STORMWATER DRAINAGE REPORT

FOR

PROPOSED

Prepared for:

TRB
Development Group, Inc.

ASSESSOR'S MAP 3F, LOTS 118-2 & 128
400 Massachusetts Avenue (a.k.a. Route 111)
Town of Acton, Massachusetts
Middlesex County

Prepared by:

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BOHLER ENGINEERING

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I. INTRODUCTION

The following report provides an analysis of the stormwater drainage conditions that will result from the re-development of the subject site into a CVS pharmacy. The site is located along the southerly side of Massachusetts Avenue, (a.k.a. Route 111) and is identified by the Acton Assessor's Office as Map F3, Lot 128.

The site (Lot 128 containing 57,677sf plus a portion of Lot 118-2 containing 7,080sf, totaling 64,757sf of land) is currently partially paved with an existing "Goodyear" Tire and related parking and landscaped areas. The property is bound to the north by Massachusetts Avenue (a.k.a. Route 111), a two-way, two-lane road under State jurisdiction, to the south by vacant land (Lot 118-2), to the west by "TD Bank" (Lot 127) along with a utility and access easement between the existing site and the "TD Bank", and to the east by the "Acton Children's School" (Lot 134). The properties described above along with the utility and access easement are under common ownership. The site is located entirely in the flood hazard Zone X (areas outside the 100 year flood plain) per FEMA mapping.

This report includes an analysis of the existing and proposed drainage characteristics of the site including building, parking and landscaped areas, and provides a detailed analysis of the proposed stormwater management facilities and best management practices (BMPs) that will control the stormwater outflow associated with the post-redeveloped site.

This report addresses a comparative analysis of the pre and post development site stormwater runoff conditions with the following primary design constraints being:

1. Meeting the standards of the Massachusetts Department of Environmental Protection Agency's Stormwater Management Standards,
2. Complying with the Town of Acton's Site Plan Special permit regulations for Drainage Calculations (Section 3.6), as well as adherence to the Town's stormwater runoff bylaw (10.4.3.1).

II. DRAINAGE – EXISTING SITE CONDITIONS

The subject site is part of a larger watershed, which has been analyzed in this report and separated into two drainage areas, E-1 and E-2. The larger watershed was analyzed as part of this design in order to ensure that peak rate of runoff from the site will be reduced, demonstrating that there will be no negative impact to the respective discharge points DPE-1 (wetlands) & DPE-2 (Abutting properties to south).

Drainage Area E-1 is further separated into two drainage sub-basins called drainage area E-1 and drainage area E-1A. The first sub-basin Drainage Area E-1 contains 310,012 sf of land which consists of pavement, woods and landscaped areas that sheetflow to inlets before being discharged to the wetlands untreated or via direct sheetflow into the wetlands untreated (Design Point DPE-1). The second sub-basin (E-1A) contains 5,430 sf of land which consists of pavement and landscaped areas that sheetflows into inlets before being discharged to the wetlands untreated, similar to drainage area E-1.

Drainage Area E-2 contains 81,486 sf of land which consists of pavement, woods and landscaped areas that sheet flow untreated onto the abutting properties to the south (DPE2).

Calculations in this report will demonstrate that the peak rate of runoff discharged from the proposed site as a whole has been reduced, thus demonstrating that there will be no negative impacts to the wetlands (DPE1) located downstream of the development along with the abutter properties to the south (DPE2).

All of the existing drainage areas are shown on "Existing Drainage Tributary Map" which is included within the Appendices of this report.

III. DRAINAGE- PROPOSED SITE CONDITIONS

The post-development conditions include a 13,602 sf +/- CVS pharmacy (footprint) along with associated site improvements which include stormwater management facilities, utility improvements, parking areas, landscaping, lighting, and various site improvements as illustrated on the Site Development Plans prepared by Bohler Engineering. It should be noted that post development conditions will result in an increase in the amount impervious areas which will be mitigated by the new stormwater management facilities described within this report.

The goals of the stormwater management system design were to maintain existing site drainage patterns, mitigate peak post development flows, and improve the water quality of the stormwater leaving the site and ultimately the receiving drainage systems and resource areas. The proposed drainage system on-site includes a series of deep-sump hooded catch basins and manholes which are routed into stormwater quality units and into an underground detention system before discharging to the existing 24" drain line located within the Town's drainage easement on-site. This area ultimately discharges to the existing vegetated wetland located to the east.

