ASB
design group LLC
Civil Engineering
Traffic Engineering
Architecture
Landscape Design & Construction

363 Boston Street, Route 1
Topsfield MA. 01983
978-500-8419
www.asbdesigngroup.com

Notice of Intent
Barn Relocation and New Cheesery

Lillooet Farm LLC
42 Topsfield Road
Boxford MA. 01921

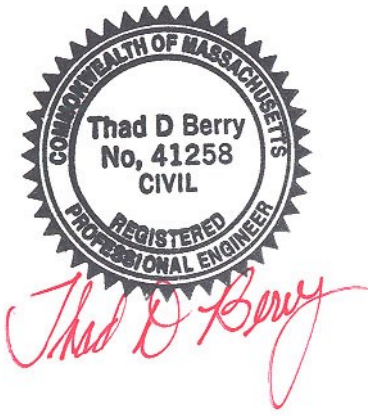
Date: August 6, 2015

PREPARED FOR:

Lillooet Farm LLC
42 Topsfield Road
Boxford, MA. 01921

PREPARED BY:

ASB design group, llc
363 Boston Street, Route 1
Topsfield, MA 01983
T- 978-500-8419



August 6, 2015

TABLE OF CONTENTS

Existing Conditions

Proposed Conditions

Section 1 & 2

INTRODUCTION

The purpose of this report is to document the impacts for the relocation of an existing barn and the construction of a sheep farm and cheese making facility located at 42 Topsfield Road in Boxford MA. (Map 33, Block 1, Lots 16, 16.1 and 16.2 - see Figure 1). Figure 1 outlines the 30' x 40' section of the existing barn that will relocated from the rear of the property to the front southwest corner of the property as shown in Figure 2. The remaining portion of the existing barn will be demolished and is shown hatched in Figure 1.

A new cheese making facility and an attached barn to house sheep will be constructed in the rear of the site and will be placed outside the 100' resource area to Bordering Vegetated Wetlands as shown in Figure 2.

SECTION I EXISTING CONDITIONS

1.1 EXISTING SITE DESCRIPTION

The project site location is depicted graphically in Figure 1 (also refer to Sheet C2 Existing Conditions Survey)**.** Presently the site has a single family home with an existing barn located in the rear yard. A paved driveway provides access off of Topsfield Road. All other driveway areas area gravel. The site is predominantly forested except for the areas that encompass the existing single family home and barn. Open pasture/fields also define this area.

Zoning for the parcel is **Residential-Agriculture R-A** and falls within the Boxford Historic Overlay District.

The wetlands have been flagged by Leah Basbanes of Basbanes Wetland Consulting and are shown on Sheet C2 along with the local and state wetland resource area buffer zones (also see Notice of Intent prepared by Rimmer Environmental Consulting LLC).

The site does not fall within a Flood Insurance Rate Map (FIRM) for the Town of Boxford.

1.2 EXISTING UTILITIES

The site is serviced by gas, telephone and electric and all utilities are all located within the Topsfield Road Right-Of-Way. A septic system and well service the existing single family home.

1.3 SOILS

Soil information for the proposed new development was obtained from the ***Soil Survey of Essex County – Northern Part, Massachusetts,*** as provided by the United States Department of Agriculture, Soil Conservation Service (see Figure 2A, Sheet C3 - C4 and Figures D1 and D2). The soils shown on the map are broken down into four hydrologic soil groups and are summarized below (also see Figure 2B).

Group A soils have a low runoff potential and high infiltration rates when thoroughly wetted. They consist chiefly of deep well to excessively drained sands and gravels and have a high rate of water transmission (greater than 0.3 in/hr.).

Group B soils have a moderate infiltration rates when thoroughly wetted, and consist chiefly of moderately deep-to-deep moderately well to well drained soils with moderately fine to moderately course textures. These soils have a moderate rate of water transmission (0.15-.30 in/hr.).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, and soils with moderately fine-to-fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr.).

Group D soils have high runoff potential. They have low infiltration rates when thoroughly wetted, and consist chiefly of clay soils with high swelling potential, soils with a permanent high water, soils with a clay pan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low transmission (0-0.05 in/hr.).

The site and associated water shed is comprised of 3 soil groups as shown in Figure 2A and Sheet C3. Table 1 below summarizes the 3 soil groups with their corresponding hydrologic soil group in.

Table 1 Soil Summary

Symbol	Soil Name	Slope %	Hydrologic Group
51A	Swansea Muck	0 to 1	B/D
421B	Canton Fine Sandy Loam	3 to 8	A
422 C	Canton Fine Sandy Loam	8 to 15	A

The Hydrologic Soil Group (HSG) shown in Table 1 was determined from the soils map as shown in Figure 2B.

1.4 EXISTING CONDITIONS PRE-HYDROLOGY

1.41 Methodology

The pre and post hydrology study was conducted using ***HydroCAD*** a ***Stormwater Modeling System***. The Runoff Curve Numbers were selected from the tables listed within the ***Soil Conservation Service Technical Release 55***. The terminology used by ***HydroCAD*** is summarized below.

1. ***Subcatchment*** - refers to a relatively homogenous area of land that drains into a single reach or pond.
2. ***Reach***- refers to a uniform stream, Channel, or pipe that conveys water from one point to another reach or pond.
3. ***Pond***- refers to a pond, swamp, dam, or other impoundment that fills with water from one or more sources and empties in a manner determined by a weir, culvert, ex-filtration or devise(s) at its outlet.

Four storm events were analyzed as part of the pre-development drainage study. They are the 2, 10, 25, and 100 year twenty-four hour rainfall events. The rainfall data maps for Massachusetts were taken from the ***Guidelines for Soil & Water Conservation In Urbanizing Areas of Massachusetts*** (see Rainfall Data Maps for Massachusetts Figure 4). The ***Rainfall Distribution*** is ***Type III***, which is typical for Massachusetts and is shown on Figure 3.

1.42 Pre-Hydrology

Three design points were studied; Design Points 1 - 3. They are shown on the Pre-Development Drainage Plan (D1) that is attached to this report. The Design Points are summarized below.

- **Design Point 1** represents the stormwater runoff that flows to the westerly front side yard property line towards the wetland resource area defined by wetland flags B26-B32. This area is defined by Subcatchment E1.

- **Design Point 2** represents the stormwater runoff that flows to an existing low area in the front yard defined by elevation 81. This area is defined by Subcatchment E2.

- **Design Point 3** represents the stormwater runoff that flows to Still Pond. This area is defined by Subcatchment E3.

The Pre-Development Drainage Plan depicts each of the subcatchments (E1-3) with the corresponding soil type taken from the Soil Conservation Service soils maps. The Design Points and longest flow paths are shown for each of the subcatchments.

With the soil type, existing surface conditions, and hydrologic soil group, the runoff curve numbers can be determined. (See Existing Hydrology Calculations, Section 3)

The 2, 10, 25, and 100-year 24-hour storm events were run. The results of the peak flows are shown in Table 2 below and given in cubic feet/second (cfs) to the two design points. Table 1 summarizes the peak flow to Design Point 1.

Table 2 Peak Rate of Runoff – Pre Conditions (cfs)

Design Point	2 Year Storm (3.1”)	10 Year Storm (4.7”)	25 Year Storm (5.8”)	100 Year Storm (8.3”)
Design Point 1	0.00	0.01	0.07	.46
Design Point 2	0.00	0.00	.01	.17
Design Point 2	0.00	.03	.18	.99

SECTION II PROPOSED CONDITIONS

2.1 PROJECT DESCRIPTION

The proposed project will consist of the follow (see Figures 1 and 2 and Sheets C1-C7):

- Construction of a new cheese making facility with attached barn to house sheep. The new structure will be constructed outside the 100' buffer zone to the existing wetland resource area.
- Relocation of existing 30' x 40' barn to the front of the property with a new addition. The remaining existing barn structure will be demolished.
- A temporary wetland filling at an existing culvert to facilitate the moving of the barn. The temporary fill areas for the barn moving are shown in red on sheets C3 and C4.
- Installation of new gas, power and communications to the new Cheesery and relocated barn.
- Construction of new gravel driveways to new Cheesery and relocated barn.
- Installation of a new dry-hydrant for fire protection.
- Construction of a new grass pull off area for the fire pump truck.
- Construction on new septic system and well for the Cheesery. This work will be located outside the 100' buffer zone to the existing wetland resource area.

