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Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

ENTERING
EST. 1870
NORFOLK

STORMWATER MANAGEMENT REPORT

April 19, 2016

Project:

Lakeland Farms
A Townhouse Community
84 Cleveland Street
Norfolk, MA 02056

Assessors Map/Lot:

Map 15, Block 54, Lot 43

Owner / Applicant:

Lakeland Farms, LLC
84 Cleveland Street
Norfolk, MA 02056

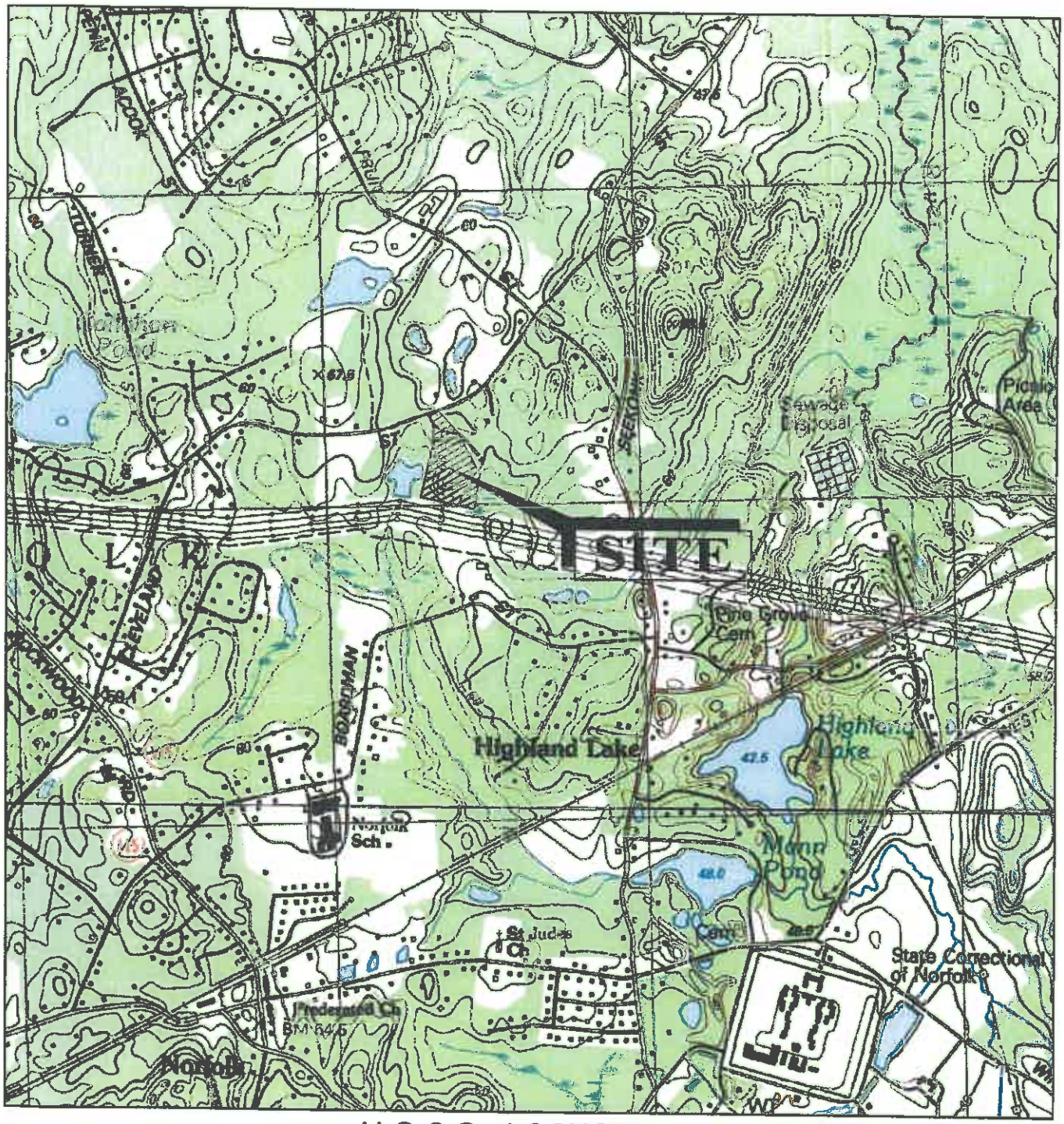
Representative:

Andrews Survey & Engineering, Inc.
104 Mendon Street
Uxbridge, MA 01569

ASE JN: 2014-111

Uxbridge
104 Mendon Street
Uxbridge, MA 01569
Tel. 508 278-3897 Fax. 508 278-2289

North Attleboro
500 East Washington Street
North Attleboro, MA 02760
Tel. 508 316-0452 Fax. 508 316-0963



U.S.G.S. LOCUS MAP

SCALE: 1"=1500'

LAKELAND FARMS
84 CLEVELAND STREET
NORFOLK, MASSACHUSETTS

ASE

Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

P.O. Box 312, 104 Mendon Street
Uxbridge, Massachusetts 01569-0312
P: 508-278-3897 F: 508-278-2289

N

FIGURE 1.0

STORMWATER MANAGEMENT REPORT

Lakeland Farms
Townhouse Community
84 Cleveland Street
Norfolk, MA 02056

April 19, 2016

Prepared for:

Lakeland Farms, LLC
84 Cleveland Street
Norfolk, MA 02056

Prepared by:

Andrews Survey & Engineering, Inc.
P.O. Box 312, 104 Mendon Street
Uxbridge, MA 01569

ASE Project #2014-111

Prepared by: Travis R. Brown
Travis R. Brown

Reviewed by: COMMONWEALTH OF MASSACHUSETTS PAUL B. HUTNAK CIVIL No. 45872 REGISTERED PROFESSIONAL ENGINEER 4.19.16
Paul B. Hutnak, P.E.

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PART 1 – SUMMARY

1.0 PROJECT DESCRIPTION

Lakeland Farms is a 40-unit townhouse community located on the south side of Cleveland Street approximately 1 mile north/northeast of Route 115 in Norfolk, MA. The project address is 84 Cleveland Street and has a total area of 8.81 acres. It is the primary residence of the applicant and consists of an existing single-family dwelling, detached garage, and numerous farm structures that were used while the applicant operated Brambly Farms. The property is bounded on the north by Cleveland Street, on the east by undeveloped residential property, on the south by a large electric transmission & gas easement, and on the west by undeveloped residential property comprised mostly of a small pond. The property is further identified on the Norfolk Assessor Tax Map 15, Block 54, Lot 43.

Wetland resources on the property have been delineated by B&C Associates, Inc. and are illustrated on the enclosed Site Plans. A Bordering Vegetated Wetland (BVW) is located on the south and west sides of the site and consumes approximately 2 acres of the property. The remainder of the property consists of a mix of gravel access drives, maintained lawn, wild grasses, and mature evergreen & deciduous trees.

The proposed project consists of grading, utilities, drainage and erosion controls. The paved areas flow through a piped system into two (2) Detention Basins and an Infiltration Basin through either to a proprietary unit or forebay. The forebay will then then flow into an infiltration area sized with the appropriate water quality and infiltration volumes.

The property is entirely located within an area mapped as Estimated & Priority Habitat by the latest edition of the Massachusetts Natural Heritage Atlas. The property was reviewed by NHESP during a recent meeting with the MA Division of Fisheries & Wildlife to review the project. A preliminary finding is that the project would result in a "conditional take" and that mitigation acceptable to NHESP would be required for the project to move forward. The property is not located within other environmentally-sensitive areas such as 100-year floodplain, Outstanding Resource Waters (ORW), Areas of Critical Environmental Concern (ACEC), or a Zone II of a public water supply.

2.0 BACKGROUND DATA

Soils information was taken from U.S.D.A. Natural Resource Conservation Service (NRCS) Soil Survey Report. Soils mapping indicated that the soils on the site are generally categorized as Charlton-Hollis-Rock outcrop complex, with a portion being Swansea Muck, having soil type have a hydrologic soil group rating of A and B/D respectively.

3.0 COMPLIANCE WITH STORMWATER STANDARDS

3.1 Untreated Stormwater (Standard 1)

The project is designed so that new stormwater conveyances (outfalls/ discharges) do not discharge untreated stormwater into, or cause erosion to, wetlands.

Standard #1 is met.

3.2 Post-Development Peak Rates (Standard 2)

Hydrologic calculations were performed to determine the rate of runoff for the 2, 10, 25 and 100-year storm events under pre-development (present) conditions. This value was established as the future (post-development) maximum allowable rate. Unmitigated post-development rates were then computed in a similar manner. It is the intent of the stormwater management system to minimize impacts to drainage patterns of downstream property and wetlands while simultaneously providing water quality treatment to runoff prior to its release from the site or discharge to wetlands.

The U.S.D.A. Soil Conservation Service (SCS) Technical Release 55 (TR-55), 1986, was used as the procedure for estimating runoff. A SCS TR-20-based computer program, "HydroCAD," was used for estimating peak discharges. TR-55 is a generally accepted model for use on small sites that begins with a rainfall amount uniformly imposed on the watershed over a specified time distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). CN is based on soils, ground cover, impervious areas, interception and surface storage. Runoff is then transformed into a hydrograph that depends on runoff travel time through segments of the watershed. Development in a watershed changes its response to precipitation. The most common effects are reduced infiltration and decreased travel time, which result in significantly higher peak rates of runoff. The volume of runoff is determined primarily by the amount of precipitation and by infiltration characteristics related to soil type, antecedent rainfall, and type of vegetative cover, impervious surfaces, and surface retention. Travel time is determined primarily by slope, flow length, depth of flow surfaces. Peak rates of discharge are based on the relationship of the above parameters as well as the total drainage area of the watershed, the location of the development in relation to the total drainage area, and the effect of any flood control works or other manmade storage. Peak rates of discharge are also influenced by the distribution of rainfall within a given storm event.

Stormwater management computations for the project site were performed using SCS-based Hydrocad for existing and proposed conditions, curve numbers, time

of concentration, and unit hydrograph computations. The following were considered as part of runoff calculations.

Since urban areas are seldom completely covered by impervious structure, soils and soil properties are an important factor in estimating the total volume of direct runoff. The infiltration and percolation rates of soils indicate their potential to absorb rainfall and thereby reduce the amount of direct runoff. Soils having a high infiltration rate (sands or gravels) have a low runoff potential, and soils having a low infiltration rate (clays) have a high runoff potential. Urbanization on soils with a high infiltration rate increases the volume of runoff and peak discharge more than urbanization on soils with a low infiltration rate.

The type of surface cover and its hydrologic condition affects runoff volume through its influence on the infiltration rate of the soil. Unused cultivated land yields more runoff than forested land for a given soil type. Covering areas with impervious material reduces surface storage and infiltration and increases the volume of runoff.

Some rainfall is retained on the ground surface and by vegetation before runoff begins. Interception is rainfall that is caught by foliage, twigs, branches, leaves, etc. This rainfall is lost to evaporation and thus never reaches the ground surface. Increasing the vegetative cover increases the amount of interception.

Surface depression storage begins when precipitation exceeds infiltration. Overland flow starts when the surface depressions are full. The water in depression storage is not available as direct runoff.

Initial abstraction is the sum of interception, depression, storage, and infiltration before runoff begins. It occurs on all types of cover, from lawn in good condition to pavement. However, the amount of initial abstraction is less on pavement than on lawn.

Travel time (Tt) is the time it takes water to travel from one location to another in a watershed. Tt is a component of time of concentration (Tc) that is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. Tc is computed by summing all the travel time for consecutive components of the drainage conveyance system.

Tc influences the shape and peak of the runoff hydrograph. Urbanization usually decreases Tc thereby increasing the peak discharge.
Development can change the effective slope of a watershed if flow paths are altered by channeling and by changing the surface grading for building lots, roads and ditches. The slopes of street gutters, roads and overland flow areas as well as stream channels are significant in determining travel times through urban watersheds.

Flow length may be reduced if natural meandering streams are changed to straight channels. It may be increased if overland flows are diverted through ditches, storm drains, or street gutters to larger collections systems.

Surface roughness is also a consideration. Flow velocity normally increases significantly when the flow path is changed from flow over rough surfaces of woodland, grassland and natural channels to sheet flow over smooth surfaces of parking lots, storm drains, gutters and lined channels.

3.2.1 Existing Conditions

Under existing conditions, the area consists of an existing single-family dwelling, detached garage, and numerous farm structures that were used while the applicant operated Brambly Farms. The property is bounded on the north by Cleveland Street, on the east by undeveloped residential property, on the south by a large electric transmission & gas easement, and on the west by undeveloped residential property comprised mostly of a small pond. The site discharges to the small pond and Bordering Vegetated Wetland associated with it.

3.2.2 Proposed Conditions

Post-development peak rates were determined and routed through the existing and modified basins with the resulting hydrographs added to the hydrographs for the overland areas. Based upon these analyses, the peak rates of runoff for the 2, 10, 25 and 100-year storm events are as follows:

Table 3.2.2.1 Stormwater Peak rate Summary

Pre-Development (cfs)				
Analysis Point	2-YR	10-YR	25-YR	100-YR
AP 1	0.0	0.4	1.3	4.0
Post Development (cfs)				
Analysis Point	2-YR	10-YR	25-YR	100-YR
AP 1	0.0	0.3	0.7	1.4
Pre-Development vs. Post Developed (cfs)				
Analysis Point	2-YR	10-YR	25-YR	100-YR
AP 1	**0.0**	**-0.1**	**-0.6**	**-2.6**

Standard #2 is met.