Water quality will be improved for the developed site through a combination of various measures including deep-sump hooded catch basins, and stormwater quality units. These treatments will greatly enhance the amount of total suspended solids (TSS) removed from site runoff compared to the existing condition. In the proposed condition, runoff from impervious areas will achieve greater than 80% TSS removal, compared to the existing conditions, which provide little, if any, TSS removal.

Similar to existing conditions, the post-development site has been divided into two separate drainage areas, P-1 and P-2. Drainage area P-1 is further broken into four sub-drainage areas. These sub-drainage areas are known as P-1A, P-1B, P-1C and P1-D. All of these sub-drainage areas eventually discharge to the wetland located to the east (DPP1).

Drainage area P-1A, which is the developed portion of the project, consists of 65,255 sf of pavement, meadow and landscaped areas. Stormwater from this area is collected via deep-sump hooded catch basins before being routed through stormwater quality units. This area will then be conveyed into an underground detention basin before leaving the site via an Outlet Control Structure which eventually discharges to the town's 24" pipe located on the north side of the property and then to the wetland (DPP1). The outlet control structure has been designed to detain stormwater while reducing peak rates of discharge when compared to existing conditions for all storm events.

Drainage area P-1B consists of the runoff area from the roof of the CVS building and contains 13,602 sf of impervious area. Stormwater from this area is collected via roof drains and is then routed through the underground detention basin described above.

Drainage area P-1C consists of 232,975 sf of pavement, woods, meadow and landscaped areas. This area encompasses a portion of the site that is to be cleared and rough graded for potential future development along with existing areas that drain to the wetlands. Stormwater from this area sheetflows to inlets that are piped to the wetlands or by direct sheetflow into the wetlands (Design Point DPP-1) as in existing conditions, however the stormwater runoff is slowed by the planting of meadow grass which helps promote infiltration and groundwater recharge.

Drainage area P-1D consists of 12,845 sf of pavement and landscaped areas. Stormwater from this area sheetflows to inlets within the State ROW that are piped to the wetlands (Design Point DPP-1) as in existing conditions. Areas that sheetflow into the ROW were minimized to the extent practicable given the site, grading and shallow depth to groundwater constraints.

Drainage area "P-2" consists of 72,164 sf of woods, landscaped areas and pavement. Stormwater from this area flows to the abutting properties to the south, similar to existing conditions.

Please refer to the "Proposed Drainage Tributary Map" included within the Appendices of this report for a graphical representation of the proposed drainage areas.

IV. DRAINAGE ANALYSIS METHODOLGY

The methodology utilized to design the subject stormwater management system to demonstrate compliance with the Town of Acton, State and Federal requirements/guidelines is based on the SCS TR 55 Urban Hydrology for small watersheds method.

In addition, times of concentration were generated from the SCS TR 55 Urban Hydrology for small watersheds method. Runoff coefficients for the existing and post-development conditions were developed using widely accepted runoff coefficients.

Compliance with the Massachusetts Department of Environmental Protection's Stormwater Management Standards and the Town of Acton Requirements has been achieved through the proposed drainage system design. The rainfall rates used were based on the SCS TR 55 Urban Hydrology rates.

V. DRAINAGE ANALYSIS RESULTS

The analysis of post development stormwater conditions indicate that the peak rates of runoff and volumes to the design points will be decreased compared to the existing conditions, as shown on the attached tables.

Table 1 - Stormwater Runoff Rate - Summary to Design Point 1 (DPP-1, Wetlands)

Storm Frequency	Existing Flow (CFS)	Proposed Flow (CFS)	Change (CFS)
2 year	7.42	6.99	-0.43
10 year	14.00	12.90	-1.10
25 year	17.94	16.54	-1.40
100 year	23.96	22.97	-0.99

Table 2 - Stormwater Runoff Rate - Summary to Design Point 2 (DPP-2, Offsite)

Storm Frequency	Existing Flow (CFS)	Proposed Flow (CFS)	Change (CFS)
2 year	2.43	2.28	-0.15
10 year	4.84	4.45	-0.39
25 year	6.31	5.77	-0.54
100 year	8.58	7.79	-0.79