2.2 PROPOSED UTILITIES

The site will be serviced by with new, gas, telephone and electric. All new utilities will be located within the Topsfield Road Right-of-Way. A new septic system and well will service the proposed Cheesery.

Please note - the final utility service connection locations will be coordinated with the individual utility provider.

2.3 PROPOSED CONDITIONS POST HYDROLOGY

2.31 Methodology

See Section 1.41

2.32 Post-Hydrology

As a result of the proposed development, there will be a very small increase in the amount of impervious surface (roof). This increase in impervious surface will result in an increase in the storm water runoff rate (cfs) and volume (cf) associated with the site. To mitigate the increase in the peak rate of storm water runoff the design team has incorporated the following Low Impact Design (LID) techniques into the project:

- All new driveway surfaces will be gravel (maximum width 14').
- Roof runoff will be directed to either a gravel surface or grassed surface (un - concentrated – no gutters) to promote stormwater infiltration.
- Stormwater will be directed to natural low areas to promote stormwater infiltration and mitigate pre and post development peak rate of runoff (cfs).
- Proposed site grading will be placed so to prevent concentrated stormwater runoff to promote stormwater infiltration.
- Construction of new Cheesery will be placed outside of the 100' buffer zone.

The site development will not create TSS loads that will need to be accounted for.

The subcatchments for each Design Point are shown on the Post Development Drainage Plan (D2). Figure D2 is intended to highlight the subcatchment areas. The Post Development Drainage Plan depicts each of the subcatchments with their corresponding soil types taken from the Soil Conservation Service soils maps. The longest flow paths for the subcatchments areas are also shown.

Please note, under proposed conditions any subcatchment that resulted in a Time of Concentration (Tc) of less than 5 minutes was entered as Direct Entry with a corresponding Tc of 5 minutes. For these subcatchments the Longest Flow Paths are not shown.

Overall Drainage Summary

The design team worked to minimize the amount of area that would be impacted (tree removal and site grading) due to the construction process. This included implementing:

- Placement of new Cheesery outside the 100' buffer zone within a grass pasture area.
- Placement of new Cheesery septic system outside the 100' buffer zone within a grass pasture area.
- Tree removal limited to front yard and new vegetated screening will be introduced.
- Site grading laid out to protect existing trees.
- The creation of subcatchments and site grading to promoted un-concentrated stormwater flow. This will reduce stormwater velocity to promote stormwater infiltration and treatment.

Smaller drainage areas and de-concentrated flow are the most effective means to control stormwater runoff. It result in lower peak rates, lower velocities, smaller sized BMPs and greater water quality treatment

As result of the LID measures there will not be an increase in the rate of stormwater runoff from the site.

Table 4 Peak Rate of Runoff (cfs) - Proposed Conditions

Design Point (DP)	2 Year Storm (3.1")	10 Year Storm (4.6")	25 Year Storm (5.4")	100 Year Storm (6.5")
DP 1 Pre	0.00	0.01	0.07	.46
DP 1 Post	0.00	0.00	.03	.29
DP 2 Pre	0.00	0.00	.01	.17
DP 2 Post	0.00	0.00	.02	.19
DP 3 Pre	0.00	.03	.18	.99
DP 3 Post	0.00	.02	.01	.72

2.4 EROSION CONTROL MITIGATION MEASURES

The proposed project includes a comprehensive set of mitigation measures to protect the existing and surrounding sites from impacts due to construction and they are shown on Sheets C3-C7.

Erosion and Sedimentation Control Program

An Erosion Control and Sedimentation Control Program will be implemented to prevent indirect impacts to existing roadways and surrounding sites during the construction of the proposed new, utility/stormwater installation, roadway construction, and building site construction. The program incorporates Best Management Practices (BMP's) as specified in the guidelines developed by DEP and the Environmental Protection Agency and complies with the requirements of the NPDES General Permit for Storm Water Discharges for Construction Activities. These measures include the installation of temporary erosion and sedimentation

controls and construction sequencing. Areas of exposed soil will be kept to a minimum and a permanent vegetative cover or other forms of stabilization will be established as soon as practicable.

Proper implementation of the erosion and sedimentation control program will:

- Minimize exposed soils through temporary mulching and/or temporary seeding
- Place structures to manage runoff and erosion
- Establish a permanent vegetative cover or other forms of stabilization as soon as practicable

The following erosion and sedimentation control BMP's are presented in the sequence they will be implemented at the site. The measures will be inspected on a weekly basis or immediately before and or after storm events. The controls will be routinely maintained throughout the duration of the project. Any damaged controls will be repaired and or replaced immediately. The locations of the specific sedimentation and erosion control measures are depicted on Sheets, C3-C7

Erosion Control Barriers

Erosion control barriers will be installed at the down gradient limit of work prior to undertaking any ground disturbance for the driveway or building construction. The barriers will consist of siltation fence, hay bales, or erosion control sock and will be entrenched into the substrate to prevent under flow. When necessary, additional hay bales, silt fence, erosion control sock barriers will be installed immediately down gradient of the erosion-prone areas, such as the base of steep exposed slopes and around the base of stockpile areas, throughout the construction phase of the project. A sufficient supply of materials will be kept at the work site to facilitate the repair or replacement of the barriers. Final erosion control barriers will be dependent on final Town of Boxford approvals. Contractor must obtain all conditions of approval as documented by the town prior to construction.

Temporary Surface and Slope Stabilization

Any areas of exposed soils that remain un-stabilized for a period of more than 30 days will be covered with a layer of hay, mulch, or temporary seeding until the time of final loam and seeding.

Temporary Seeding

A temporary vegetative cover of fast growing indigenous grasses will be established on areas of exposed soils that remain un-stabilized for a period of 30 days. Depending on the slope, the seeded surfaces will be covered with a layer of mulch.

Permanent Seeding

Upon completion of final grading, any areas not covered by pavement, other forms of stabilization, or other landscape methods will be loomed and seeded with conventional grass seed.