3.3 Recharge to Groundwater (Standard 3)

Although runoff volumes will not increase after construction; recharge shall be provided. Therefore, stormwater runoff volume to be recharged to groundwater should be determined using the existing site (pre-development) soil conditions and the annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site, based on soil types.

Hydrologic Soil Group	Volume to Recharge (x Total Impervious Area)
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

Required Recharge Volume

0.60 inches runoff x total impervious area = Recharge Volume, "A" soil
0.35 inches runoff x total impervious area = Recharge Volume, "B" soil
0.25 inches runoff x total impervious area = Recharge Volume, "C" soil
0.10 inches runoff x total impervious area = Recharge Volume, "D" soil

0.60 inches x (1ft. /12in.) x (145,134) sq. ft. = 7,257 cubic feet.

Total Volume Required for Recharge = 7,257 cubic feet

Recharge Volume Provided

Infiltration Basin = 20,475 cubic feet

Total Volume Provided for Recharge = 20,475 cubic feet

Drawdown Time

To determine whether an infiltration BMP will drain within 72 hours, the following formula must be used[1]:

$$Time_{drawdown} = \frac{Rv}{(K)(Bottom\ Area)}$$

Where:
Rv = Storage Volume

K = Saturated Hydraulic Conductivity For "Static" and "Simple Dynamic" Methods, use Rawls Rate (see Table 2.3.3). For "Dynamic Field" Method, use 50% of the in-situ saturated hydraulic conductivity.
Bottom Area = Bottom Area of Recharge Structure

Basin Storage Volume / ((Infiltration Rate / 12) x Basin Bottom Area))

*See Stage-Storage Calculations for drawdown time

Per the Massachusetts Stormwater Standards a mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four (4) feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm.

Mounding analysis calculated using the Hantush (1967) method. Automated calculator available online from the Aquifer Test Forum sponsored by HydroSOLVE, Inc. The calculated mounds will not interfere with the draining of the infiltration basins, the results are as follows:

Infiltration Basin

	Infiltration Area	Prop. Basin
Hydraulic Conductivity	ft/day	39
		Standard value for "Loamy Sand" material
Specific Yield		0.23
		Standard value for "Loamy Sand" material
Initial Saturated Thickness	ft	20
		Depth to bedrock
Design Recharge Rate	ft/day	2.04
		infiltration rate
Time	days	3
		Minimum 72 hr evaluation period
Bottom Infiltrating Area	sf	7,044
Length of Infiltration Area	ft	160
Width of Infiltration Area	ft	30
Time when Infiltration Stops	days	2.12
		Calculated Drawdown Time (see Above)
Maximum Water table rise at 72 hours[1]	ft	0.69
	In	8

- Resulting mound will not interfere with the full draining of the infiltration area in accordance with Mass Stormwater Standards -

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Standard #3 is met.

3.4 Removal of 80% TSS (Standard 4)

The proposed stormwater management system design calls for 4' deep sump catch basins to collect runoff from the roadway. Stormwater runoff from pavement areas will then be conveyed by a closed pipe system through either a proprietary stormwater treatment unit (Downstream Defender) which discharges to a sediment forebay followed by a detention basin or an infiltration basin. Calculations for removal rates for all paved runoff are below. These calculations are shown on the attached TSS Calculation Worksheets.

Deep Sump Catch Basins	25%
Downstream Defender	70%
Infiltration Basin w/ sediment forebay	80%
Detention Basin w/ sediment forebay	50%

Water Quality

Vwq = (Dwq ÷ 12inches/foot) (Aimp)

Where:
Vwq = Required Water Quality Volume (cubic feet)
Dwq = Water Quality Depth – 0.5 inches
Aimp = Impervious Area (s.f.)

Vwq Required

1 inch x (1ft. /12in.) x (145,134) sq. ft. = 7,257 cubic feet.

Water Quality Volume Provided
Outlet in the infiltration basins are set at an elevation above the required water quality volume.

Water Quality Volume Provided
Infiltration Basin = 20,475 cu. ft.

Forebay Sizing

The forebay volume is based on 0.1-inch over the contributing impervious area, including pavers.

Volume required = 0.1 inches x (1ft. /12in.) x (145,134) sq. ft. = 1,210 c.f.

Volume Provided Infiltration Basin = 1,276 c.f.

Standard #4 is met.

3.5 Land Uses with Higher Potential (Standard 5)

This project does not contain areas with higher potential for pollution.

Standard #5 is met.

3.6 Critical Areas (Standard 6 – Water Quality Treatments)

This site does not lie within a critical area.

Standard #6 is met.

3.7 Redevelopment (Standard 7)

Redevelopment projects are those that involve development, rehabilitation or expansion on previously developed sites provided the redevelopment results in no net increase in impervious area. Furthermore, components of redevelopment project, which include development of previously undeveloped sites, do not fall under Standard 7. In addition, redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

This site is not a redevelopment project.

Standard #7 is not applicable.

3.8 Erosion and Sedimentation Controls (Standard 8)

An Erosion and Sedimentation Control Plan is provided as part of the site plan application to the Zoning Board of Appeals.

Standard #8 is met.

3.9 Operation and Maintenance Plan (Standard 9)

An Operation and Maintenance Plan is provided as part of the site plan application to the Zoning Board of Appeals.

Standard #9 is met.

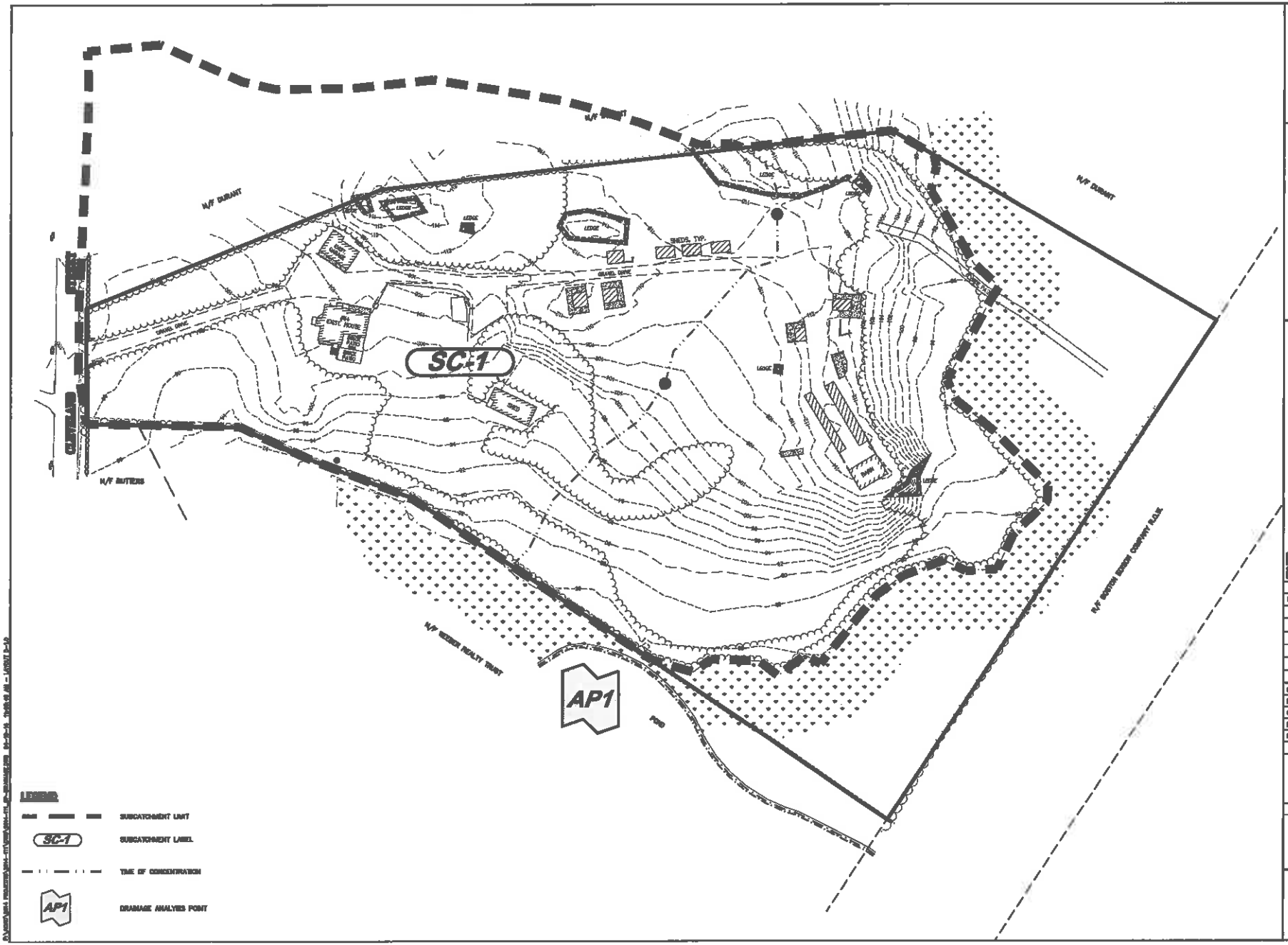
3.10 Ilicit Discharges (Standard 10)

On, March 10, 2016 a site inspection was performed by Andrews Survey & Engineering, Inc. and no illicit discharges were found.

A pollution prevention plan is incorporated into this report to prevent illicit discharges during and after construction.

Standard #10 is met.

PART II – PRE & POST-CONSTRUCTION COMPUTATIONS



ASE
Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning
P.O. Box 312, 104 Meadow Street
Uxbridge, Massachusetts 01569
P: 508-278-3397 F: 508-278-2569
500 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-9452 F: 508-316-9983

PROJECT: LAKELAND FARMS TOWNHOUSE COMMUNITY
84 CLEVELAND STREET
NORFOLK, MA 02056

APPLICANT: LAKELAND FARMS, LLC
84 CLEVELAND STREET
NORFOLK, MA 02056

NO.	DATE	DESCRIPTION

CAD FILE	.\dwg\2014-111_SP.dwg
DRAWN BY	BJD, TRB
CHECKED BY	PDH, BJD
DATE	APRIL 30, 2014
PROJECT NO.	2014-111

GRAPHIC SCALE
(IN FEET)
1 inch = 50 feet

SHEET TITLE
WATERSHED MAP
EXISTING CONDITIONS

SHEET NO.
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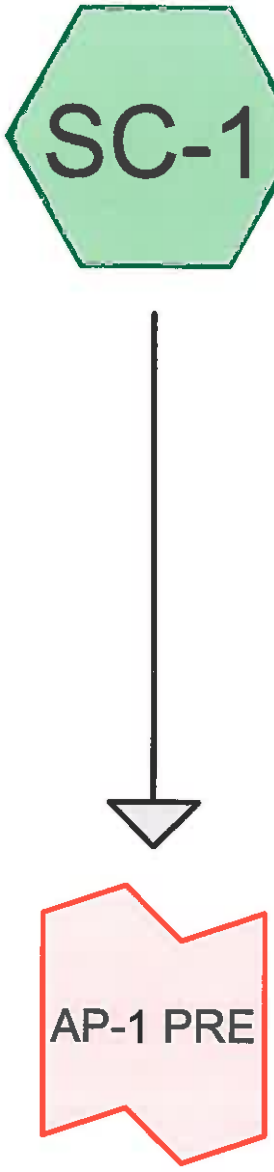


Subcat Reach Pond Link

Routing Diagram for 2014-111
Prepared by Andrews Survey & Engineering, Printed 4/18/2016

Summary for Subcatchment SC-1:

Runoff = 0.01 cfs @ 22.68 hrs, Volume= 0.005 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
18,939	96	Gravel surface, HSG A
2,804	98	Paved parking, HSG A
6,288	98	Roofs, HSG A
143,808	39	>75% Grass cover, Good, HSG A
165,816	30	Woods, Good, HSG A
21,677	55	Woods, Good, HSG B
7,405	61	>75% Grass cover, Good, HSG B
366,737	41	Weighted Average
357,645		97.52% Pervious Area
9,092		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0800	0.17		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.00"
1.3	212	0.0280	2.69		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.8	228	0.0820	4.61		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
7.0	490	Total			

Summary for Link AP-1 PRE:

Inflow Area = 8.419 ac, 2.48% Impervious, Inflow Depth = 0.01" for 2-Year event
Inflow = 0.01 cfs @ 22.68 hrs, Volume= 0.005 af
Primary = 0.01 cfs @ 22.68 hrs, Volume= 0.005 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Summary for Subcatchment SC-1:

Runoff = 0.37 cfs @ 12.47 hrs, Volume= 0.144 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
18,939	96	Gravel surface, HSG A
2,804	98	Paved parking, HSG A
6,288	98	Roofs, HSG A
143,808	39	>75% Grass cover, Good, HSG A
165,816	30	Woods, Good, HSG A
21,677	55	Woods, Good, HSG B
7,405	61	>75% Grass cover, Good, HSG B
366,737	41	Weighted Average
357,645		97.52% Pervious Area
9,092		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0800	0.17		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.00"
1.3	212	0.0280	2.69		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.8	228	0.0820	4.61		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
7.0	490	Total			

Summary for Link AP-1 PRE:

Inflow Area = 8.419 ac, 2.48% Impervious, Inflow Depth = 0.20" for 10-Year event
Inflow = 0.37 cfs @ 12.47 hrs, Volume= 0.144 af
Primary = 0.37 cfs @ 12.47 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Summary for Subcatchment SC-1:

Runoff = 1.33 cfs @ 12.36 hrs, Volume= 0.284 af, Depth= 0.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
18,939	96	Gravel surface, HSG A
2,804	98	Paved parking, HSG A
6,288	98	Roofs, HSG A
143,808	39	>75% Grass cover, Good, HSG A
165,816	30	Woods, Good, HSG A
21,677	55	Woods, Good, HSG B
7,405	61	>75% Grass cover, Good, HSG B
366,737	41	Weighted Average
357,645		97.52% Pervious Area
9,092		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0800	0.17		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.00"
1.3	212	0.0280	2.69		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.8	228	0.0820	4.61		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
7.0	490	Total			

Summary for Link AP-1 PRE:

Inflow Area = 8.419 ac, 2.48% Impervious, Inflow Depth = 0.40" for 25-Year event
Inflow = 1.33 cfs @ 12.36 hrs, Volume= 0.284 af
Primary = 1.33 cfs @ 12.36 hrs, Volume= 0.284 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Summary for Subcatchment SC-1:

Runoff = 4.04 cfs @ 12.15 hrs, Volume= 0.563 af, Depth= 0.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

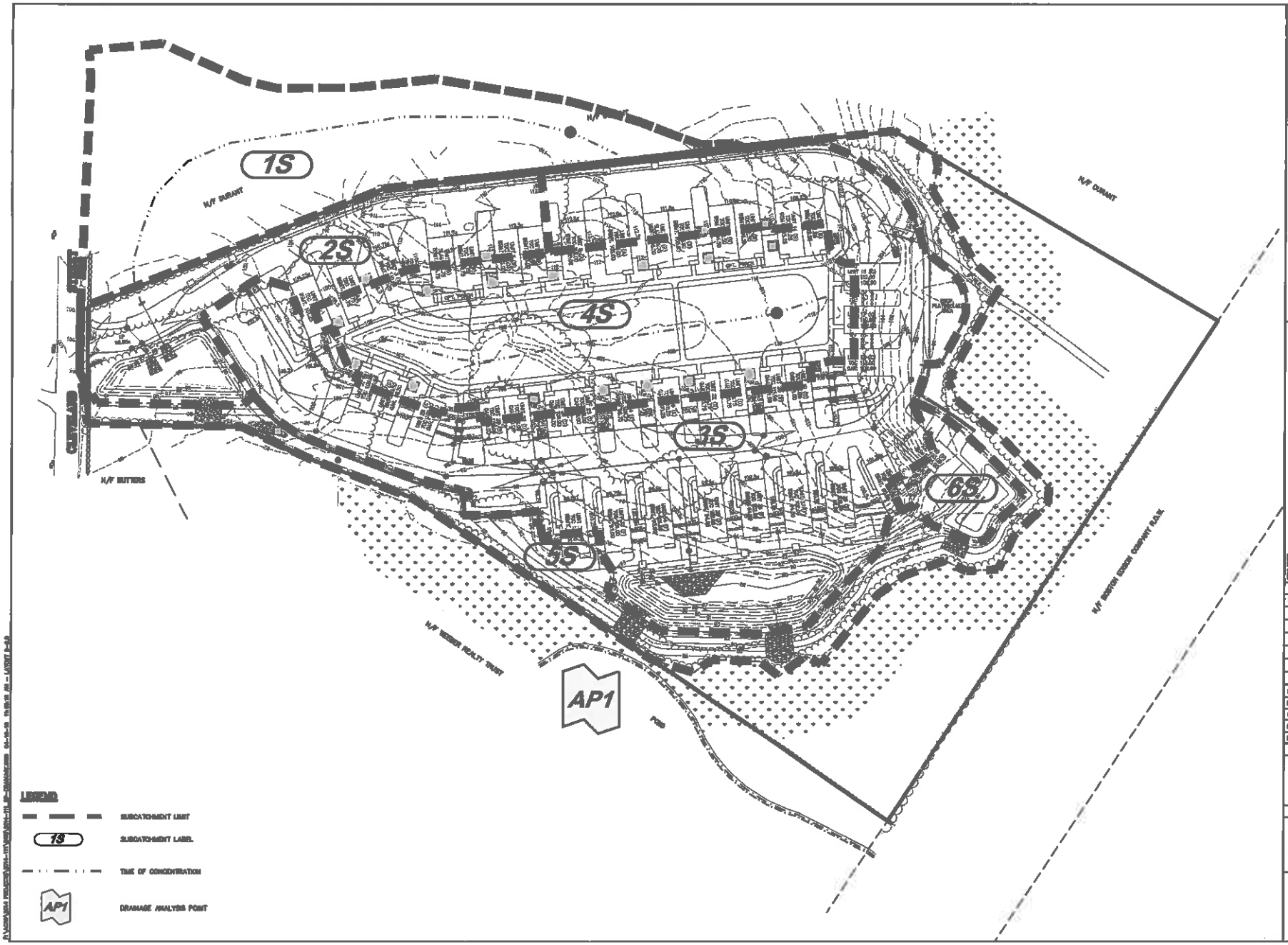
Area (sf)	CN	Description
18,939	96	Gravel surface, HSG A
2,804	98	Paved parking, HSG A
6,288	98	Roofs, HSG A
143,808	39	>75% Grass cover, Good, HSG A
165,816	30	Woods, Good, HSG A
21,677	55	Woods, Good, HSG B
7,405	61	>75% Grass cover, Good, HSG B
366,737	41	Weighted Average
357,645		97.52% Pervious Area
9,092		2.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0800	0.17		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.00"
1.3	212	0.0280	2.69		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.8	228	0.0820	4.61		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
7.0	490	Total			

Summary for Link AP-1 PRE:

Inflow Area = 8.419 ac, 2.48% Impervious, Inflow Depth = 0.80" for 100-Year event
Inflow = 4.04 cfs @ 12.15 hrs, Volume= 0.563 af
Primary = 4.04 cfs @ 12.15 hrs, Volume= 0.563 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs



ASE
Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning
P.O. Box 312, 104 Mendon Street
Uxbridge, Massachusetts 01569
P: 508-278-5897 F: 508-278-2289
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P: 508-316-9452 F: 508-316-9943

PROJECT
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NORFOLK, MA 02056

APPLICANT
LAKELAND FARMS, LLC
84 CLEVELAND STREET
NORFOLK, MA 02056

REVISIONS

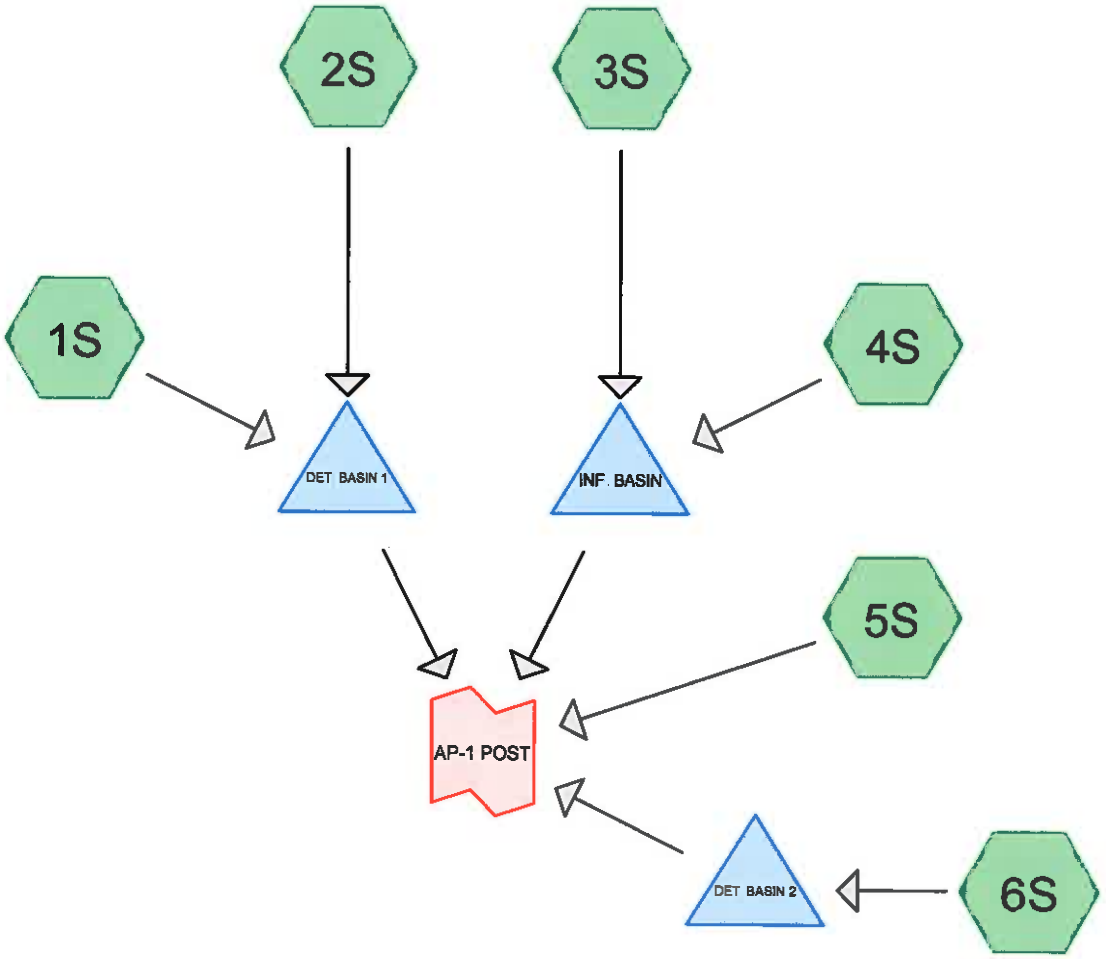
NO.	DATE	DESCRIPTION

CAD FILE	\plan\2014-111_SP.dwg
DRAWN BY	BJC, TRS
CHECKED BY	PEH, BJA
DATE	APRIL 10, 2015
PROJECT NO.	2014-111

GRAPHIC SCALE
(IN FEET)
1 inch = 60 ft.

SHEET TITLE
WATERSHED MAP
DEVELOPED CONDITIONS

DRAWING NO.
D-2.0



Subcat Reach Pond Link

Routing Diagram for 2014-111
Prepared by Andrews Survey & Engineering, Printed 4/18/2016
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Summary for Subcatchment 1S:

Runoff = 0.00 cfs @ 24.04 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
68,943	39	>75% Grass cover, Good, HSG A
68,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0218	0.07		**Sheet Flow, Segment A** Woods: Light underbrush n= 0.400 P2= 3.00"
3.7	526	0.0218	2.38		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.1	50	0.0250	7.17	5.63	**Pipe Channel, Segment C** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.1	626	Total			

Summary for Subcatchment 2S:

Runoff = 0.66 cfs @ 12.10 hrs, Volume= 0.055 af, Depth= 0.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
15,527	98	Paved parking, HSG A
3,840	98	Roofs, HSG A
20,018	39	>75% Grass cover, Good, HSG A
39,385	68	Weighted Average
20,018		50.83% Pervious Area
19,367		49.17% Impervious Area

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

Summary for Subcatchment 3S:

Runoff = 2.94 cfs @ 12.10 hrs, Volume= 0.230 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
49,136	98	Paved parking, HSG A
23,823	98	Roofs, HSG A
62,395	39	>75% Grass cover, Good, HSG A
1,477	61	>75% Grass cover, Good, HSG B
136,831	71	Weighted Average
63,872		46.68% Pervious Area
72,959		53.32% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 0.34 cfs @ 12.35 hrs, Volume= 0.055 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
25,513	98	Paved parking, HSG A
44,640	39	>75% Grass cover, Good, HSG A
70,153	60	Weighted Average
44,640		63.63% Pervious Area
25,513		36.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	50	0.0085	0.07		**Sheet Flow, A** Grass: Dense n= 0.240 P2= 3.00"
4.1	361	0.0085	1.48		**Shallow Concentrated Flow, B** Unpaved Kv= 16.1 fps
16.0	411	Total			

Summary for Subcatchment 5S:

Runoff = 0.02 cfs @ 13.68 hrs, Volume= 0.009 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
570	98	Roofs, HSG A
12,882	39	>75% Grass cover, Good, HSG A
7,393	30	Woods, Good, HSG A
16,032	61	>75% Grass cover, Good, HSG B
6,466	55	Woods, Good, HSG B
43,343	49	Weighted Average
42,773		98.68% Pervious Area
570		1.32% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.13 cfs @ 12.10 hrs, Volume= 0.011 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
1,212	98	Roofs, HSG A
466	96	Gravel surface, HSG B
392	39	>75% Grass cover, Good, HSG A
6,048	61	>75% Grass cover, Good, HSG B
8,118	67	Weighted Average
6,906		85.07% Pervious Area
1,212		14.93% Impervious Area