DISCHARGE TO EXISTING 24" PIPE

As mentioned in the body of this report, stormwater from the underground detention basin is proposed to discharge to the existing 24" pipe located in the drainage easement at the front of the property. In order to discharge to this pipe, the Town Engineer requested that calculations be included within this report to demonstrate that the time of concentration corresponding to the peak rate of discharge for the subject site to the municipal conveyance system is offset from the peak rate of flow from upstream tributary runoff. The methodology for completing this analysis included determining the upstream area contributing to the 24" pipe, and calculating the time of concentration, and corresponding time of peak flow for this area in the 24" pipe. These calculations have been provided and demonstrate that the peak rate of discharge from the subject site to the municipal pipe will be offset approximately one half hour compared to the time of peak rates calculated for the upstream tributary areas. As a result, and given the relatively small tributary drainage area associated with the CVS development (1.81 ac) compared to the upstream area contributing to the flow to the 24" pipe (65.0 ac), it is reasonable to conclude that the capacity of the existing pipe will not be compromised as a result of the site's proposed stormwater discharge. See supporting calculations within appendices of this report.

VI. CONCLUSIONS

Analysis of the proposed stormwater management system indicates that the proposed development will ultimately result in a decrease in the post-development peak runoff rates. Additionally, the proposed best management practices will provide the benefits of improving TSS removal for the site's runoff prior to discharge to the municipal drainage system, as well as to their respective design points. As a result, there will be no negative impacts to the existing drainage infrastructure or receiving waters as a result of the proposed development.

VII. STORMWATER MANAGEMENT STANDARDS

As outlined below, the proposed drainage system was designed in accordance with the Massachusetts Stormwater Management Policy.

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

Runoff from impervious areas on site will be collected via deep sump catch basins and treated by stormwater quality units.

Standard #2: **Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates.**

Runoff rates for the post-redevelopment conditions were calculated for the 2-year, 10-year, 25-year and 100-year 24-hour storm events and as demonstrated within this report, peak post-development stormwater runoff rates do not exceed pre-development rates.

Standard #3: **Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance.**

Due to the shallow groundwater conditions demonstrated by the geotechnical investigations, the site was not conducive towards infiltration, therefore the site design used an approach that minimized or replicated disturbance of existing trees. Areas planted with meadow grass will slow down stormwater runoff to help improve infiltration and recharge when compared to the existing condition. The water balance calculations included in the Appendix of this report demonstrate that loss of annual recharge to groundwater will be eliminated / minimized.

Standard #4: **Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS).**

Water quality measures have been provided for this site including stormceptor units in combination with of deep sump and hooded catch basins to achieve a "process train" of TSS removal. The total TSS for each process train exceeds the 80% TSS requirement.

Standard #5: **For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable.**

The proposed use is a land use with higher potential pollutant loads and the proposed project has been designed to provide exceed 44% pretreatment TSS removal.

Standard #6: **Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook.**

The site does not contain, nor directly discharge to any critical areas, as defined by the Department of Environmental protection.

Standard #7: **A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable.**

The site qualifies as a re-development as we are improving the site from existing conditions with the reduction of peak rates and the water quality measures introduced. Standards 1, 2, 4, 5, 6, 7, 8, 9 & 10 have been met. All other standards have been met to the maximum extent practicable.

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

An erosion and sediment control plan has been developed for this project implementing: silt fence, a crushed stone construction exit, catch basin inlet protection, and provisions for stabilizing disturbed areas.

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

An Operation and Maintenance Plan for the proposed BMP's has been developed for this project and is included within the appendices of this report.

Standard #10: **All illicit discharges to the stormwater management system are prohibited.**
No illicit discharges will be created as part of the site construction in the area in question.

APPENDIX 1

USGS & FIRM MAP

MAP SCALE 1" = 500'

50 0 500 1000 FEET

METER

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0352E

FIRM

FLOOD INSURANCE RATE MAP

MIDDLESEX COUNTY, MASSACHUSETTS
(ALL JURISDICTIONS)

