20	0.20	2.4
0.40	2.1%	87.4%	0.22	0.22	1.8
0.48	2.5%	89.9%	0.26	0.26	2.1
0.56	2.0%	91.9%	0.30	0.30	1.7
0.64	1.4%	93.3%	0.35	0.35	1.1
0.72	1.0%	94.3%	0.39	0.39	0.8
0.80	1.1%	95.4%	0.43	0.43	0.8
1.00	1.6%	97.1%	0.54	0.54	1.2
1.20	0.9%	98.0%	0.65	0.65	0.6
1.40	0.6%	98.6%	0.76	0.76	0.4
1.60	0.5%	99.1%	0.87	0.87	0.3
1.80	0.5%	99.6%	0.98	0.98	0.2
0.00	0.0%	99.6%	0.00	0.00	0.0
					90.9
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.6%
				Predicted Net Annual Load Removal Efficiency =	**90.9%**

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.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

SKYVIEW ESTATES RESIDENTIAL SUBDIVISION LEICESTER, MA

Area	1.10 ac	Unit Site Designation	DMH-30
Weighted C	0.9	Rainfall Station #	70
t_c	6 min		
CDS Model	2015-5	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	14.4
0.08	24.6%	39.7%	0.08	0.08	22.9
0.12	13.7%	53.4%	0.12	0.12	12.5
0.16	9.4%	62.8%	0.16	0.16	8.4
0.20	6.6%	69.5%	0.20	0.20	5.8
0.24	5.2%	74.7%	0.24	0.24	4.5
0.28	4.8%	79.5%	0.28	0.28	4.0
0.32	3.1%	82.6%	0.32	0.32	2.6
0.36	2.7%	85.3%	0.36	0.36	2.2
0.40	2.1%	87.4%	0.40	0.40	1.6
0.48	2.5%	89.9%	0.47	0.47	1.8
0.56	2.0%	91.9%	0.55	0.55	1.4
0.64	1.4%	93.3%	0.63	0.63	0.9
0.72	1.0%	94.3%	0.71	0.71	0.6
0.80	1.1%	95.4%	0.79	0.79	0.6
1.00	1.6%	97.1%	0.99	0.99	0.8
1.20	0.9%	98.0%	1.19	1.19	0.4
1.40	0.6%	98.6%	1.38	1.38	0.2
1.60	0.5%	99.1%	1.58	1.40	0.1
1.80	0.5%	99.6%	1.78	1.40	0.1
0.00	0.0%	99.6%	0.00	0.00	0.0
					86.0
				Removal Efficiency Adjustment[2] =	0.0%
				Predicted % Annual Rainfall Treated =	99.4%
				Predicted Net Annual Load Removal Efficiency =	**86.0%**

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.

Stormwater Pipe Sizing Calculation

ALLEN & MAJOR ASSOCIATES, INC.

DRAINAGE PIPE DESIGN ANALYSIS

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

A&M Job No.	2889-01
Date:	7/16/2021

Project Location:
Skyview Estates
Main Street
Leicester, MA

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

PIPE	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
DS-1A	0.59	0.013	12	0.79	3.14	0.25	0.077	9.88	OK	12.58	0.06	0.51	6.42	OK
DS-1B	3.08	0.013	12	0.79	3.14	0.25	0.050	7.97	OK	10.14	0.39	0.91	9.23	OK
DS-1C	4.95	0.013	15	1.23	3.93	0.31	0.010	6.46	OK	5.26	0.77	1.11	5.84	OK
DS-2B	1.26	0.013	8	0.35	2.09	0.17	0.011	1.27	OK	3.65	0.99	1.15	4.19	OK
DMH-01	5.37	0.013	15	1.23	3.93	0.31	0.010	6.46	OK	5.26	0.83	1.12	5.90	OK
DMH-02	7.48	0.013	18	1.77	4.71	0.38	0.032	18.88	OK	10.68	0.40	0.93	9.94	OK
DMH-03	2.11	0.013	15	1.23	3.93	0.31	0.033	11.66	OK	9.50	0.18	0.73	6.94	OK
DMH-05	3.39	0.013	12	0.79	3.14	0.25	0.056	8.43	OK	10.73	0.40	0.93	9.98	OK
DMH-20	6.19	0.013	18	1.77	4.71	0.38	0.040	21.01	OK	11.89	0.29	0.84	9.99	OK
DMH-30	9.74	0.013	18	1.77	4.71	0.38	0.026	16.94	OK	9.58	0.58	1.03	9.87	OK
CB-21A	5.14	0.013	24	3.14	6.28	0.50	0.015	27.71	OK	8.82	0.19	0.74	6.53	OK

MADEP Calculations

ALLEN & MAJOR ASSOCIATES, INC.