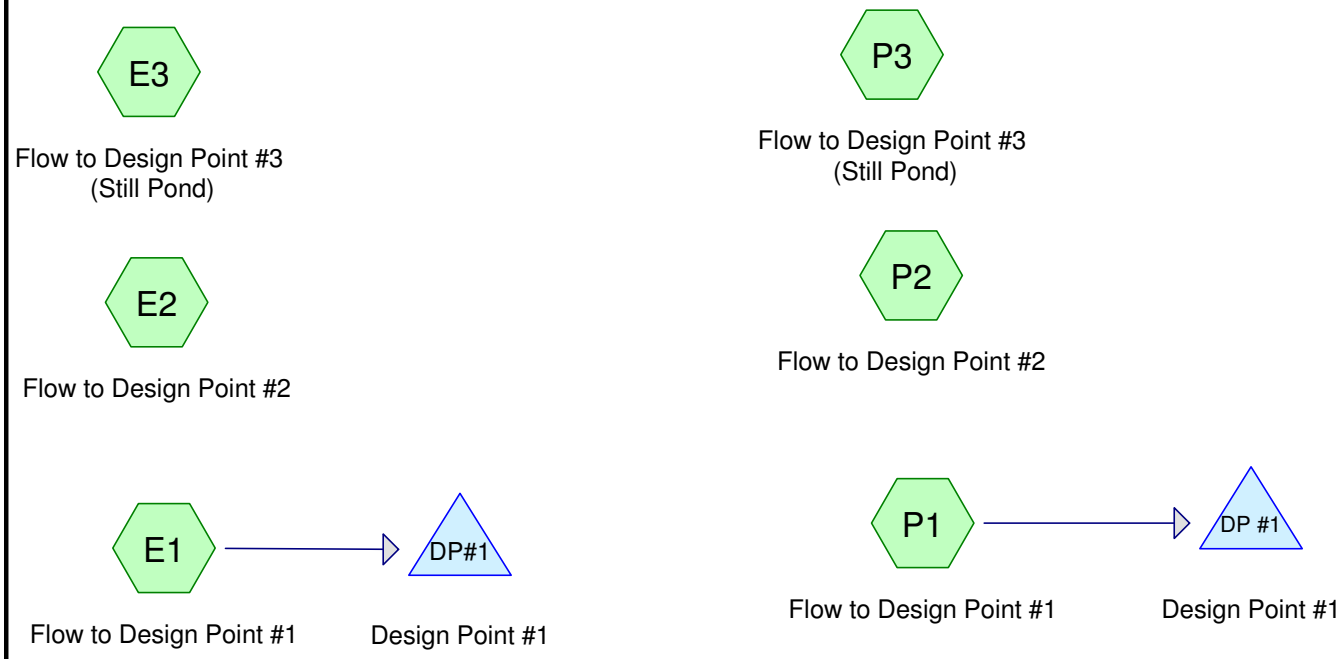
2.5 OPERATION AND MAINTENANCE

The operation and maintenance for the site will be limited to grass mowing and maintenance (re-grading if required) of gravel driveways. The inlet and outlet to the existing culvert should be kept clear and inspected in the spring and fall. Clean as may be required.

Existing and Proposed Hydrology Calculations

2, 10, 25, and 100 Year Storm Events

Section 3



Subcat Reach Pond Link

Routing Diagram for 2015-28 Lillooet Cheesery
Prepared by Microsoft, Printed 8/6/2015

Summary for Subcatchment E1: Flow to Design Point #1

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.10"

Area (sf)	CN	Description
16,567	39	>75% Grass cover, Good, HSG A
6,951	30	Woods, Good, HSG A
1,043	98	Paved parking, HSG A
24,561	39	Weighted Average
23,518		95.75% Pervious Area
1,043		4.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	179	0.0360	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E2: Flow to Design Point #2

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.10"

Area (sf)	CN	Description
9,112	39	>75% Grass cover, Good, HSG A
7,106	30	Woods, Good, HSG A
16,218	35	Weighted Average
16,218		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E3: Flow to Design Point #3 (Still Pond)

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.10"

	Area (sf)	CN	Description
	47,385	39	>75% Grass cover, Good, HSG A
	2,318	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	2,025	35	Gravel roads, HSG A
	56,849	40	Weighted Average
	54,531		95.92% Pervious Area
	2,318		4.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.4	336	0.0270	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P1: Flow to Design Point #1

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.10"

	Area (sf)	CN	Description
	13,849	39	>75% Grass cover, Good, HSG A
	4,715	30	Woods, Good, HSG A
	0	98	Roofs, HSG A
*	3,899	35	Gravel roads, HSG A
	22,463	36	Weighted Average
	22,463		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	142	0.0480	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P2: Flow to Design Point #2

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.10"

	Area (sf)	CN	Description
	8,878	39	>75% Grass cover, Good, HSG A
	4,444	30	Woods, Good, HSG A
*	1,719	35	Gravel roads, HSG A
	0	98	Roofs, HSG A
	15,041	36	Weighted Average
	15,041		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P3: Flow to Design Point #3 (Still Pond)

Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Storm Rainfall=3.10"

	Area (sf)	CN	Description
	43,239	39	>75% Grass cover, Good, HSG A
	0	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	4,715	35	Gravel roads, HSG A
	53,075	38	Weighted Average
	53,075		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	336	0.0270	0.23		**Lag/CN Method, Overland Flow**

Summary for Pond DP #1: Design Point #1

Inflow Area = 22,463 sf, 0.00% Impervious, Inflow Depth = 0.00" for 2 Year Storm event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.25' @ 5.00 hrs Surf.Area= 200 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.25'	12,575 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.25	200	0	0
80.50	1,071	159	159
81.00	2,391	866	1,024
82.00	5,962	4,177	5,201
83.00	8,787	7,375	12,575

Summary for Pond DP#1: Design Point #1

Inflow Area = 24,561 sf, 4.25% Impervious, Inflow Depth = 0.00" for 2 Year Storm event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.15' @ 5.00 hrs Surf.Area= 145 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.15'	5,431 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.15	145	0	0
81.00	3,275	1,453	1,453
81.80	6,669	3,978	5,431

Summary for Subcatchment E1: Flow to Design Point #1

Runoff = 0.01 cfs @ 13.86 hrs, Volume= 222 cf, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=4.70"

Area (sf)	CN	Description
16,567	39	>75% Grass cover, Good, HSG A
6,951	30	Woods, Good, HSG A
1,043	98	Paved parking, HSG A
24,561	39	Weighted Average
23,518		95.75% Pervious Area
1,043		4.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	179	0.0360	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E2: Flow to Design Point #2

Runoff = 0.00 cfs @ 15.68 hrs, Volume= 42 cf, Depth> 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=4.70"

Area (sf)	CN	Description
9,112	39	>75% Grass cover, Good, HSG A
7,106	30	Woods, Good, HSG A
16,218	35	Weighted Average
16,218		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E3: Flow to Design Point #3 (Still Pond)

Runoff = 0.03 cfs @ 13.84 hrs, Volume= 627 cf, Depth> 0.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
	47,385	39	>75% Grass cover, Good, HSG A
	2,318	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	2,025	35	Gravel roads, HSG A
	56,849	40	Weighted Average
	54,531		95.92% Pervious Area
	2,318		4.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.4	336	0.0270	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P1: Flow to Design Point #1

Runoff = 0.00 cfs @ 15.33 hrs, Volume= 87 cf, Depth> 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
	13,849	39	>75% Grass cover, Good, HSG A
	4,715	30	Woods, Good, HSG A
	0	98	Roofs, HSG A
*	3,899	35	Gravel roads, HSG A
	22,463	36	Weighted Average
	22,463		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	142	0.0480	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P2: Flow to Design Point #2

Runoff = 0.00 cfs @ 15.33 hrs, Volume= 59 cf, Depth> 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
	8,878	39	>75% Grass cover, Good, HSG A
	4,444	30	Woods, Good, HSG A
*	1,719	35	Gravel roads, HSG A
	0	98	Roofs, HSG A
	15,041	36	Weighted Average
	15,041		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P3: Flow to Design Point #3 (Still Pond)

Runoff = 0.02 cfs @ 14.98 hrs, Volume= 371 cf, Depth> 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Storm Rainfall=4.70"

	Area (sf)	CN	Description
	43,239	39	>75% Grass cover, Good, HSG A
	0	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	4,715	35	Gravel roads, HSG A
	53,075	38	Weighted Average
	53,075		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	336	0.0270	0.23		**Lag/CN Method, Overland Flow**

Summary for Pond DP #1: Design Point #1

Inflow Area = 22,463 sf, 0.00% Impervious, Inflow Depth > 0.05" for 10 Year Storm event
Inflow = 0.00 cfs @ 15.33 hrs, Volume= 87 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.42' @ 20.00 hrs Surf.Area= 803 sf Storage= 87 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.25'	12,575 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.25	200	0	0
80.50	1,071	159	159
81.00	2,391	866	1,024
82.00	5,962	4,177	5,201
83.00	8,787	7,375	12,575

Summary for Pond DP#1: Design Point #1

Inflow Area = 24,561 sf, 4.25% Impervious, Inflow Depth > 0.11" for 10 Year Storm event
Inflow = 0.01 cfs @ 13.86 hrs, Volume= 222 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.46' @ 20.00 hrs Surf.Area= 1,286 sf Storage= 222 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.15'	5,431 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.15	145	0	0
81.00	3,275	1,453	1,453
81.80	6,669	3,978	5,431