PANEL 352 OF 656

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ACTON TOWN OF	250176	0352	E

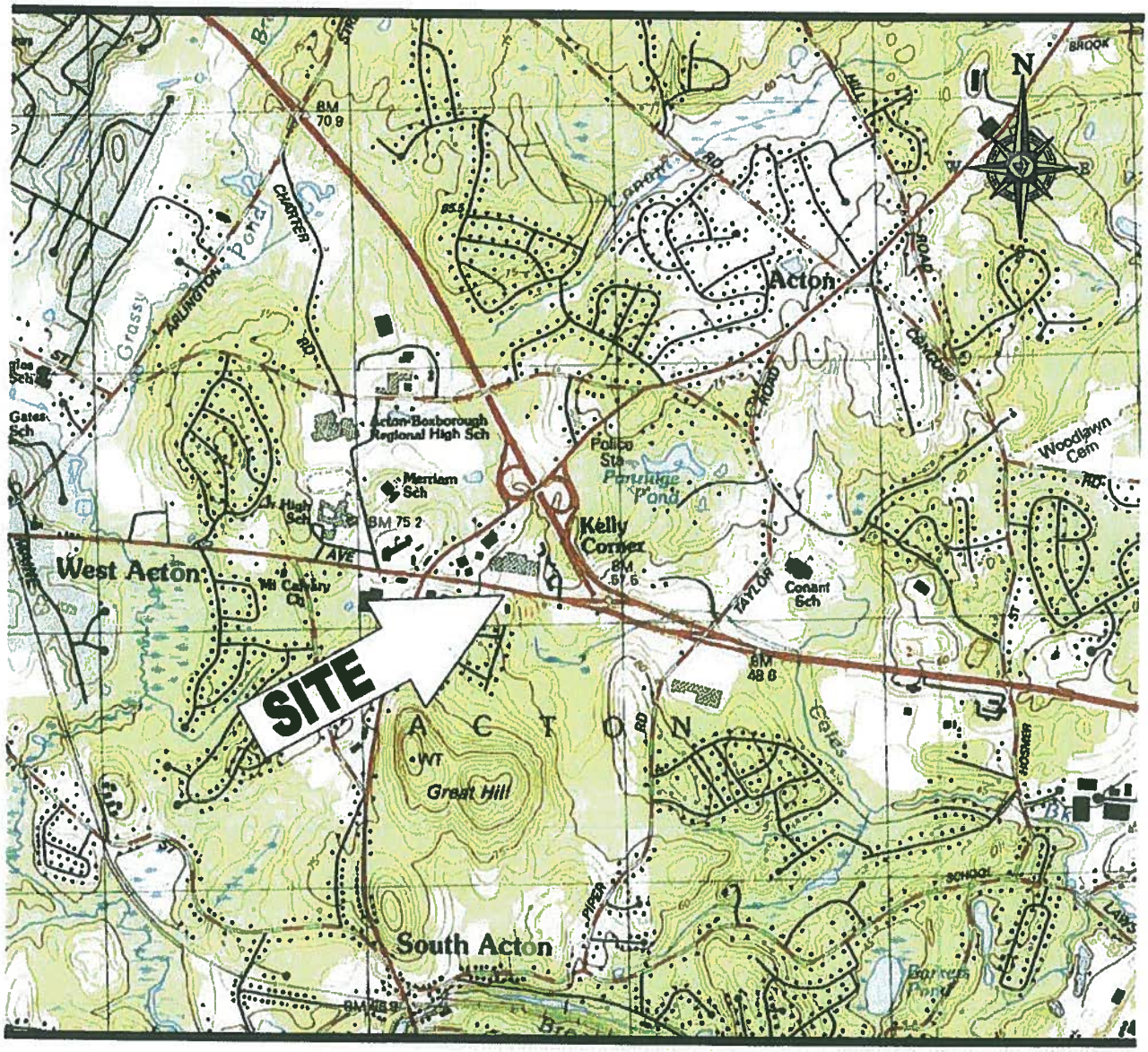
Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community

MAP NUMBER
25017C0352E

EFFECTIVE DATE
JUNE 4, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



LOCATION MAP

SCALE: 1"=2000'
PLAN REFERENCE: MASSGIS USGS IMAGE

APPENDIX 2

NRCS Soil Mapping

Custom Soil Resource Report
Soil Map

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Units

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features

- Gully
- Short Steep Slope
- Other

Political Features

- Cities

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:2,340 if printed on A size (8.5" × 11") sheet.