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

Summary for Pond DET. BASIN 1:

Inflow Area = 2.487 ac, 17.88% Impervious, Inflow Depth = 0.27" for 2-Year event
Inflow = 0.66 cfs @ 12.10 hrs, Volume= 0.055 af
Outflow = 0.01 cfs @ 24.07 hrs, Volume= 0.038 af, Atten= 99%, Lag= 717.9 min
Primary = 0.01 cfs @ 24.07 hrs, Volume= 0.038 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 95.58' @ 24.07 hrs Surf.Area= 3,559 sf Storage= 2,031 cf

Plug-Flow detention time= 1,610.3 min calculated for 0.038 af (70% of inflow)
Center-of-Mass det. time= 1,500.5 min (2,384.0 - 883.5)

Volume	Invert	Avail.Storage	Storage Description
#1	95.00'	13,227 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.00	3,051	275.0	0	0	3,051
96.00	3,920	304.0	3,476	3,476	4,418
97.00	4,869	326.0	4,386	7,862	5,565
98.00	5,876	345.0	5,365	13,227	6,634

Device	Routing	Invert	Outlet Devices
#1	Primary	94.80'	**12.0" Round Culvert** L= 40.7' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.80' / 94.00' S= 0.0197 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.30'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	97.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.01 cfs @ 24.07 hrs HW=95.58' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.01 cfs of 1.57 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 3.59 fps)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DET. BASIN 2:

Inflow Area = 0.186 ac, 14.93% Impervious, Inflow Depth = 0.69" for 2-Year event
Inflow = 0.13 cfs @ 12.10 hrs, Volume= 0.011 af
Outflow = 0.00 cfs @ 17.92 hrs, Volume= 0.010 af, Atten= 96%, Lag= 348.9 min
Primary = 0.00 cfs @ 17.92 hrs, Volume= 0.010 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 90.18' @ 17.92 hrs Surf.Area= 1,196 sf Storage= 289 cf

Plug-Flow detention time= 791.8 min calculated for 0.010 af (96% of inflow)
Center-of-Mass det. time= 771.8 min (1,658.9 - 887.0)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	3,236 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	1,097	150.0	0	0	1,097
92.00	2,203	205.0	3,236	3,236	2,691

Device	Routing	Invert	Outlet Devices
#1	Primary	91.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	90.00'	**0.7" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.00 cfs @ 17.92 hrs HW=90.18' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└—**2=Orifice/Grate** (Orifice Controls 0.00 cfs @ 1.86 fps)

Summary for Pond INF. BASIN:

Inflow Area = 4.752 ac, 47.57% Impervious, Inflow Depth = 0.72" for 2-Year event
Inflow = 3.01 cfs @ 12.10 hrs, Volume= 0.285 af
Outflow = 0.21 cfs @ 15.85 hrs, Volume= 0.285 af, Atten= 93%, Lag= 225.0 min
Discarded = 0.19 cfs @ 15.85 hrs, Volume= 0.257 af
Primary = 0.02 cfs @ 15.85 hrs, Volume= 0.028 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 88.99' @ 15.85 hrs Surf.Area= 5,577 sf Storage= 6,337 cf

Plug-Flow detention time= 410.2 min calculated for 0.285 af (100% of inflow)
Center-of-Mass det. time= 410.3 min (1,293.6 - 883.3)

Volume	Invert	Avail.Storage	Storage Description
#1	87.00'	40,385 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
87.00	746	314.0	0	0	746
88.00	3,427	379.0	1,924	1,924	4,347
89.00	5,606	407.0	4,472	6,396	6,142
90.00	7,044	426.0	6,311	12,707	7,469
91.00	8,515	446.0	7,768	20,475	8,923
92.00	9,971	466.0	9,233	29,709	10,445
93.00	11,398	485.0	10,677	40,385	11,959

Device	Routing	Invert	Outlet Devices
#1	Primary	86.80'	**12.0" Round Culvert** L= 33.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 86.80' / 86.50' S= 0.0090 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	87.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	91.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Primary	92.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	87.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 85.00'

Discarded OutFlow Max=0.19 cfs @ 15.85 hrs HW=88.99' (Free Discharge)
└**5=Exfiltration** (Controls 0.19 cfs)

Primary OutFlow Max=0.02 cfs @ 15.85 hrs HW=88.99' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.02 cfs of 3.88 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 6.74 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP-1 POST:

Inflow Area = 8.420 ac, 32.61% Impervious, Inflow Depth > 0.12" for 2-Year event
Inflow = 0.04 cfs @ 14.76 hrs, Volume= 0.085 af
Primary = 0.04 cfs @ 14.76 hrs, Volume= 0.085 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Summary for Subcatchment 1S:

Runoff = 0.03 cfs @ 13.90 hrs, Volume= 0.019 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
68,943	39	>75% Grass cover, Good, HSG A
68,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0218	0.07		**Sheet Flow, Segment A** Woods: Light underbrush n= 0.400 P2= 3.00"
3.7	526	0.0218	2.38		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.1	50	0.0250	7.17	5.63	**Pipe Channel, Segment C** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.1	626	Total			

Summary for Subcatchment 2S:

Runoff = 1.70 cfs @ 12.09 hrs, Volume= 0.126 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
15,527	98	Paved parking, HSG A
3,840	98	Roofs, HSG A
20,018	39	>75% Grass cover, Good, HSG A
39,385	68	Weighted Average
20,018		50.83% Pervious Area
19,367		49.17% Impervious Area

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

Summary for Subcatchment 3S:

Runoff = 6.82 cfs @ 12.09 hrs, Volume= 0.495 af, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
49,136	98	Paved parking, HSG A
23,823	98	Roofs, HSG A
62,395	39	>75% Grass cover, Good, HSG A
1,477	61	>75% Grass cover, Good, HSG B
136,831	71	Weighted Average
63,872		46.68% Pervious Area
72,959		53.32% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 1.36 cfs @ 12.25 hrs, Volume= 0.152 af, Depth= 1.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
25,513	98	Paved parking, HSG A
44,640	39	>75% Grass cover, Good, HSG A
70,153	60	Weighted Average
44,640		63.63% Pervious Area
25,513		36.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	50	0.0085	0.07		**Sheet Flow, A** Grass: Dense n= 0.240 P2= 3.00"
4.1	361	0.0085	1.48		**Shallow Concentrated Flow, B** Unpaved Kv= 16.1 fps
16.0	411	Total			

Summary for Subcatchment 5S:

Runoff = 0.30 cfs @ 12.14 hrs, Volume= 0.044 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
570	98	Roofs, HSG A
12,882	39	>75% Grass cover, Good, HSG A
7,393	30	Woods, Good, HSG A
16,032	61	>75% Grass cover, Good, HSG B
6,466	55	Woods, Good, HSG B
43,343	49	Weighted Average
42,773		98.68% Pervious Area
570		1.32% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.33 cfs @ 12.10 hrs, Volume= 0.025 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
1,212	98	Roofs, HSG A
466	96	Gravel surface, HSG B
392	39	>75% Grass cover, Good, HSG A
6,048	61	>75% Grass cover, Good, HSG B
8,118	67	Weighted Average
6,906		85.07% Pervious Area
1,212		14.93% Impervious Area

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

Summary for Pond DET. BASIN 1:

Inflow Area = 2.487 ac, 17.88% Impervious, Inflow Depth = 0.70" for 10-Year event
Inflow = 1.70 cfs @ 12.09 hrs, Volume= 0.145 af
Outflow = 0.04 cfs @ 23.97 hrs, Volume= 0.078 af, Atten= 98%, Lag= 712.7 min
Primary = 0.04 cfs @ 23.97 hrs, Volume= 0.078 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 96.43' @ 23.97 hrs Surf.Area= 4,326 sf Storage= 5,352 cf

Plug-Flow detention time= 1,561.7 min calculated for 0.078 af (54% of inflow)
Center-of-Mass det. time= 1,421.0 min (2,301.9 - 880.9)

Volume	Invert	Avail.Storage	Storage Description
#1	95.00'	13,227 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.00	3,051	275.0	0	0	3,051
96.00	3,920	304.0	3,476	3,476	4,418
97.00	4,869	326.0	4,386	7,862	5,565
98.00	5,876	345.0	5,365	13,227	6,634

Device	Routing	Invert	Outlet Devices
#1	Primary	94.80'	**12.0" Round Culvert** L= 40.7' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.80' / 94.00' S= 0.0197 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.30'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	97.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.04 cfs @ 23.97 hrs HW=96.43' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.04 cfs of 3.17 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 5.69 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.02 cfs @ 1.22 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DET. BASIN 2:

Inflow Area = 0.186 ac, 14.93% Impervious, Inflow Depth = 1.60" for 10-Year event
Inflow = 0.33 cfs @ 12.10 hrs, Volume= 0.025 af
Outflow = 0.01 cfs @ 18.90 hrs, Volume= 0.024 af, Atten= 97%, Lag= 408.5 min
Primary = 0.01 cfs @ 18.90 hrs, Volume= 0.024 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 90.47' @ 18.90 hrs Surf.Area= 1,356 sf Storage= 757 cf

Plug-Flow detention time= 1,100.4 min calculated for 0.024 af (97% of inflow)
Center-of-Mass det. time= 1,082.7 min (1,941.9 - 859.2)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	3,236 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	1,097	150.0	0	0	1,097
92.00	2,203	205.0	3,236	3,236	2,691

Device	Routing	Invert	Outlet Devices
#1	Primary	91.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	90.00'	**0.7" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 18.90 hrs HW=90.47' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└—**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 3.19 fps)

Summary for Pond INF. BASIN:

Inflow Area = 4.752 ac, 47.57% Impervious, Inflow Depth = 1.63" for 10-Year event
Inflow = 7.54 cfs @ 12.10 hrs, Volume= 0.647 af
Outflow = 0.36 cfs @ 16.35 hrs, Volume= 0.647 af, Atten= 95%, Lag= 254.9 min
Discarded = 0.33 cfs @ 16.35 hrs, Volume= 0.595 af
Primary = 0.02 cfs @ 16.35 hrs, Volume= 0.052 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 90.55' @ 16.35 hrs Surf.Area= 7,856 sf Storage= 16,995 cf

Plug-Flow detention time= 626.5 min calculated for 0.647 af (100% of inflow)
Center-of-Mass det. time= 626.7 min (1,484.8 - 858.0)

Volume	Invert	Avail.Storage	Storage Description
#1	87.00'	40,385 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
87.00	746	314.0	0	0	746
88.00	3,427	379.0	1,924	1,924	4,347
89.00	5,606	407.0	4,472	6,396	6,142
90.00	7,044	426.0	6,311	12,707	7,469
91.00	8,515	446.0	7,768	20,475	8,923
92.00	9,971	466.0	9,233	29,709	10,445
93.00	11,398	485.0	10,677	40,385	11,959

Device	Routing	Invert	Outlet Devices
#1	Primary	86.80'	**12.0" Round Culvert** L= 33.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 86.80' / 86.50' S= 0.0090 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	87.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	91.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Primary	92.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	87.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 85.00'

Discarded OutFlow Max=0.33 cfs @ 16.35 hrs HW=90.55' (Free Discharge)
└─**5=Exfiltration** (Controls 0.33 cfs)

Primary OutFlow Max=0.02 cfs @ 16.35 hrs HW=90.55' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.02 cfs of 5.38 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 9.04 fps)
  └─**3=Orifice/Grate** (Controls 0.00 cfs)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP-1 POST:

Inflow Area = 8.420 ac, 32.61% Impervious, Inflow Depth > 0.28" for 10-Year event
Inflow = 0.33 cfs @ 12.14 hrs, Volume= 0.198 af
Primary = 0.33 cfs @ 12.14 hrs, Volume= 0.198 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Summary for Subcatchment 1S:

Runoff = 0.13 cfs @ 12.55 hrs, Volume= 0.041 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
68,943	39	>75% Grass cover, Good, HSG A
68,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0218	0.07		**Sheet Flow, Segment A** Woods: Light underbrush n= 0.400 P2= 3.00"
3.7	526	0.0218	2.38		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.1	50	0.0250	7.17	5.63	**Pipe Channel, Segment C** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.1	626	Total			

Summary for Subcatchment 2S:

Runoff = 2.33 cfs @ 12.09 hrs, Volume= 0.169 af, Depth= 2.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
15,527	98	Paved parking, HSG A
3,840	98	Roofs, HSG A
20,018	39	>75% Grass cover, Good, HSG A
39,385	68	Weighted Average
20,018		50.83% Pervious Area
19,367		49.17% Impervious Area

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

Summary for Subcatchment 3S:

Runoff = 9.12 cfs @ 12.09 hrs, Volume= 0.655 af, Depth= 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
49,136	98	Paved parking, HSG A
23,823	98	Roofs, HSG A
62,395	39	>75% Grass cover, Good, HSG A
1,477	61	>75% Grass cover, Good, HSG B
136,831	71	Weighted Average
63,872		46.68% Pervious Area
72,959		53.32% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 2.04 cfs @ 12.24 hrs, Volume= 0.215 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
25,513	98	Paved parking, HSG A
44,640	39	>75% Grass cover, Good, HSG A
70,153	60	Weighted Average
44,640		63.63% Pervious Area
25,513		36.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	50	0.0085	0.07		**Sheet Flow, A** Grass: Dense n= 0.240 P2= 3.00"
4.1	361	0.0085	1.48		**Shallow Concentrated Flow, B** Unpaved Kv= 16.1 fps
16.0	411	Total			

Summary for Subcatchment 5S:

Runoff = 0.67 cfs @ 12.12 hrs, Volume= 0.070 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
570	98	Roofs, HSG A
12,882	39	>75% Grass cover, Good, HSG A
7,393	30	Woods, Good, HSG A
16,032	61	>75% Grass cover, Good, HSG B
6,466	55	Woods, Good, HSG B
43,343	49	Weighted Average
42,773		98.68% Pervious Area
570		1.32% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 0.034 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 25-Year Rainfall=5.50"

Area (sf)	CN	Description
1,212	98	Roofs, HSG A
466	96	Gravel surface, HSG B
392	39	>75% Grass cover, Good, HSG A
6,048	61	>75% Grass cover, Good, HSG B
8,118	67	Weighted Average
6,906		85.07% Pervious Area
1,212		14.93% Impervious Area

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

Summary for Pond DET. BASIN 1:

Inflow Area = 2.487 ac, 17.88% Impervious, Inflow Depth = 1.01" for 25-Year event
Inflow = 2.33 cfs @ 12.09 hrs, Volume= 0.210 af
Outflow = 0.08 cfs @ 19.61 hrs, Volume= 0.139 af, Atten= 97%, Lag= 450.8 min
Primary = 0.08 cfs @ 19.61 hrs, Volume= 0.139 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 96.71' @ 19.61 hrs Surf.Area= 4,598 sf Storage= 6,611 cf

Plug-Flow detention time= 1,119.5 min calculated for 0.139 af (66% of inflow)
Center-of-Mass det. time= 1,001.8 min (1,877.3 - 875.5)

Volume	Invert	Avail.Storage	Storage Description
#1	95.00'	13,227 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.00	3,051	275.0	0	0	3,051
96.00	3,920	304.0	3,476	3,476	4,418
97.00	4,869	326.0	4,386	7,862	5,565
98.00	5,876	345.0	5,365	13,227	6,634

Device	Routing	Invert	Outlet Devices
#1	Primary	94.80'	**12.0" Round Culvert** L= 40.7' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.80' / 94.00' S= 0.0197 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.30'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	97.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.08 cfs @ 19.61 hrs HW=96.71' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.08 cfs of 3.55 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 6.25 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.06 cfs @ 2.77 fps)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond DET. BASIN 2:

Inflow Area = 0.186 ac, 14.93% Impervious, Inflow Depth = 2.16" for 25-Year event
Inflow = 0.46 cfs @ 12.09 hrs, Volume= 0.034 af
Outflow = 0.01 cfs @ 19.51 hrs, Volume= 0.032 af, Atten= 98%, Lag= 444.8 min
Primary = 0.01 cfs @ 19.51 hrs, Volume= 0.032 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 90.66' @ 19.51 hrs Surf.Area= 1,460 sf Storage= 1,063 cf

Plug-Flow detention time= 1,245.6 min calculated for 0.032 af (96% of inflow)
Center-of-Mass det. time= 1,223.1 min (2,073.2 - 850.0)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	3,236 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	1,097	150.0	0	0	1,097
92.00	2,203	205.0	3,236	3,236	2,691

Device	Routing	Invert	Outlet Devices
#1	Primary	91.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	90.00'	**0.7" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 19.51 hrs HW=90.66' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 3.82 fps)

Summary for Pond INF. BASIN:

Inflow Area = 4.752 ac, 47.57% Impervious, Inflow Depth = 2.20" for 25-Year event
Inflow = 10.29 cfs @ 12.10 hrs, Volume= 0.870 af
Outflow = 0.59 cfs @ 15.52 hrs, Volume= 0.870 af, Atten= 94%, Lag= 205.6 min
Discarded = 0.40 cfs @ 15.52 hrs, Volume= 0.759 af
Primary = 0.19 cfs @ 15.52 hrs, Volume= 0.111 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 91.25' @ 15.52 hrs Surf.Area= 8,878 sf Storage= 22,775 cf

Plug-Flow detention time= 658.5 min calculated for 0.870 af (100% of inflow)
Center-of-Mass det. time= 658.8 min (1,508.3 - 849.5)

Volume	Invert	Avail.Storage	Storage Description
#1	87.00'	40,385 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
87.00	746	314.0	0	0	746
88.00	3,427	379.0	1,924	1,924	4,347
89.00	5,606	407.0	4,472	6,396	6,142
90.00	7,044	426.0	6,311	12,707	7,469
91.00	8,515	446.0	7,768	20,475	8,923
92.00	9,971	466.0	9,233	29,709	10,445
93.00	11,398	485.0	10,677	40,385	11,959

Device	Routing	Invert	Outlet Devices
#1	Primary	86.80'	**12.0" Round Culvert** L= 33.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 86.80' / 86.50' S= 0.0090 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	87.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	91.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Primary	92.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	87.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 85.00'

Discarded OutFlow Max=0.40 cfs @ 15.52 hrs HW=91.25' (Free Discharge)
└**5=Exfiltration** (Controls 0.40 cfs)

Primary OutFlow Max=0.19 cfs @ 15.52 hrs HW=91.25' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.19 cfs of 5.93 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.03 cfs @ 9.89 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.17 cfs @ 1.70 fps)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP-1 POST:

Inflow Area = 8.420 ac, 32.61% Impervious, Inflow Depth > 0.50" for 25-Year event
Inflow = 0.71 cfs @ 12.12 hrs, Volume= 0.352 af
Primary = 0.71 cfs @ 12.12 hrs, Volume= 0.352 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs

Summary for Subcatchment 1S:

Runoff = 0.46 cfs @ 12.44 hrs, Volume= 0.088 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
68,943	39	>75% Grass cover, Good, HSG A
68,943		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.3	50	0.0218	0.07		**Sheet Flow, Segment A** Woods: Light underbrush n= 0.400 P2= 3.00"
3.7	526	0.0218	2.38		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
0.1	50	0.0250	7.17	5.63	**Pipe Channel, Segment C** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013 Corrugated PE, smooth interior
16.1	626	Total			

Summary for Subcatchment 2S:

Runoff = 3.34 cfs @ 12.09 hrs, Volume= 0.239 af, Depth= 3.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
15,527	98	Paved parking, HSG A
3,840	98	Roofs, HSG A
20,018	39	>75% Grass cover, Good, HSG A
39,385	68	Weighted Average
20,018		50.83% Pervious Area
19,367		49.17% Impervious Area

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

Summary for Subcatchment 3S:

Runoff = 12.76 cfs @ 12.09 hrs, Volume= 0.909 af, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
49,136	98	Paved parking, HSG A
23,823	98	Roofs, HSG A
62,395	39	>75% Grass cover, Good, HSG A
1,477	61	>75% Grass cover, Good, HSG B
136,831	71	Weighted Average
63,872		46.68% Pervious Area
72,959		53.32% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 3.19 cfs @ 12.23 hrs, Volume= 0.321 af, Depth= 2.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
25,513	98	Paved parking, HSG A
44,640	39	>75% Grass cover, Good, HSG A
70,153	60	Weighted Average
44,640		63.63% Pervious Area
25,513		36.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.9	50	0.0085	0.07		**Sheet Flow, A** Grass: Dense n= 0.240 P2= 3.00"
4.1	361	0.0085	1.48		**Shallow Concentrated Flow, B** Unpaved Kv= 16.1 fps
16.0	411	Total			

Summary for Subcatchment 5S:

Runoff = 1.37 cfs @ 12.11 hrs, Volume= 0.118 af, Depth= 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
570	98	Roofs, HSG A
12,882	39	>75% Grass cover, Good, HSG A
7,393	30	Woods, Good, HSG A
16,032	61	>75% Grass cover, Good, HSG B
6,466	55	Woods, Good, HSG B
43,343	49	Weighted Average
42,773		98.68% Pervious Area
570		1.32% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.66 cfs @ 12.09 hrs, Volume= 0.048 af, Depth= 3.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
1,212	98	Roofs, HSG A
466	96	Gravel surface, HSG B
392	39	>75% Grass cover, Good, HSG A
6,048	61	>75% Grass cover, Good, HSG B
8,118	67	Weighted Average
6,906		85.07% Pervious Area
1,212		14.93% Impervious Area

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

Summary for Pond DET. BASIN 1:

Inflow Area = 2.487 ac, 17.88% Impervious, Inflow Depth = 1.57" for 100-Year event
Inflow = 3.36 cfs @ 12.09 hrs, Volume= 0.326 af
Outflow = 0.35 cfs @ 14.19 hrs, Volume= 0.251 af, Atten= 90%, Lag= 125.8 min
Primary = 0.35 cfs @ 14.19 hrs, Volume= 0.251 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 97.03' @ 14.19 hrs Surf.Area= 4,904 sf Storage= 8,049 cf

Plug-Flow detention time= 786.7 min calculated for 0.251 af (77% of inflow)
Center-of-Mass det. time= 695.1 min (1,562.0 - 866.9)

Volume	Invert	Avail.Storage	Storage Description
#1	95.00'	13,227 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
95.00	3,051	275.0	0	0	3,051
96.00	3,920	304.0	3,476	3,476	4,418
97.00	4,869	326.0	4,386	7,862	5,565
98.00	5,876	345.0	5,365	13,227	6,634

Device	Routing	Invert	Outlet Devices
#1	Primary	94.80'	**12.0" Round Culvert** L= 40.7' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.80' / 94.00' S= 0.0197 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	95.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	96.30'	**2.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	97.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.35 cfs @ 14.19 hrs HW=97.03' TW=0.00' (Dynamic Tailwater)
- **1=Culvert** (Passes 0.10 cfs of 3.93 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.02 cfs @ 6.82 fps)
  - **3=Orifice/Grate** (Orifice Controls 0.08 cfs @ 3.89 fps)
- **4=Broad-Crested Rectangular Weir** (Weir Controls 0.24 cfs @ 0.46 fps)

Summary for Pond DET. BASIN 2:

Inflow Area = 0.186 ac, 14.93% Impervious, Inflow Depth = 3.07" for 100-Year event
Inflow = 0.66 cfs @ 12.09 hrs, Volume= 0.048 af
Outflow = 0.01 cfs @ 20.26 hrs, Volume= 0.044 af, Atten= 98%, Lag= 489.9 min
Primary = 0.01 cfs @ 20.26 hrs, Volume= 0.044 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 90.97' @ 20.26 hrs Surf.Area= 1,634 sf Storage= 1,572 cf

Plug-Flow detention time= 1,392.5 min calculated for 0.044 af (92% of inflow)
Center-of-Mass det. time= 1,351.0 min (2,190.6 - 839.7)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	3,236 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
90.00	1,097	150.0	0	0	1,097
92.00	2,203	205.0	3,236	3,236	2,691

Device	Routing	Invert	Outlet Devices
#1	Primary	91.00'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#2	Primary	90.00'	**0.7" Vert. Orifice/Grate** C= 0.600

Primary OutFlow Max=0.01 cfs @ 20.26 hrs HW=90.97' TW=0.00' (Dynamic Tailwater)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)
└─**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 4.67 fps)

Summary for Pond INF. BASIN:

Inflow Area = 4.752 ac, 47.57% Impervious, Inflow Depth = 3.11" for 100-Year event
Inflow = 14.69 cfs @ 12.10 hrs, Volume= 1.230 af
Outflow = 0.97 cfs @ 14.83 hrs, Volume= 1.230 af, Atten= 93%, Lag= 163.7 min
Discarded = 0.48 cfs @ 14.83 hrs, Volume= 0.880 af
Primary = 0.49 cfs @ 14.83 hrs, Volume= 0.350 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs
Peak Elev= 92.07' @ 14.83 hrs Surf.Area= 10,068 sf Storage= 30,432 cf

Plug-Flow detention time= 580.7 min calculated for 1.230 af (100% of inflow)
Center-of-Mass det. time= 581.1 min (1,420.8 - 839.7)

Volume	Invert	Avail.Storage	Storage Description
#1	87.00'	40,385 cf	**Custom Stage Data (Irregular)** Listed below

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
87.00	746	314.0	0	0	746
88.00	3,427	379.0	1,924	1,924	4,347
89.00	5,606	407.0	4,472	6,396	6,142
90.00	7,044	426.0	6,311	12,707	7,469
91.00	8,515	446.0	7,768	20,475	8,923
92.00	9,971	466.0	9,233	29,709	10,445
93.00	11,398	485.0	10,677	40,385	11,959

Device	Routing	Invert	Outlet Devices
#1	Primary	86.80'	**12.0" Round Culvert** L= 33.5' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 86.80' / 86.50' S= 0.0090 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	87.00'	**0.7" Vert. Orifice/Grate** C= 0.600
#3	Device 1	91.00'	**3.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Primary	92.50'	**15.0' long x 10.0' breadth Broad-Crested Rectangular Weir X 2.00** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64
#5	Discarded	87.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 85.00'