Summary for Subcatchment E1: Flow to Design Point #1

Runoff = 0.07 cfs @ 12.47 hrs, Volume= 658 cf, Depth> 0.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.80"

Area (sf)	CN	Description
16,567	39	>75% Grass cover, Good, HSG A
6,951	30	Woods, Good, HSG A
1,043	98	Paved parking, HSG A
24,561	39	Weighted Average
23,518		95.75% Pervious Area
1,043		4.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	179	0.0360	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E2: Flow to Design Point #2

Runoff = 0.01 cfs @ 13.66 hrs, Volume= 221 cf, Depth> 0.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.80"

Area (sf)	CN	Description
9,112	39	>75% Grass cover, Good, HSG A
7,106	30	Woods, Good, HSG A
16,218	35	Weighted Average
16,218		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E3: Flow to Design Point #3 (Still Pond)

Runoff = 0.18 cfs @ 12.60 hrs, Volume= 1,723 cf, Depth> 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.80"

	Area (sf)	CN	Description
	47,385	39	>75% Grass cover, Good, HSG A
	2,318	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	2,025	35	Gravel roads, HSG A
	56,849	40	Weighted Average
	54,531		95.92% Pervious Area
	2,318		4.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.4	336	0.0270	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P1: Flow to Design Point #1

Runoff = 0.03 cfs @ 12.52 hrs, Volume= 373 cf, Depth> 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.80"

	Area (sf)	CN	Description
	13,849	39	>75% Grass cover, Good, HSG A
	4,715	30	Woods, Good, HSG A
	0	98	Roofs, HSG A
*	3,899	35	Gravel roads, HSG A
	22,463	36	Weighted Average
	22,463		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	142	0.0480	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P2: Flow to Design Point #2

Runoff = 0.02 cfs @ 12.51 hrs, Volume= 250 cf, Depth> 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.80"

	Area (sf)	CN	Description
	8,878	39	>75% Grass cover, Good, HSG A
	4,444	30	Woods, Good, HSG A
*	1,719	35	Gravel roads, HSG A
	0	98	Roofs, HSG A
	15,041	36	Weighted Average
	15,041		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P3: Flow to Design Point #3 (Still Pond)

Runoff = 0.10 cfs @ 12.68 hrs, Volume= 1,216 cf, Depth> 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Storm Rainfall=5.80"

	Area (sf)	CN	Description
	43,239	39	>75% Grass cover, Good, HSG A
	0	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	4,715	35	Gravel roads, HSG A
	53,075	38	Weighted Average
	53,075		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	336	0.0270	0.23		**Lag/CN Method, Overland Flow**

Summary for Pond DP #1: Design Point #1

Inflow Area = 22,463 sf, 0.00% Impervious, Inflow Depth > 0.20" for 25 Year Storm event
Inflow = 0.03 cfs @ 12.52 hrs, Volume= 373 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.67' @ 20.00 hrs Surf.Area= 1,508 sf Storage= 373 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.25'	12,575 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.25	200	0	0
80.50	1,071	159	159
81.00	2,391	866	1,024
82.00	5,962	4,177	5,201
83.00	8,787	7,375	12,575

Summary for Pond DP#1: Design Point #1

Inflow Area = 24,561 sf, 4.25% Impervious, Inflow Depth > 0.32" for 25 Year Storm event
Inflow = 0.07 cfs @ 12.47 hrs, Volume= 658 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 80.71' @ 20.00 hrs Surf.Area= 2,205 sf Storage= 657 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.15'	5,431 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.15	145	0	0
81.00	3,275	1,453	1,453
81.80	6,669	3,978	5,431

Summary for Subcatchment E1: Flow to Design Point #1

Runoff = 0.46 cfs @ 12.24 hrs, Volume= 2,304 cf, Depth> 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.30"

Area (sf)	CN	Description
16,567	39	>75% Grass cover, Good, HSG A
6,951	30	Woods, Good, HSG A
1,043	98	Paved parking, HSG A
24,561	39	Weighted Average
23,518		95.75% Pervious Area
1,043		4.25% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.6	179	0.0360	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E2: Flow to Design Point #2

Runoff = 0.17 cfs @ 12.27 hrs, Volume= 1,054 cf, Depth> 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.30"

Area (sf)	CN	Description
9,112	39	>75% Grass cover, Good, HSG A
7,106	30	Woods, Good, HSG A
16,218	35	Weighted Average
16,218		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.6	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment E3: Flow to Design Point #3 (Still Pond)

Runoff = 0.99 cfs @ 12.42 hrs, Volume= 5,728 cf, Depth> 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.30"

	Area (sf)	CN	Description
	47,385	39	>75% Grass cover, Good, HSG A
	2,318	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	2,025	35	Gravel roads, HSG A
	56,849	40	Weighted Average
	54,531		95.92% Pervious Area
	2,318		4.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.4	336	0.0270	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P1: Flow to Design Point #1

Runoff = 0.29 cfs @ 12.22 hrs, Volume= 1,616 cf, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.30"

	Area (sf)	CN	Description
	13,849	39	>75% Grass cover, Good, HSG A
	4,715	30	Woods, Good, HSG A
	0	98	Roofs, HSG A
*	3,899	35	Gravel roads, HSG A
	22,463	36	Weighted Average
	22,463		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	142	0.0480	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P2: Flow to Design Point #2

Runoff = 0.19 cfs @ 12.21 hrs, Volume= 1,083 cf, Depth> 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.30"

	Area (sf)	CN	Description
	8,878	39	>75% Grass cover, Good, HSG A
	4,444	30	Woods, Good, HSG A
*	1,719	35	Gravel roads, HSG A
	0	98	Roofs, HSG A
	15,041	36	Weighted Average
	15,041		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	135	0.0500	0.24		**Lag/CN Method, Overland Flow**

Summary for Subcatchment P3: Flow to Design Point #3 (Still Pond)

Runoff = 0.72 cfs @ 12.47 hrs, Volume= 4,545 cf, Depth> 1.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Storm Rainfall=8.30"

	Area (sf)	CN	Description
	43,239	39	>75% Grass cover, Good, HSG A
	0	98	Roofs, HSG A
	5,121	30	Woods, Good, HSG A
*	4,715	35	Gravel roads, HSG A
	53,075	38	Weighted Average
	53,075		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.7	336	0.0270	0.23		**Lag/CN Method, Overland Flow**

Summary for Pond DP #1: Design Point #1

Inflow Area = 22,463 sf, 0.00% Impervious, Inflow Depth > 0.86" for 100 Year Storm event
Inflow = 0.29 cfs @ 12.22 hrs, Volume= 1,616 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 81.21' @ 20.00 hrs Surf.Area= 3,152 sf Storage= 1,615 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.25'	12,575 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.25	200	0	0
80.50	1,071	159	159
81.00	2,391	866	1,024
82.00	5,962	4,177	5,201
83.00	8,787	7,375	12,575

Summary for Pond DP#1: Design Point #1

Inflow Area = 24,561 sf, 4.25% Impervious, Inflow Depth > 1.13" for 100 Year Storm event
Inflow = 0.46 cfs @ 12.24 hrs, Volume= 2,304 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 100%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 81.23' @ 20.00 hrs Surf.Area= 4,233 sf Storage= 2,301 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	80.15'	5,431 cf	**Ponding Area (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
80.15	145	0	0
81.00	3,275	1,453	1,453
81.80	6,669	3,978	5,431

Figures 1 – 4

Figures D1 and D2

Appendix A

Soil Map—Essex County, Massachusetts, Northern Part
(Soil Map Figure 2A)

Map Scale: 1:2,450 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 35 70 140 210

Feet: 0 100 200 400 600

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 1:15,800.