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 accurate map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 19N NAD83

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

Soil Survey Area: Middlesex County, Massachusetts
Survey Area Data: Version 12, Feb 26, 2010

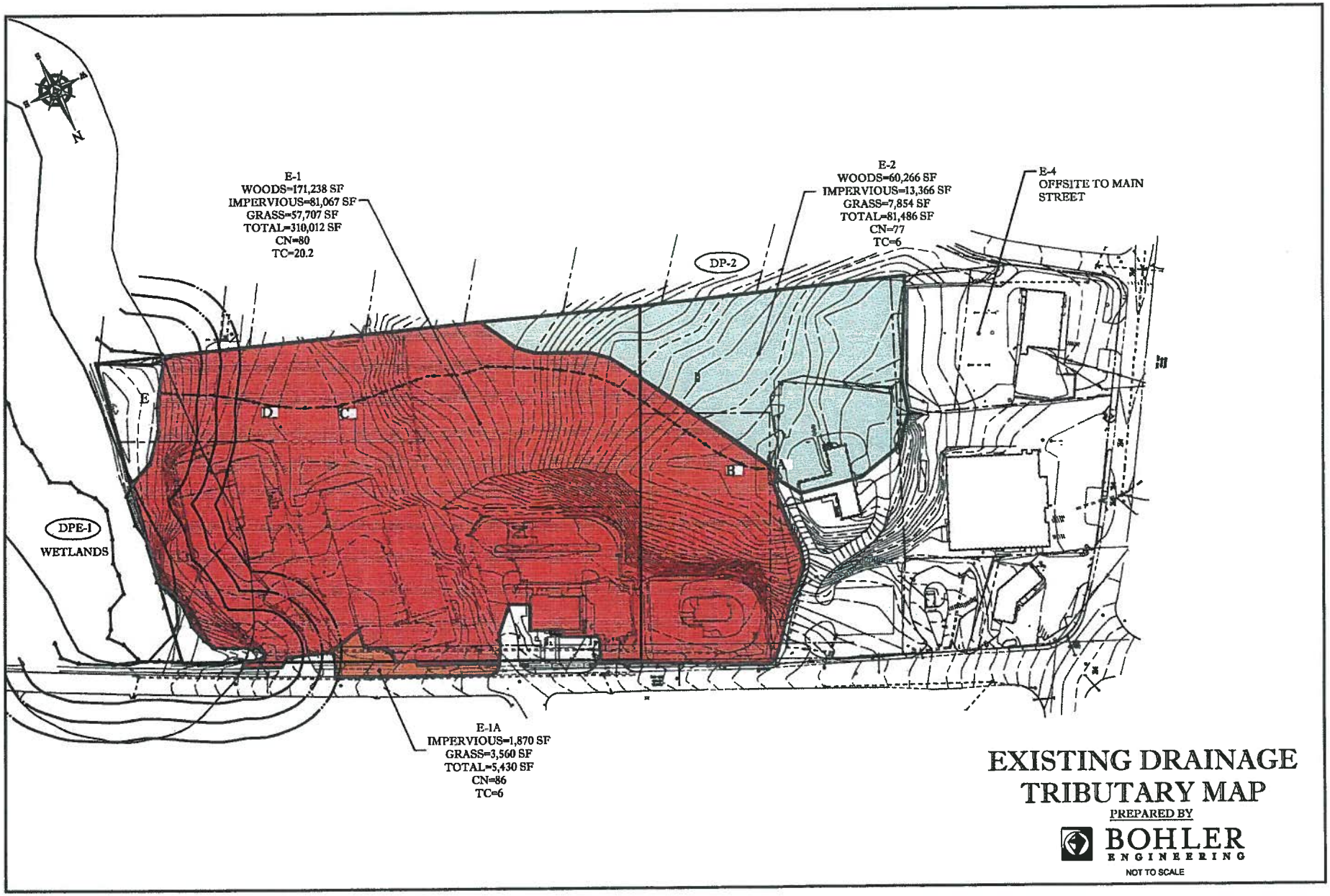
Date(s) aerial images were photographed: 7/28/2003

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

Map Unit Legend

Middlesex County, Massachusetts (MA017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	3.2	23.6%
623C	Woodbridge-Urban land complex, 3 to 15 percent slopes	5.4	39.3%
656	Udorthents-Urban land complex	5.0	37.0%
Totals for Area of Interest		**13.6**	**100.0%**