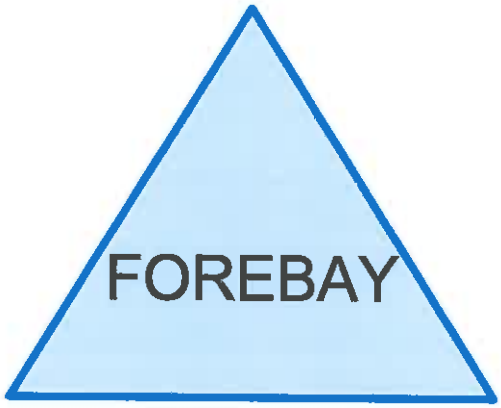
Discarded OutFlow Max=0.48 cfs @ 14.83 hrs HW=92.07' (Free Discharge)
└**5=Exfiltration** (Controls 0.48 cfs)

Primary OutFlow Max=0.49 cfs @ 14.83 hrs HW=92.07' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.49 cfs of 6.52 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.03 cfs @ 10.81 fps)
  └**3=Orifice/Grate** (Orifice Controls 0.46 cfs @ 4.68 fps)
└**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link AP-1 POST:

Inflow Area = 8.420 ac, 32.61% Impervious, Inflow Depth > 1.09" for 100-Year event
Inflow = 1.41 cfs @ 12.11 hrs, Volume= 0.762 af
Primary = 1.41 cfs @ 12.11 hrs, Volume= 0.762 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.02 hrs



Subcat Reach Pond Link

Routing Diagram for 2014-111
Prepared by Andrews Survey & Engineering, Printed 4/19/2016

Summary for Pond FOREBAY:

Volume	Invert	Avail.Storage	Storage Description
#1	88.00'	1,276 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
88.00	348	95.0	0	0	348
89.00	682	128.0	506	506	944
90.00	862	143.0	770	1,276	1,295

Stage-Area-Storage for Pond INF. BASIN:

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
87.00	746	0
87.10	1,014	192
87.20	1,282	385
87.30	1,550	577
87.40	1,818	770
87.50	2,087	962
87.60	2,355	1,154
87.70	2,623	1,347
87.80	2,891	1,539
87.90	3,159	1,732
88.00	3,427	1,924
88.10	3,645	2,371
88.20	3,863	2,818
88.30	4,081	3,266
88.40	4,299	3,713
88.50	4,517	4,160
88.60	4,734	4,607
88.70	4,952	5,054
88.80	5,170	5,502
88.90	5,388	5,949
89.00	5,606	6,396
89.10	5,750	7,027
89.20	5,894	7,658
89.30	6,037	8,289
89.40	6,181	8,921
89.50	6,325	9,552
89.60	6,469	10,183
89.70	6,613	10,814
89.80	6,756	11,445
89.90	6,900	12,076
90.00	7,044	12,707
90.10	7,191	13,484
90.20	7,338	14,261
90.30	7,485	15,038
90.40	7,632	15,815
90.50	7,780	16,591
90.60	7,927	17,368
90.70	8,074	18,145
90.80	8,221	18,922
90.90	8,368	19,698
91.00	8,515	20,475
91.10	8,661	21,399
91.20	8,806	22,322
91.30	8,952	23,245
91.40	9,097	24,169
91.50	9,243	25,092
91.60	9,389	26,015
91.70	9,534	26,939
91.80	9,680	27,862
91.90	9,825	28,785
92.00	9,971	29,709
92.10	10,114	30,776
92.20	10,256	31,844
92.30	10,399	32,912
92.40	10,542	33,979
92.50	10,685	35,047
92.60	10,827	36,115
92.70	10,970	37,182
92.80	11,113	38,250
92.90	11,255	39,318
93.00	**11,398**	**40,385**

Hydrograph for Pond INF. BASIN:

Time (hours)	Inflow (cfs)	Storage (cubic-feet)	Elevation (feet)	Outflow (cfs)	Discarded (cfs)	Primary (cfs)
0.00	0.00	0	87.00	0.00	0.00	0.00
2.00	0.00	0	87.00	0.00	0.00	0.00
4.00	0.00	0	87.00	0.00	0.00	0.00
6.00	0.00	0	87.00	0.00	0.00	0.00
8.00	0.00	0	87.00	0.00	0.00	0.00
10.00	0.18	324	87.17	0.03	0.03	0.00
12.00	**8.35**	7,792	89.22	0.23	0.21	0.02
14.00	**1.21**	**30,104**	**92.04**	**0.96**	**0.48**	**0.48**
16.00	0.66	**29,820**	**92.01**	**0.95**	**0.48**	**0.47**
18.00	0.41	27,143	91.72	0.84	0.45	0.39
20.00	0.33	24,228	91.41	0.69	0.42	0.28
22.00	0.27	22,002	91.17	0.51	0.39	0.12
24.00	0.22	20,570	91.01	0.40	0.38	0.03
26.00	0.00	17,900	90.67	0.37	0.34	0.02
28.00	0.00	15,363	90.34	0.34	0.31	0.02
30.00	0.00	13,044	90.04	0.31	0.29	0.02
32.00	0.00	10,934	89.72	0.28	0.26	0.02
34.00	0.00	9,034	89.42	0.25	0.23	0.02
36.00	0.00	7,320	89.15	0.23	0.21	0.02
38.00	0.00	5,779	88.86	0.20	0.18	0.02
40.00	0.00	4,456	88.57	0.17	0.15	0.02
42.00	0.00	3,329	88.31	0.14	0.13	0.01
44.00	0.00	2,364	88.10	0.12	0.11	0.01
46.00	0.00	1,554	87.81	0.10	0.08	0.01
48.00	0.00	978	87.51	0.07	0.06	0.01
50.00	0.00	574	87.30	0.05	0.04	0.01
52.00	0.00	289	87.15	0.03	0.03	0.00
54.00	0.00	89	87.05	0.02	0.02	0.00
56.00	0.00	0	87.00	0.00	0.00	0.00
58.00	0.00	0	87.00	0.00	0.00	0.00
60.00	0.00	0	87.00	0.00	0.00	0.00
62.00	0.00	0	87.00	0.00	0.00	0.00
64.00	0.00	0	87.00	0.00	0.00	0.00
66.00	0.00	0	87.00	0.00	0.00	0.00
68.00	0.00	0	87.00	0.00	0.00	0.00
70.00	0.00	0	87.00	0.00	0.00	0.00
72.00	0.00	0	87.00	0.00	0.00	0.00

PART III – PIPE SIZING CALCULATIONS

"Lakeland Farms"
Norfolk, MA

From	To	Area (AC.) Incremental	Weighted Runoff Coefficient "C"	CxA	Cumulative CxA	Pipe Length (Feet)	Flow Time (min) To Inlet	Flow Time (min) In Channel	Design Storm (Year)	Intensity (IN/HR)	Q (CFS)	Size (IN)	Slope (FT/FT)	Mannings n	Full Capacity (cfs)	Full Velocity (fps)	Upper End Rim	Upper End Invert	Lower End Rim	Lower End Invert
CB1	DMH1	0.27	0.61	0.16	0.16	15.50	5.0	0.05	25	6.60	1.08	12	0.0148	0.013	4.34	5.53	99.51	95.51	99.67	95.28
CB2	DMH1	0.05	0.90	0.05	0.05	6.10	5.0	0.01	25	6.60	0.33	12	0.0377	0.013	6.92	8.81	99.51	95.51	99.67	95.28
CB3	DMH1	0.36	0.70	0.26	0.26	102.40	5.0	0.22	25	6.60	1.69	12	0.0293	0.013	6.10	7.76	101.28	98.28	99.67	95.28
DMH1	DD1	–	–	–	0.47	4.00	5.0	0.01	25	6.60	3.10	12	0.0450	0.013	7.56	9.62	99.67	95.18	99.00	95.00
DD1	FES1	–	–	–	0.47	7.70	5.1	0.02	25	6.60	3.10	12	0.0130	0.013	4.06	5.17	99.00	96.00		95.90
HW1	FES2	1.60	0.30	0.48	0.48	47.80	10.0	0.14	25	5.40	2.60	12	0.0157	0.013	4.46	5.68		98.25		97.50
CB4	DMH2	0.17	0.64	0.11	0.11	7.70	5.0	0.02	25	6.60	0.71	12	0.0195	0.013	4.97	6.33	103.77	99.60	103.72	99.45
DCB5	DMH2	0.44	0.69	0.31	0.31	10.20	5.0	0.03	25	6.60	2.02	12	0.0147	0.013	4.32	5.50	103.77	99.60	103.72	99.45
DMH2	DMH3	–	–	–	0.41	129.00	5.0	0.61	25	6.60	2.73	12	0.0060	0.013	2.75	3.50	103.72	99.35	101.58	98.58
DMH3	DMH4	–	–	–	0.41	52.90	5.6	0.21	25	6.45	2.67	12	0.0089	0.013	3.36	4.28	101.58	98.48	101.01	98.01
DMH4	DMH5	–	–	–	0.41	111.30	5.9	0.31	25	6.35	2.63	12	0.0172	0.013	4.67	5.94	101.01	97.91	99.85	96.00
DCB6	DMH5	0.63	0.50	0.31	0.31	6.20	5.0	0.02	25	6.60	2.06	12	0.0097	0.013	3.50	4.46	99.70	96.70	99.65	96.64
CB7	DMH5	0.35	0.67	0.23	0.23	11.40	5.0	0.06	25	6.60	1.54	12	0.0053	0.013	2.58	3.29	99.70	96.70	99.65	96.64
DMH5	DMH6	–	–	–	0.96	68.30	6.2	0.12	25	6.30	6.06	15	0.0322	0.013	11.59	9.45	99.65	95.75	99.12	93.55
DMH6	DMH6A	–	–	–	2.65	84.00	16.5	0.15	25	4.50	11.92	18	0.0262	0.013	17.00	9.62	99.12	93.20	93.50	91.00
DMH6A	FES1	–	–	–	2.65	17.50	16.7	0.04	25	4.50	11.92	18	0.0171	0.013	13.75	7.78	93.50	90.90		90.60
DCB10	DMH10	1.61	0.52	0.84	0.84	35.90	15.0	0.11	25	4.60	3.85	12	0.0139	0.013	4.20	5.35	106.50	103.50	106.30	103.00
DMH10	DMH9	–	–	–	0.84	75.90	15.1	0.13	25	4.60	3.85	12	0.0485	0.013	7.85	9.99	108.30	100.25	99.57	96.57
DMH9	DMH8	–	–	–	0.84	127.10	15.2	0.43	25	4.60	3.85	12	0.0120	0.013	3.91	4.98	99.57	96.47	98.58	94.94
DMH8	DMH7	–	–	–	0.84	97.90	15.7	0.44	25	4.60	3.85	15	0.0050	0.013	4.57	3.72	98.58	94.69	98.00	94.20
DCB8	DMH7	0.48	0.73	0.35	0.35	6.20	5.0	0.01	25	6.60	2.31	12	0.0468	0.013	7.71	9.81	97.74	94.74	98.00	94.45
DCB9	DMH7	0.15	0.66	0.50	0.50	10.40	5.0	0.02	25	6.60	3.30	12	0.0279	0.013	5.95	7.58	97.74	94.74	98.00	94.45
DMH7	DMH6	–	–	–	1.69	116.30	16.1	0.44	25	4.50	7.59	18	0.0056	0.013	7.85	4.44	98.00	93.95	99.12	93.30

Pipe Calculations

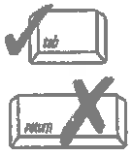
PART IV - SUPPLEMENTAL DOCUMENTATION

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.

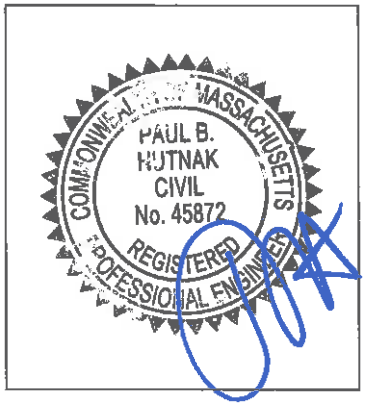
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



4.19.16

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.

MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0164E

FIRM

FLOOD INSURANCE RATE MAP

NORFOLK COUNTY, MASSACHUSETTS (ALL JURISDICTIONS)

PANEL 164 OF 430

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MEDFIELD, TOWN OF	250242	0164	E
MILLIS, TOWN OF	250244	0164	E
NORFOLK, TOWN OF	255217	0164	E

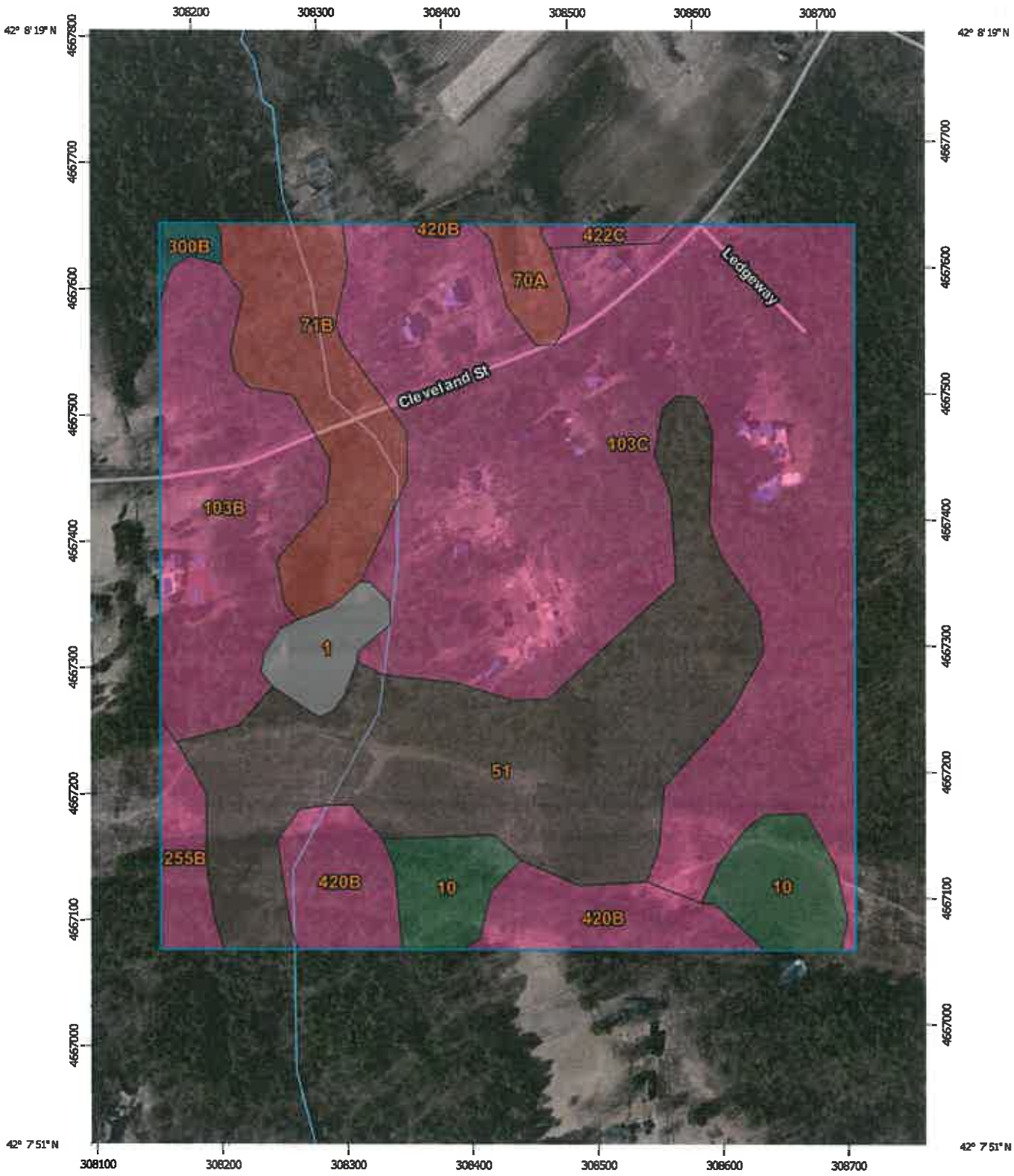
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
25021C0164E

EFFECTIVE DATE
JULY 17, 2012

Federal Emergency Management Agency

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts



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: 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: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 11, Sep 28, 2015

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

Date(s) aerial images were photographed: Mar 30, 2011—Apr 8, 2011

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 — Norfolk and Suffolk Counties, Massachusetts (MA616)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		1.5	1.9%
10	Scarboro and Birdsall soils, 0 to 3 percent slopes	A/D	4.0	5.0%
51	Swansea muck, 0 to 1 percent slopes	B/D	16.6	21.0%
70A	Ridgebury fine sandy loam, 0 to 5 percent slopes	D	1.0	1.3%
71B	Ridgebury fine sandy loam, 2 to 8 percent slopes, extremely stony	D	5.8	7.3%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	A	8.5	10.8%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	A	34.5	43.5%
255B	Windsor loamy sand, 3 to 8 percent slopes	A	1.5	1.9%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	C	0.4	0.5%
420B	Canton fine sandy loam, 3 to 8 percent slopes	A	5.0	6.3%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	A	0.4	0.5%
Totals for Area of Interest			79.3	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

Lakeland Farms - Norfolk, MA
ASE# 2014-111

FES1

Do=	1	ft
Q=	3.1	cfs (25-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	13.27	ft

$W=3Do+0.4La$

W=	8.31	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.18	ft
	2.17	in

FES2

Do=	1	ft
Q=	2.6	cfs (25-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	12.42	ft

$W=3Do+0.4La$

W=	7.97	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.14	ft
	1.72	in

FES3

Do=	1	ft
Q=	0.1	cfs (100-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	8.17	ft

$W=3Do+0.4La$

W=	6.27	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.00	ft
	0.02	in

FES4

Do=	1.5	ft
Q=	11.92	cfs (25-yr Storm)
Tw=	0.75	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	23.03	ft

$W=3Do+0.4La$

W=	13.71	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.42	ft
	5.07	in

Lakeland Farms - Norfolk, MA

ASE# 2014-111

FES5		
Do=	1	ft
Q=	0.49	cfs (100-yr Storm)
Tw=	0.5	ft
$La=1.7Q/(Do^{3/2})+8Do$		
La=	8.83	ft
W=3Do+0.4La		
W=	6.53	ft
$d50=(0.02/Tw)*((Q/Do)^{4/3})$		
d50=	0.02	ft
	0.19	in

FES6		
Do=	0.058	ft
Q=	0.01	cfs (100-yr Storm)
Tw=	0.029	ft
$La=1.7Q/(Do^{3/2})+8Do$		
La=	1.68	ft
W=3Do+0.4La		
W=	0.85	ft
$d50=(0.02/Tw)*((Q/Do)^{4/3})$		
d50=	0.07	ft
	0.79	in

TSS REMOVAL (Detention Basin 1)

A	B	C	D	E
BMP	**TSS Removal Rate**	**Starting TSS Load***	**Amount Removed (B x C)**	**Remaining Load (C - D)**
Deep sump CB's w/ hoods	25.0%	100.0%	25.0%	75.0%
Downstream Defender	70.0%	75.0%	52.5%	22.5%
Detention Basin w/ sediment forebay	50.0%	22.5%	11.3%	11.3%
		Total TSS Removal =	88.8%	

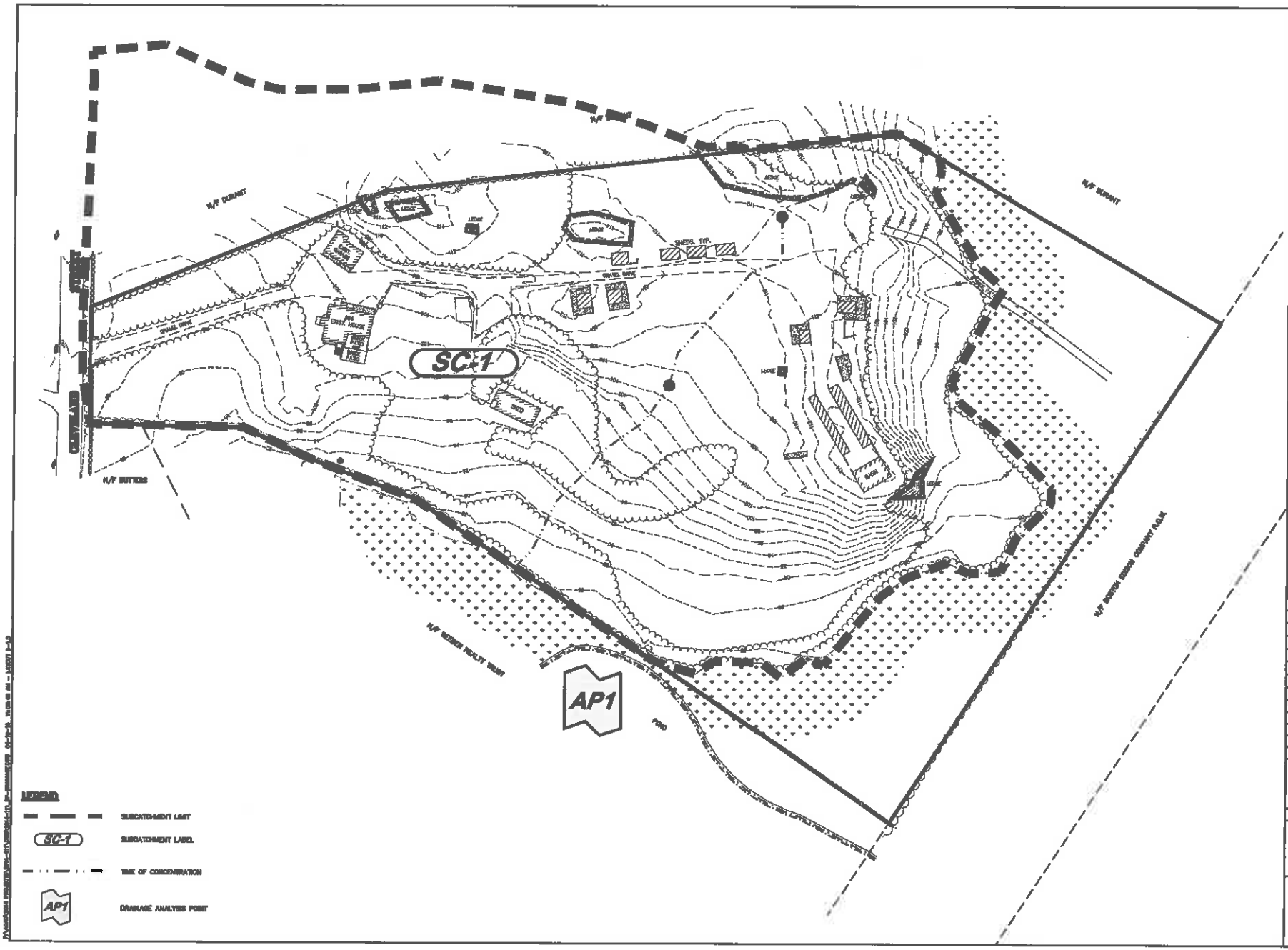
* Equals remaining load from previous BMP (E)

TSS REMOVAL (Infiltration Basin)

A	B	C	D	E
BMP	**TSS Removal Rate**	**Starting TSS Load***	**Amount Removed (B x C)**	**Remaining Load (C - D)**
Deep sump CB's w/ hoods	25.0%	100.0%	25.0%	75.0%
Infiltration Basin w/ sediment forebay	80.0%	75.0%	60.0%	15.0%
		Total TSS Removal =	85.0%	

* Equals remaining load from previous BMP (E)

PART V – MAPS



ASE
Andrews Survey & Engineering, Inc.
Land Surveying • Civil Engineering • Site Planning
P.O. Box 312, 184 Meadow Street
Uxbridge, Massachusetts 01569
P: 508-278-3897 F: 508-278-2289
560 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-0452 F: 508-316-0963