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: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 10, Sep 19, 2014

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

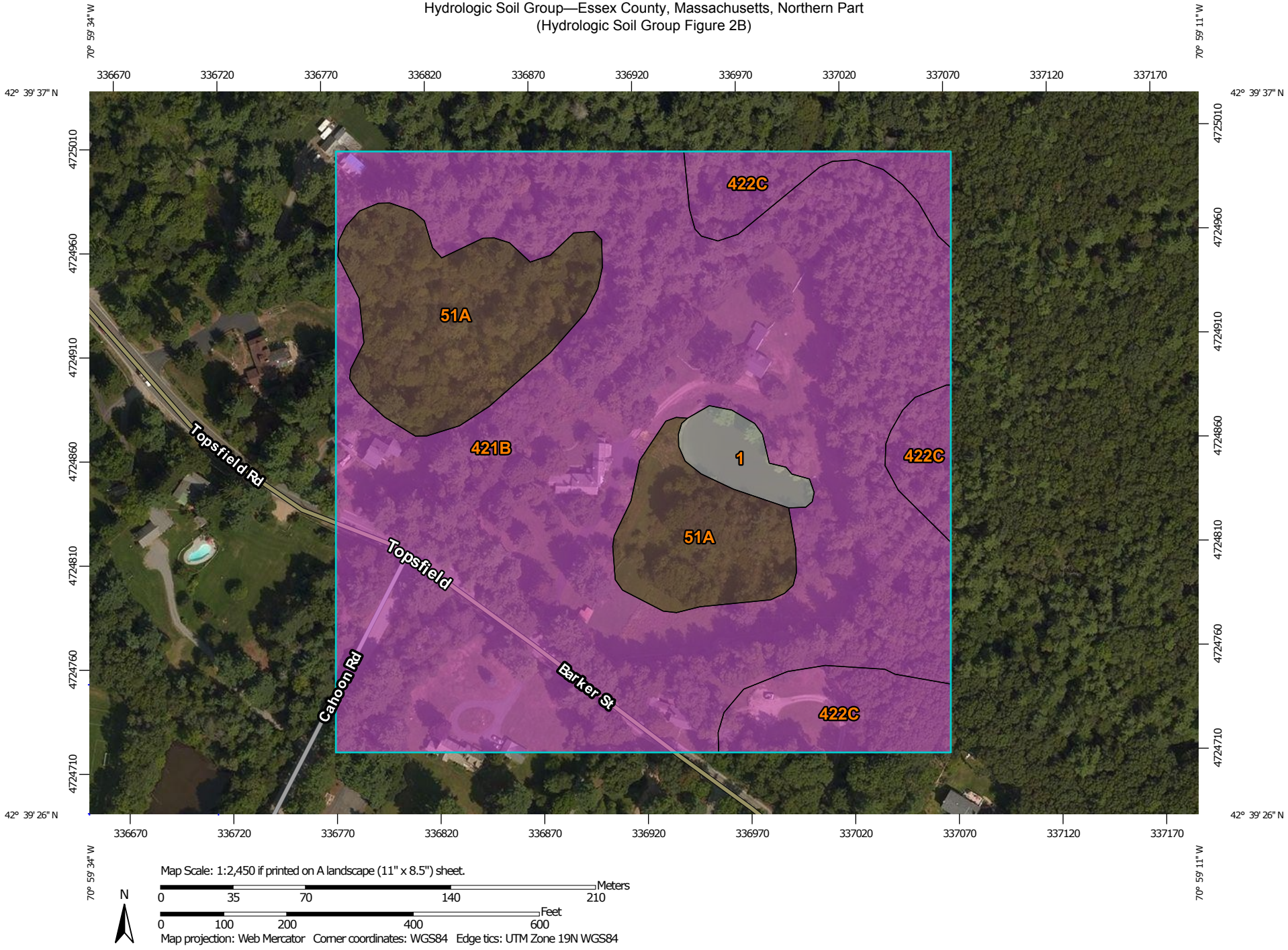
Date(s) aerial images were photographed: Aug 29, 2014—Sep 19, 2014

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

Map Unit Legend

Essex County, Massachusetts, Northern Part (MA605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1	Water	0.4	2.0%
51A	Swansea muck, 0 to 1 percent slopes	3.5	16.5%
421B	Canton fine sandy loam, 3 to 8 percent slopes, very stony	15.2	71.5%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	2.1	10.0%
Totals for Area of Interest		**21.2**	**100.0%**

Hydrologic Soil Group—Essex County, Massachusetts, Northern Part
(Hydrologic Soil Group Figure 2B)



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 1:15,800.

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: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 10, Sep 19, 2014

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

Date(s) aerial images were photographed: Aug 29, 2014—Sep 19, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Essex County, Massachusetts, Northern Part (MA605)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
1	Water		0.4	2.0%
51A	Swansea muck, 0 to 1 percent slopes	B/D	3.5	16.5%
421B	Canton fine sandy loam, 3 to 8 percent slopes, very stony	A	15.2	71.5%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	A	2.1	10.0%
Totals for Area of Interest			**21.2**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NORTH

RAINFALL DISTRIBUTION

TYPE I

TYPE IA

TYPE II

TYPE III - BOXFORD, MA.