APPENDIX 3
PRE- AND POST-DEVELOPMENT WATERSHED MAPS



EXISTING DRAINAGE TRIBUTARY MAP

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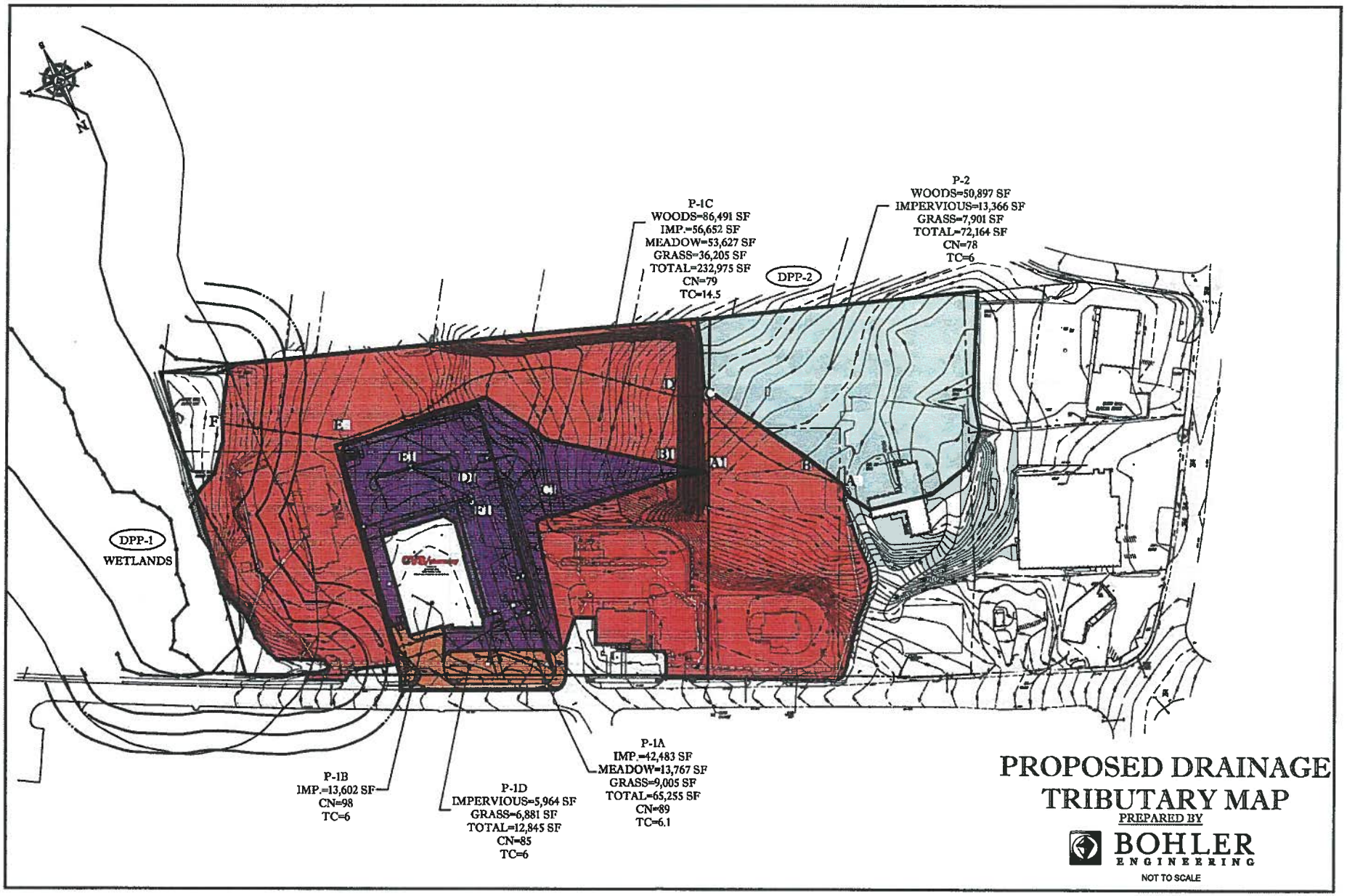
BOHLER ENGINEERING