Project No.	2889-01	**Sheet**	1
Project Description	Skyview Estates		
	Leicester, MA		
Calculated By	JG	**Date**	07/16/21
Checked By	MAM		

1 The calculations provide the TSS removal rate of a stormwater management system.

Stormwater Management BMP	TSS Removal rate
Parking Lot Sweeping	5 %
Hooded Catch Basins	25 %
Proprietary Device (CDS Unit)	80 %

Average Annual Load	=	1.0	
Parking Lot Sweeping	=	5.0	% Removal Rate
		95.0	% TSS Load Remains
TSS Load Remaining	=	95.0	%
Hooded Catch Basins	=	25.0	% Removal Rate
		71.3	% TSS Load Remains
TSS Load Remaining	=	71.3	%
Proprietary Device (CDS Unit)	=	80.0	% Removal Rate
		14.25	% TSS Load Remains

Percentage of TSS Remaining	-	Initial TSS Load	=	Final TSS Removal Rate
14.25	-	100.0	=	85.8 %

For this drainage area, this system as designed will remove an estimated
85.8 % of the annual TSS load and therefore will meet the TSS removal standard.

Allen & Major Associates, Inc.		Computation Sheet	
Title	***MA DEP Standard Calculations***	By	JG
Project	*Skyview Estates*	Chk'd	MAM
Location	Main Street, Leicester	Apprv'd	MAM
Date	July 16, 2021		
Revised			

Stormwater Recharge/Water Quality Volume Table

Rv = F * Impervious Area

Rv *= Required Recharge Volume, expressed in ft^3, cubic yards or acre-feet*

F *= Target Depth Factor associated with each Hydraulic Soil Group*

Impervious Area *= pavement & rooftop area on site*

A_{WQ} *= Required Water Quality Treatment Volume, expressed in ft^3*

D_{WQ} *= Water Quality Depth*

A_{IMP} *= Impervious Area (excluding non-metal roofs)*

Watershed (Subcatchment)	Area (Sq. Ft.)	Landscaped	Impervious Area (Square Feet)				Recharge Required		
			HSG A (F=0.6)	HSG B (F=0.35)	HSG C (F=0.25)	HSG D (F=0.10)	*F Avg. (Inches)*	*Impervious Area (Feet)*	*Rv (ft^3)*
P-1A	154,716	135,576	0	3,917	15,223	0	0.3	19,140	431
P-1B	21,856	15,637	0	3,761	2,458	0	0.3	6,219	161
P-1C	13,329	0	0	1,873	11,456	0	0.3	13,329	293
P-1D	26,093	24,960	0	1,133	0	0	0.4	1,133	33
P-1E	15,289	4,083	0	0	11,206	0	0.3	11,206	233
P-1F	29,142	14,037	0	0	15,105	0	0.3	15,105	315
P-1G	22,695	14,930	0	0	7,765	0	0.3	7,765	162
P-1H	54,842	32,049	0	0	22,793	0	0.3	22,793	475
P-1I	22,427	20,997	0	0	1,430	0	0.3	1,430	30
P-1J	10,290	10,288	0	0	2	0	0.3	2	0
P-2A	94,568	82,698	0	0	11,870	0	0.3	11,870	247
P-2B	87,512	68,182	0	0	19,330	0	0.3	19,330	403
P-2C	73,791	47,579	0	0	26,212	0	0.3	26,212	546
P-2D	54,668	36,558	0	0	18,110	0	0.3	18,110	377
P-2E	63,380	40,674	0	0	22,706	0	0.3	22,706	473
P-2F	82,198	53,089	0	0	29,109	0	0.3	29,109	606
P-2G	33,890	10,912	0	0	22,978	0	0.3	22,978	479
P-3A	198,155	184,804	0	0	13,351	0	0.3	13,351	278
P-3B	65,906	59,067	0	0	6,839	0	0.3	6,839	142
P-3C	98,968	51,128	0	0	47,840	0	0.3	47,840	997
P-4	52,520	40,368	0	768	11,384	0	0.3	12,151	260
P-5	3,673	3,090	0	0	583	0	0.3	583	12
Total	**1,279,908**	**950,706**	**0**	**11,451**	**317,748**	**0**		**329,199**	**6,954**

Allen & Major Associates, Inc.						Computation Sheet	
Title	***MA DEP Standard Calculations***					By	JG
Project	*Skyview Estates*					Chk'd	MAM
Location	Main Street, Leicester					Apprv'd	MAM
Date	July 16, 2021						

Stormwater Recharge Summary

Rv = F * Impervious Area

Rv *= Required Recharge Volume, expressed in ft^3, cubic yards or acre-feet*

F *= Target Depth Factor associated with each Hydraulic Soil Group*

Impervious Area *= pavement & rooftop area on site*

	Required (cf)	***Provided (cf)***			
ARv =	***6,954***	***7,128***			***36 Proposed Dry Wells (198 cf storage per dry well)***
ARv =	***6,954***	***7,128***			***Total***

Allen & Major Associates, Inc.		Computation Sheet	
Title	***MA DEP Standard Calculations***	By	JG
Project	*Skyview Estates*	Chk'd	MAM
Location	Main Street, Leicester	Apprv'd	MAM
Date	July 16, 2021		

Draindown Within 72 Hours

$Time_{drawdown}$=(Rv) (1/Design Infiltration Rate in inches per hour) (Conversion for inches to feet) (1/bottom area in feet)

1000 Gallon Jumbo Dry Well	
Infiltration Rate (in/Hr)=	0.575
Bottom Area (ft^2) =	86
Infiltration Volume (ft^3) =	198
$Time_{drawdown}$ (Hours)=	48.05