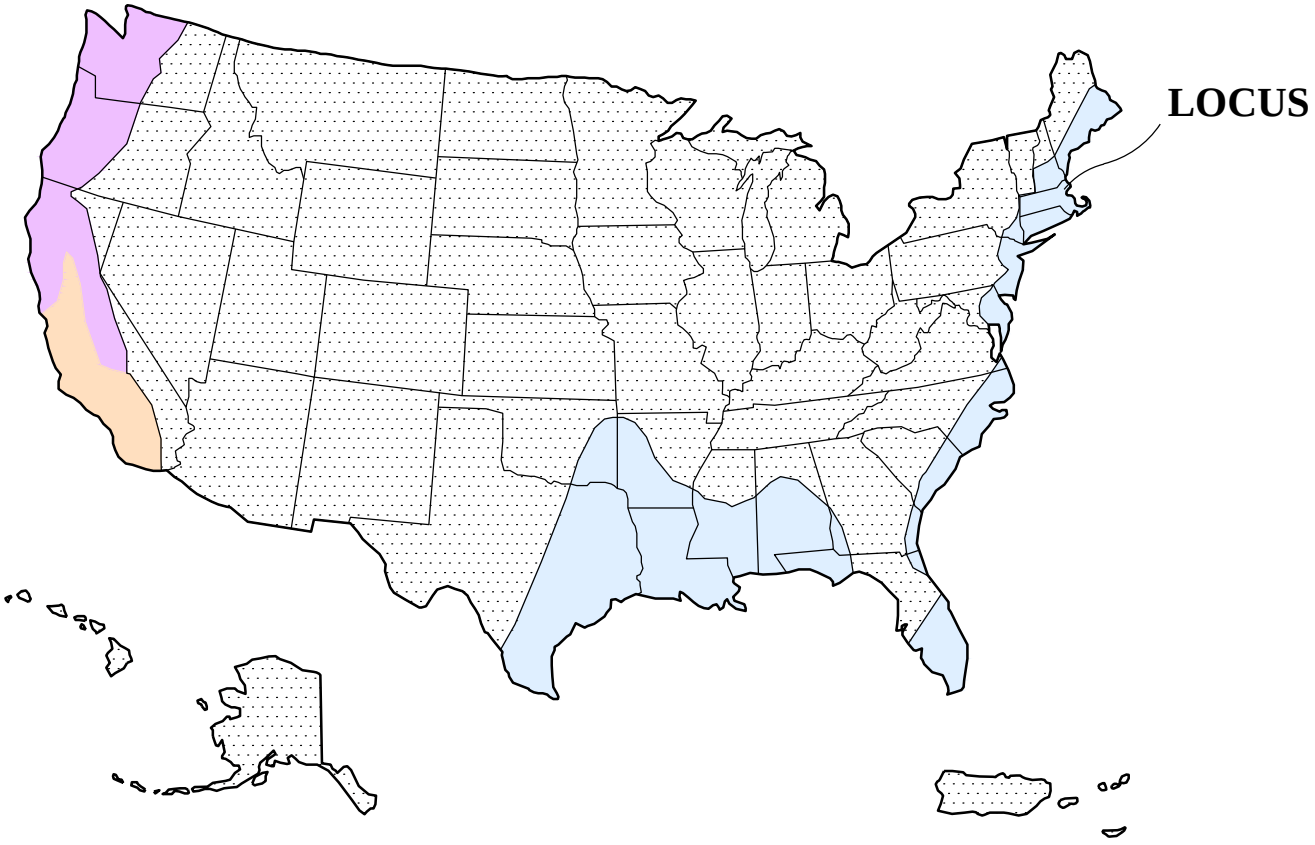
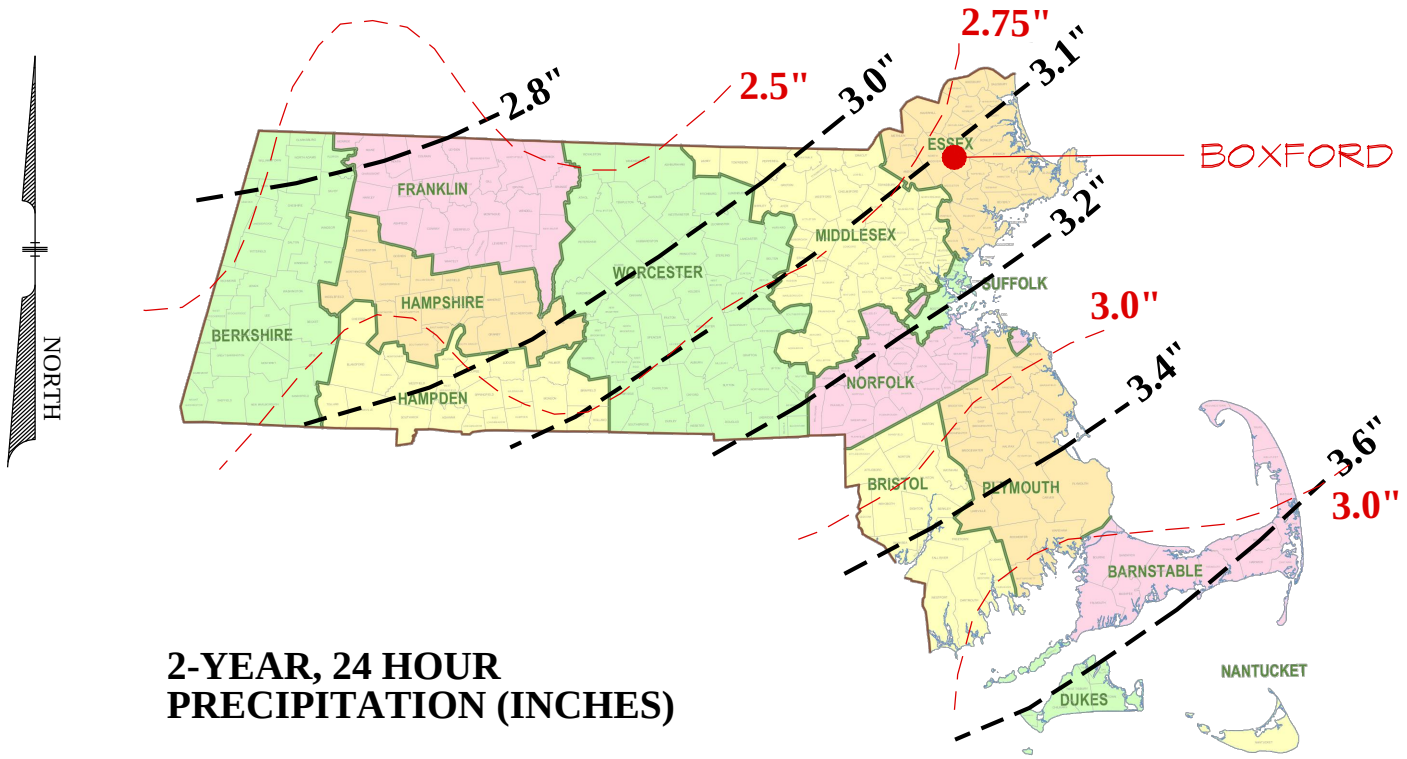


FIGURE 3
RAINFALL DISTRIBUTION MAP

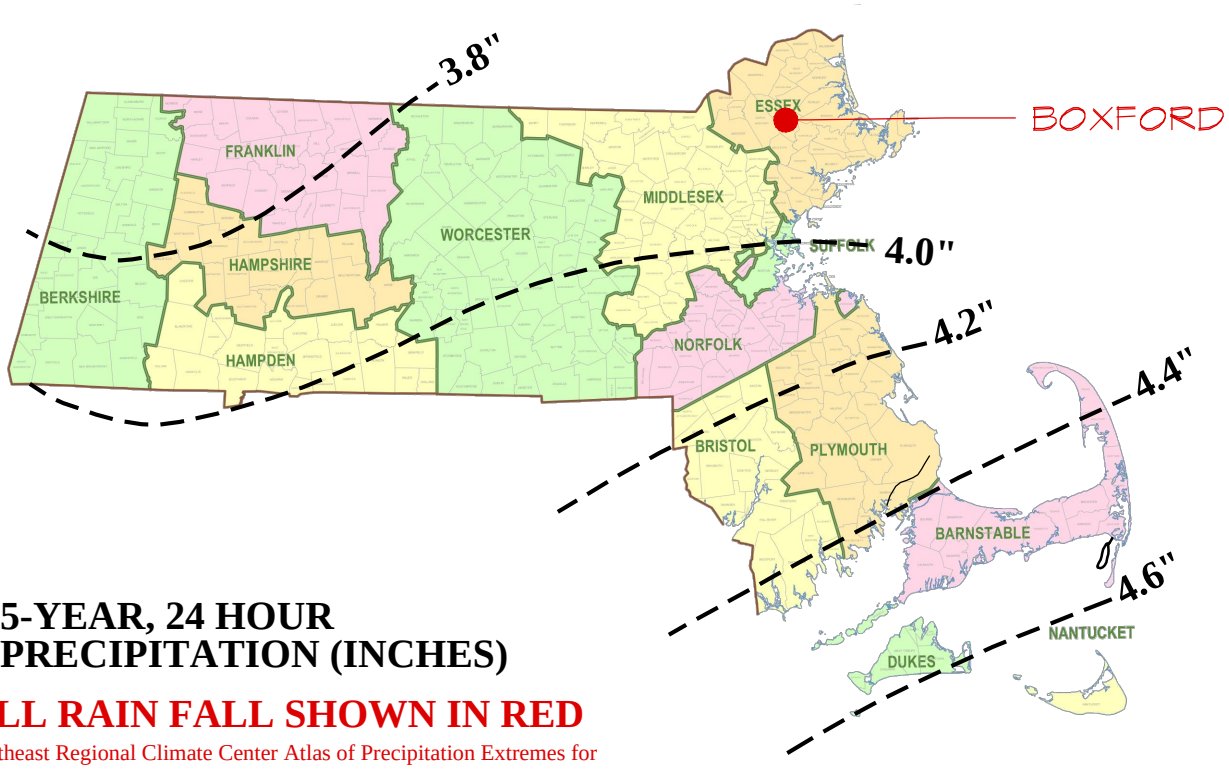
Job No. 2015-28

ASB design group LLC
363 BOSTON STREET - ROUTE 1
TOPSFIELD, MA. 01984
978-500-8419

STATE:	MASSACHUSETTS
CITY/TOWN:	BOXFORD
TYPE:	III
DATE:	AUG. 6, 2015



2-YEAR, 24 HOUR PRECIPITATION (INCHES)



5-YEAR, 24 HOUR PRECIPITATION (INCHES)

CORNELL RAIN FALL SHOWN IN RED

SOURCE: Northeast Regional Climate Center Atlas of Precipitation Extremes for Northeastern United States and Southeastern Canada, by Daniel S. Wilks and Richard P. Cember, Cornell University, NY, Publication No. RR 93-5, September 1993