PROJECT: LAKELAND FARMS
TOWNHOUSE COMMUNITY
84 CLEVELAND STREET
NORFOLK, MA 02056

OWNER: LAKELAND FARMS, LLC
84 CLEVELAND STREET
NORFOLK, MA 02056

NO.	DATE	DESCRIPTION

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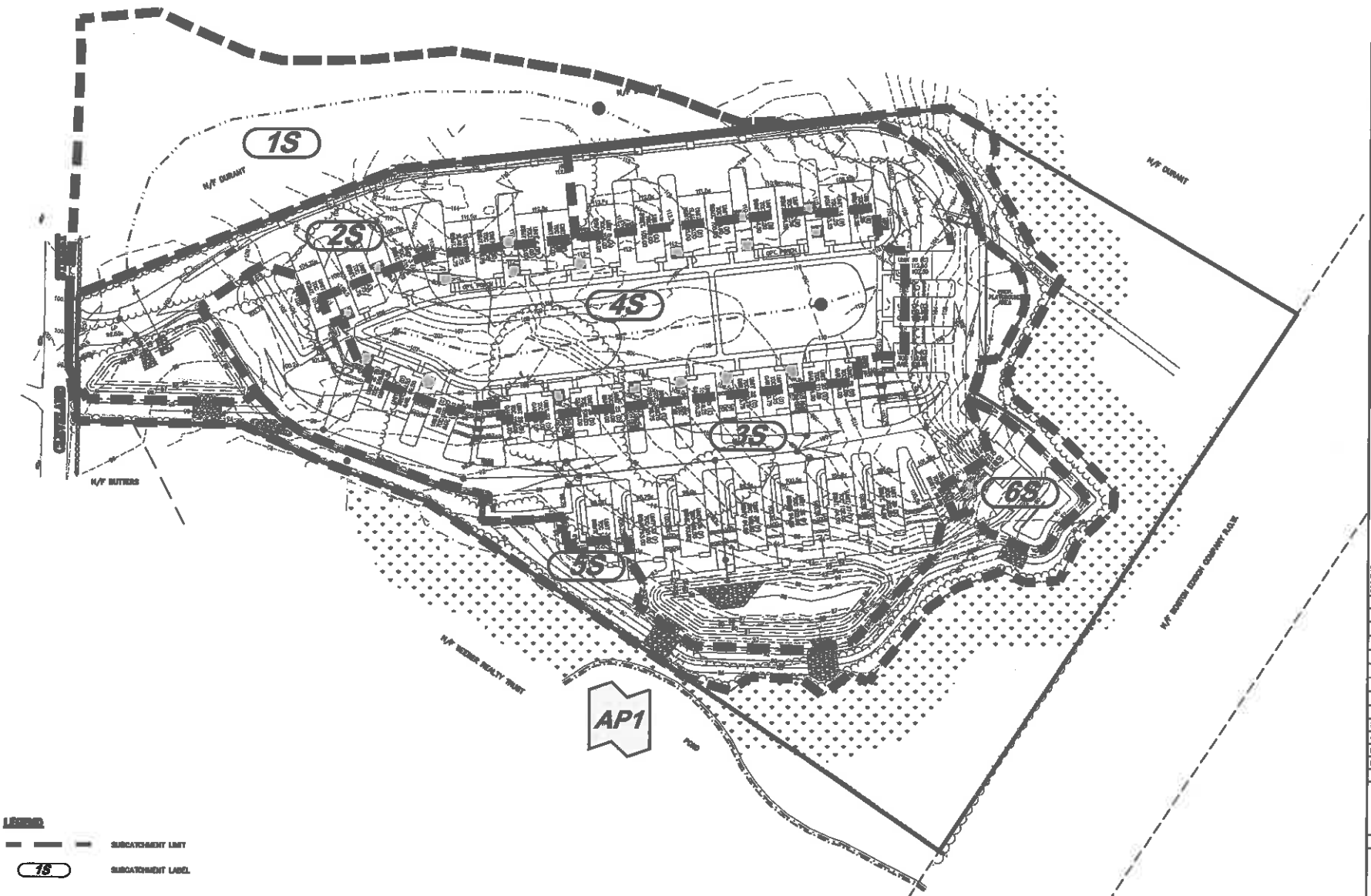
DRAWN BY	BAC, TBS
CHECKED BY	PRM, BJA
DATE	APRIL 10, 2014
PROJECT NO.	2014-111

GRAPHIC SCALE
(IN FEET)
1 inch = 50 feet

SHEET TITLE
WATERSHED MAP
EXISTING CONDITIONS

SHEET NO.
D-1.0



LEGEND

- SUBCATCHMENT LIMIT
- 1S — SUBCATCHMENT LABEL
- TIME OF CONCENTRATION
- AP1 — DRAINAGE ANALYSIS POINT

ASE

Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

P.O. Box 312, 194 Mendon Street
Uxbridge, Massachusetts 01569
P: 508-278-3997 F: 508-278-2289

300 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-9463 F: 508-316-0943

PROJECT: LAKELAND FARMS TOWNHOUSE COMMUNITY
84 CLEVELAND STREET
NORFOLK, MA 02056

APPLICANT: LAKELAND FARMS, LLC
84 CLEVELAND STREET
NORFOLK, MA 02056

REVISIONS

NO.	DATE	DESCRIPTION

CAD FILE	.\dwg\2014-171_SP.dwg
DRAWN BY	BJD, TMS
CHECKED BY	PRV, BJA
DATE	APRIL 16, 2015
PROJECT NO.	2014-171

GRAPHIC SCALE

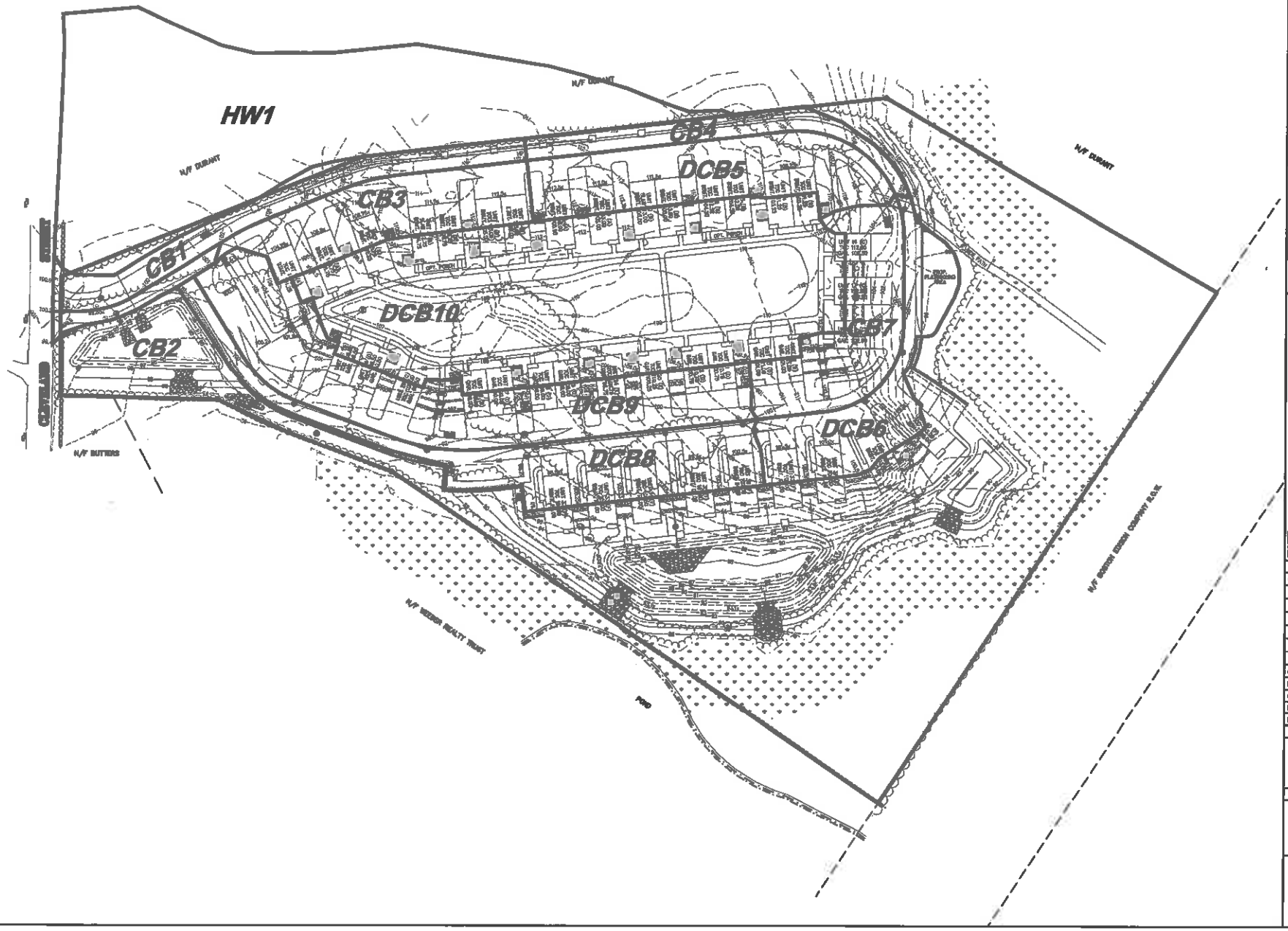
(IN FEET)
1 inch = 50 ft.

SHEET TITLE

WATERSHED MAP DEVELOPED CONDITIONS

DRAWING NO.

D-2.0



ASE
Andrews Survey & Engineering, Inc.
Land Surveyors - Civil Engineers - Site Planners
P.O. Box 313, 104 Hawden Street
Uxbridge, Massachusetts 01569
P: 508-278-3997 F: 508-278-3299
690 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-0462 F: 508-316-0463

PROJECT: LAKELAND FARMS TOWNHOUSE COMMUNITY 84 CLEVELAND STREET NORFOLK, MA 02056

APPLICANT: LAKELAND FARMS, LLC 84 CLEVELAND STREET NORFOLK, MA 02056

NO.	DATE	DESCRIPTION

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DRAWN BY	SJD, TBD
CHECKED BY	PEH, EAA
DATE	APRIL 10, 2015
PROJECT NO.	2014-111

GRAPHIC SCALE

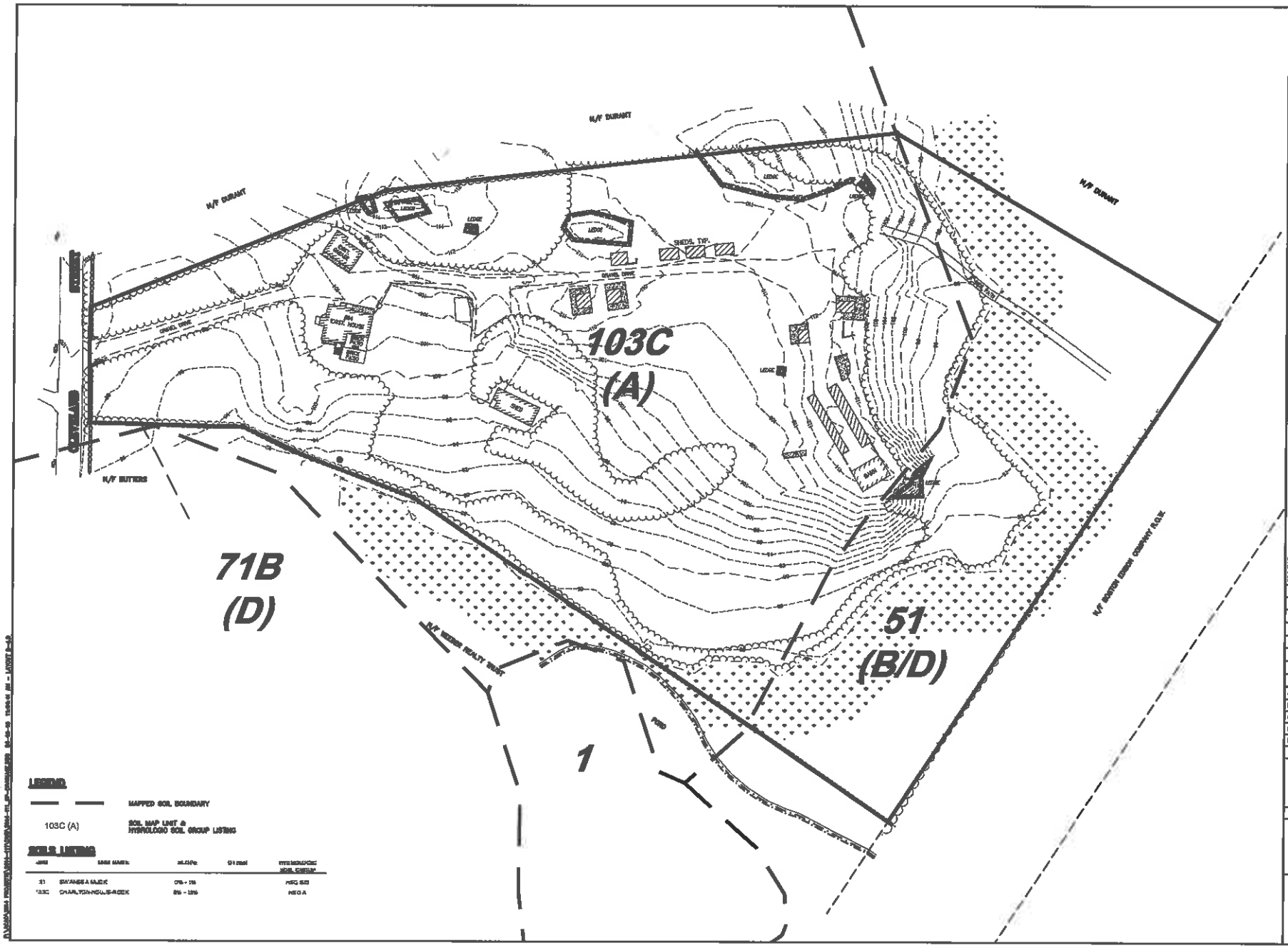
(IN FEET)
1 inch = 60 ft.

SHEET TITLE

CATCH BASIN SUBCATCHMENT AREAS

DRAWING NO.

D-3.0



ASE

Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

P.O. Box 312, 184 Maiden Street
Uxbridge, Massachusetts 01569
P: 508-278-5597 F: 508-278-1289

300 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-5625 F: 508-316-5963

PROJECT: LAKELAND FARMS TOWNHOUSE COMMUNITY
84 CLEVELAND STREET
NORFOLK, MA 02056

APPLICANT: LAKELAND FARMS, LLC
84 CLEVELAND STREET
NORFOLK, MA 02056

REVISIONS

NO.	DATE	DESCRIPTION

CAD FILE	\dwg\2014-111_SP.dwg
DRAWN BY	BJD, TRB
CHECKED BY	PEH, BJA
DATE	APRIL 10, 2015
PROJECT NO.	2014-111

GRAPHIC SCALE

1 inch = 60 ft.

SHEET TITLE

SOIL MAPPING

DRAWING NO.

D-4.0