FIGURE 4

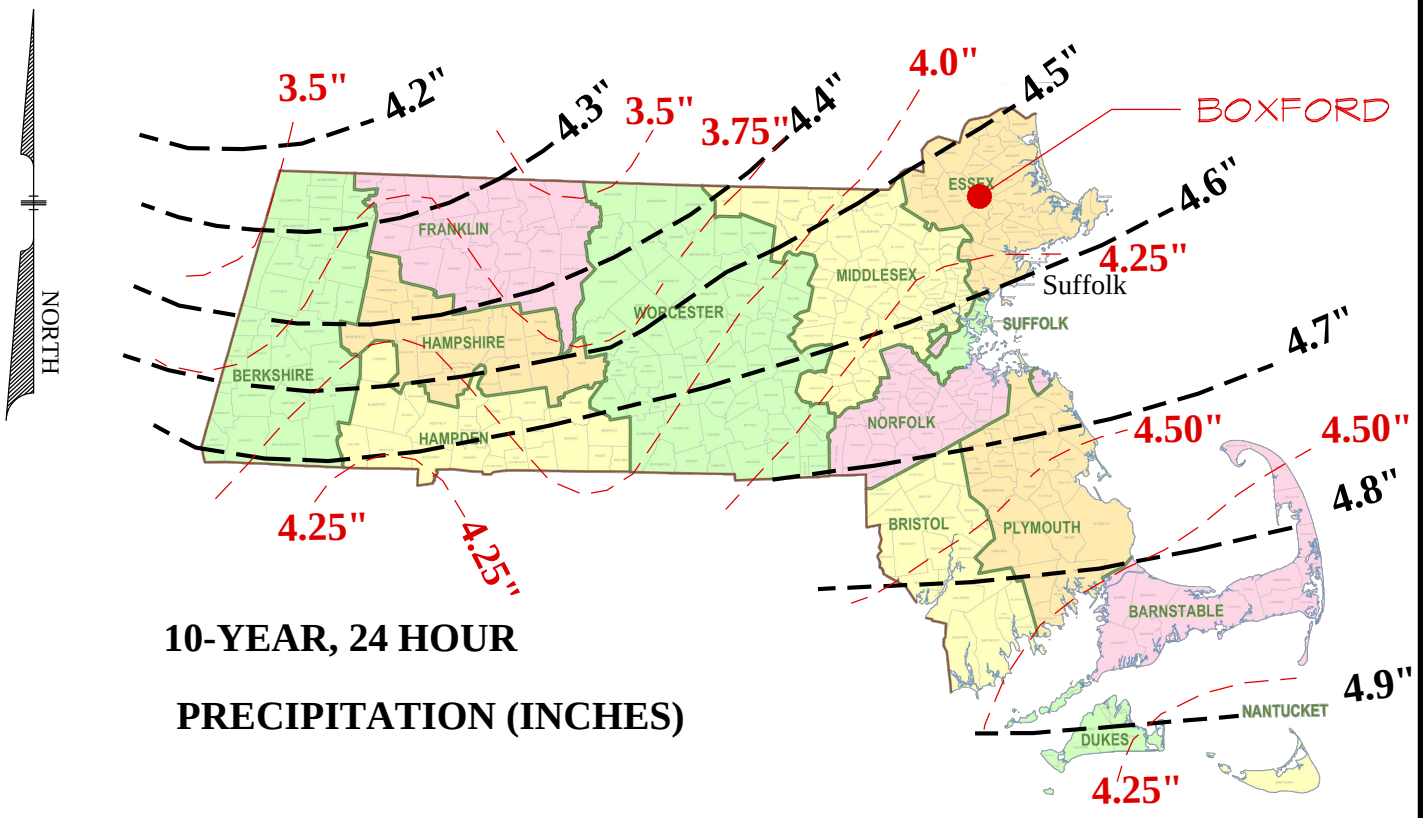
RAINFALL DATA MAPS

SHEET 1 OF 3

Job No. 2015-28

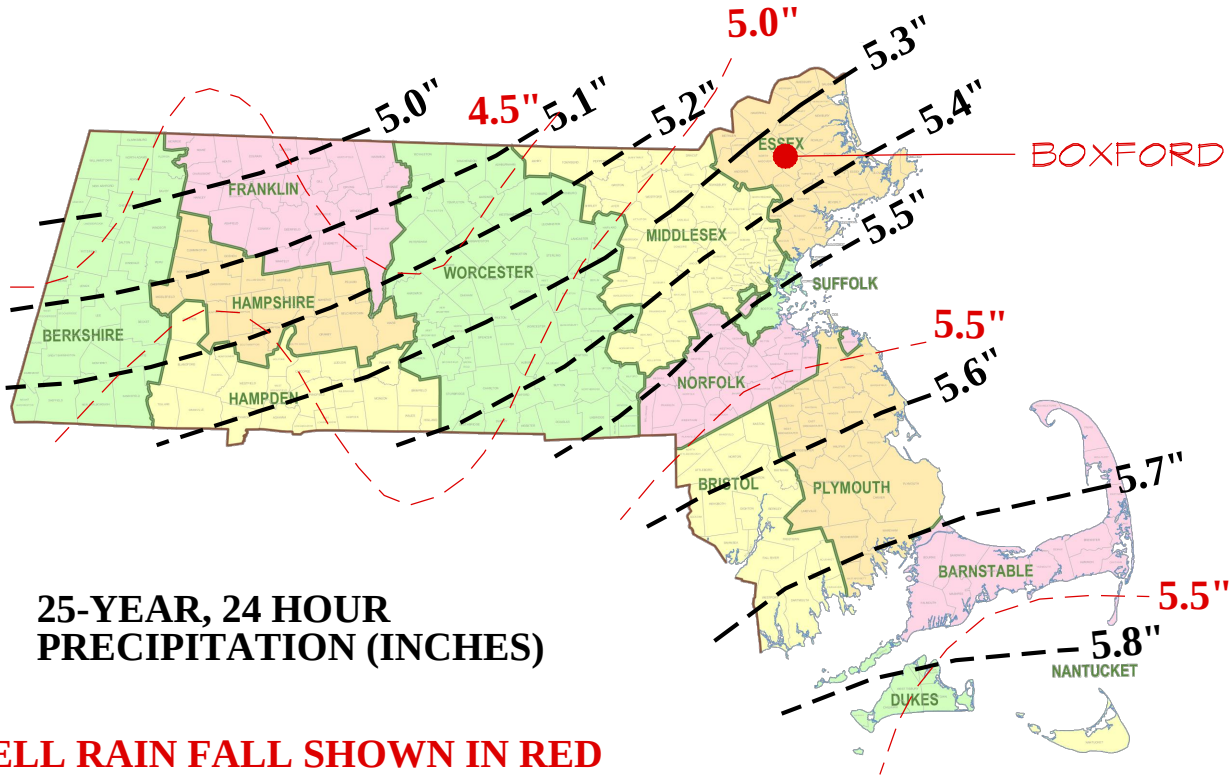
ASB design group LLC
363 BOSTON STREET - ROUTE 1
TOPSFIELD, MA. 01984
978-500-8419

STATE:	MASSACHUSETTS
CITY/TOWN:	BOXFORD
STORM:	2- and 5-YEAR
DATE:	AUG. 6, 2015



10-YEAR, 24 HOUR

PRECIPITATION (INCHES)



25-YEAR, 24 HOUR
PRECIPITATION (INCHES)

CORNELL RAIN FALL SHOWN IN RED

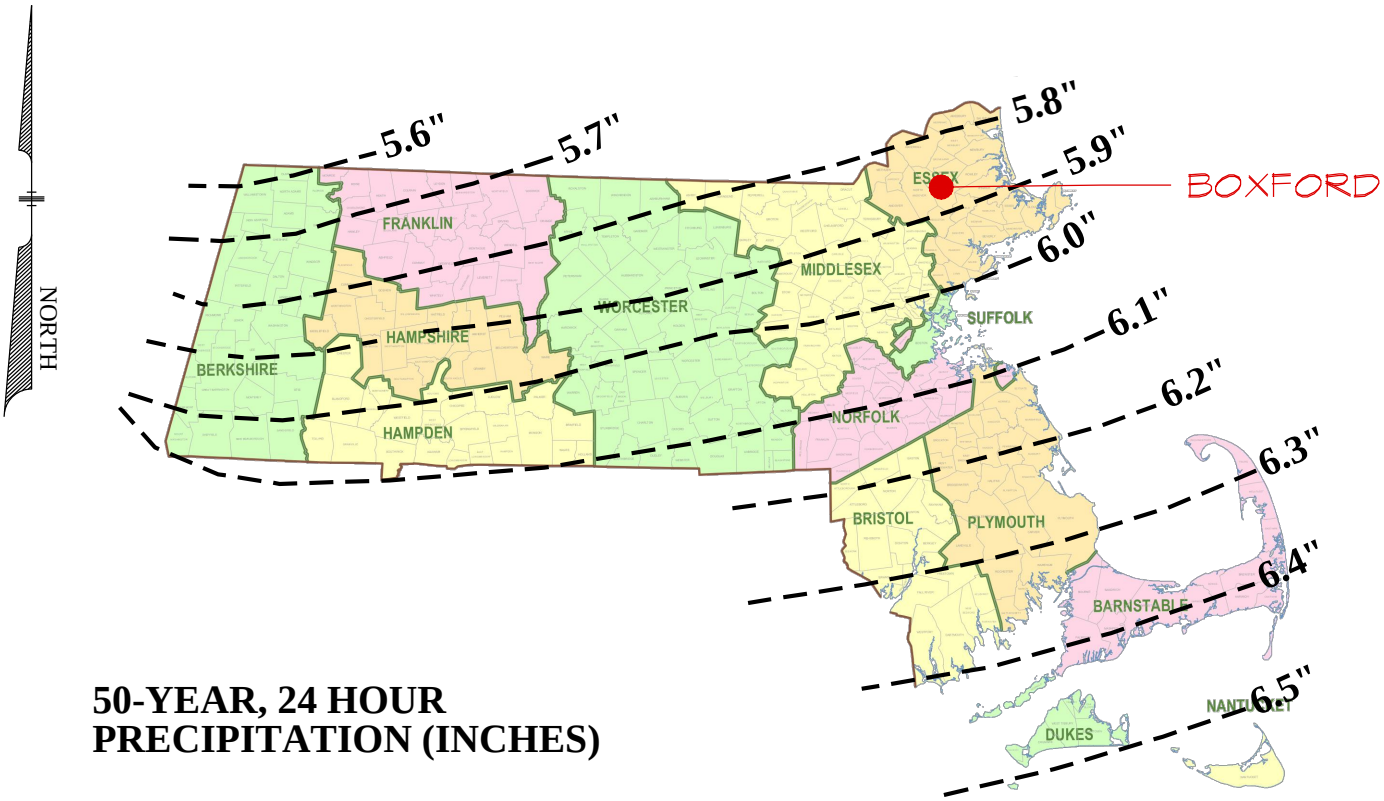
SOURCE: Northeast Regional Climate Center Atlas of Precipitation Extremes for Northeastern United States and Southeastern Canada, by Daniel S. Wilks and Richard P. Cember, Cornell University, NY, Publication No. RR 93-5, September 1993

FIGURE 4
RAINFALL DATA MAPS
SHEET 2 OF 3

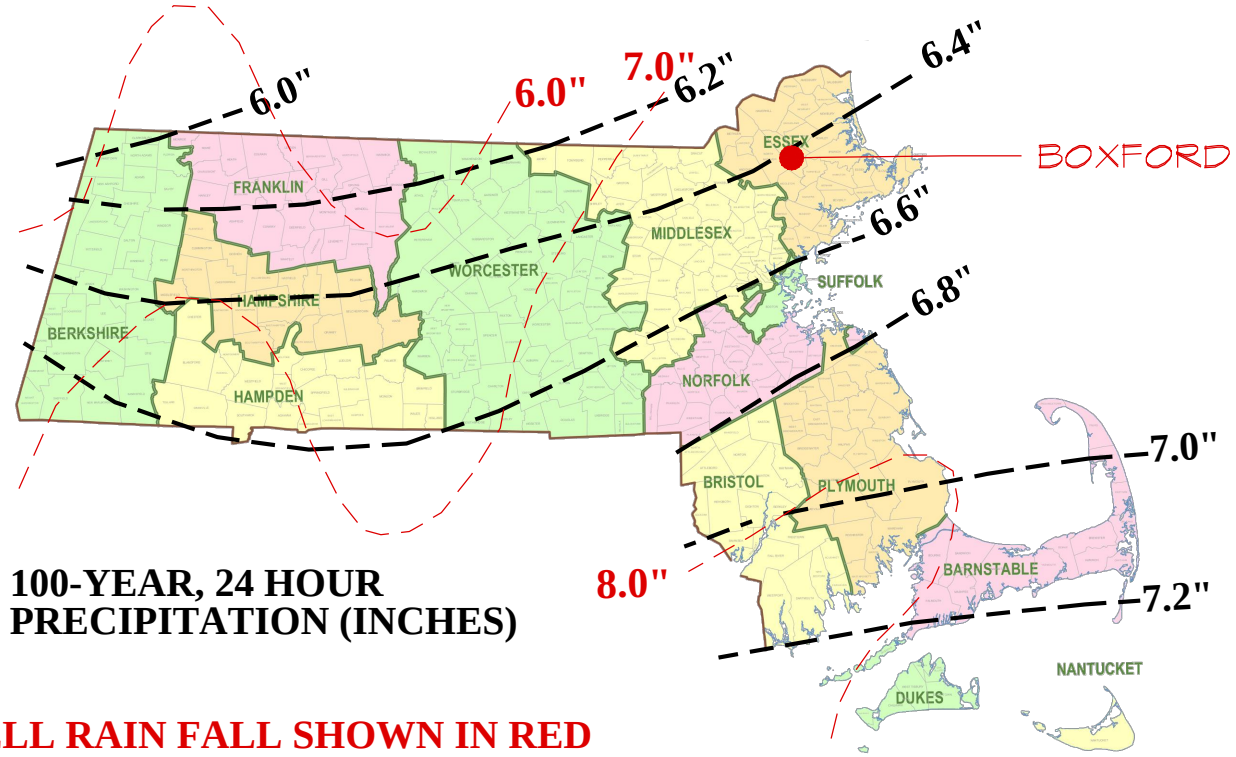
Job No. 2015-28

ASB design group LLC
363 BOSTON STREET - ROUTE 1
TOPSFIELD, MA. 01984
978-500-8419

STATE:	MASSACHUSETTS
CITY/TOWN:	BOXFORD
STORM:	10- and 25-YEAR
DATE:	AUG. 6, 2015



50-YEAR, 24 HOUR PRECIPITATION (INCHES)



100-YEAR, 24 HOUR PRECIPITATION (INCHES)

CORNELL RAIN FALL SHOWN IN RED

SOURCE: Northeast Regional Climate Center Atlas of Precipitation Extremes for Northeastern United States and Southeastern Canada, by Daniel S. Wilks and Richard P. Cember, Cornell University, NY, Publication No. RR 93-5, September 1993

FIGURE 4
RAINFALL DATA MAPS
SHEET 3 OF 3

Job No. 2015-28

ASB design group LLC
363 BOSTON STREET - ROUTE 1
TOPSFIELD, MA. 01984
978-500-8419

STATE:	MASSACHUSETTS
CITY/TOWN:	BOXFORD
STORM:	50- and 100-YEAR
DATE:	AUG. 6, 2015

Stormwater Check List

Appendix B