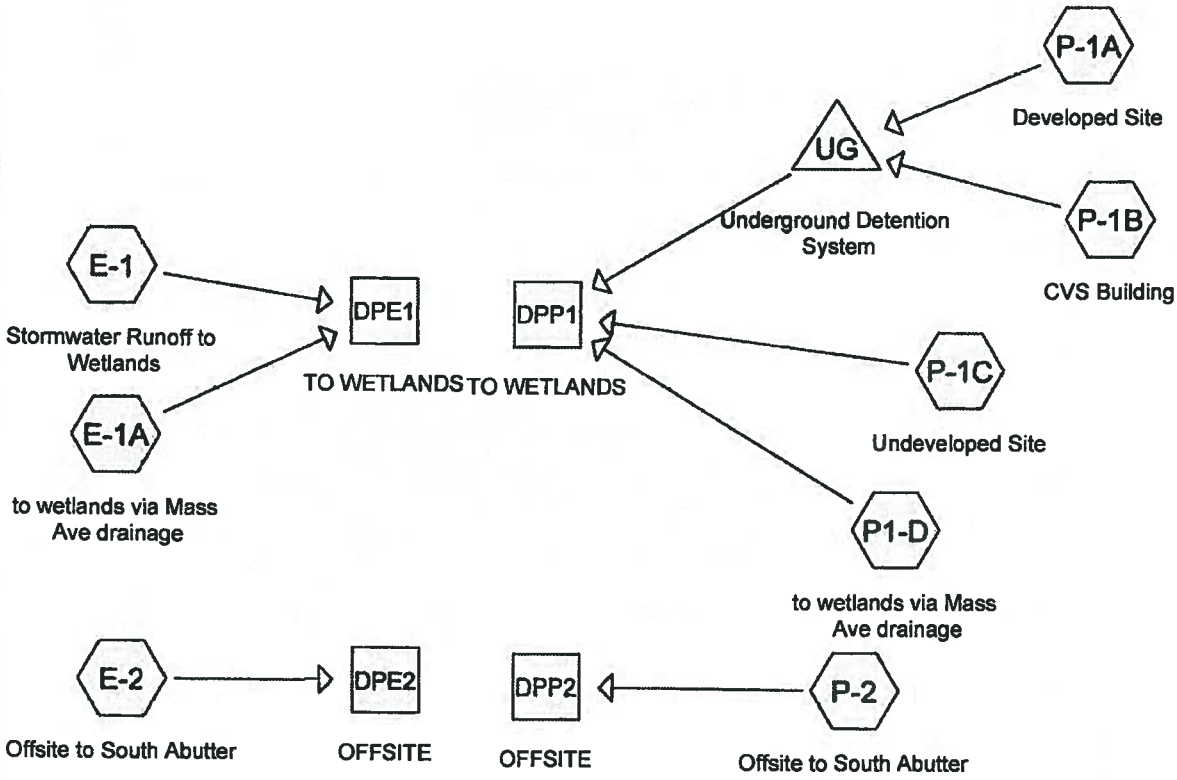
NOT TO SCALE

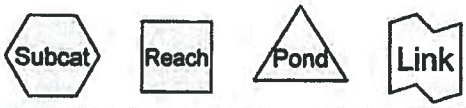

P-1C
WOODS=86,491 SF
IMP.=56,652 SF
MEADOW=53,627 SF
GRASS=36,205 SF
TOTAL=232,975 SF
CN=79
TC=14.5
P-2
WOODS=50,897 SF
IMPERVIOUS=13,366 SF
GRASS=7,901 SF
TOTAL=72,164 SF
CN=78
TC=6
DPP-2
DPP-1
WETLANDS
P-1B
IMP.=13,602 SF
CN=98
TC=6
P-1D
IMPERVIOUS=5,964 SF
GRASS=6,881 SF
TOTAL=12,845 SF
CN=85
TC=6
P-1A
IMP.=42,483 SF
MEADOW=13,767 SF
GRASS=9,005 SF
TOTAL=65,255 SF
CN=89
TC=6.1
PROPOSED DRAINAGE
TRIBUTARY MAP
PREPARED BY
BOHLER
ENGINEERING
NOT TO SCALE

APPENDIX 4
STORMWATER ATTENUATION CALCULATIONS AND RAINFALL DATA

Rainfall Frequencies for Massachusetts Counties

	1	2	5	10	25	50	100
"BARNSTABLE"	2.5	3.6	4.5	4.8	5.7	6.4	7.1
"BERKSHIRE"	2.5	2.9	3.8	4.4	5.1	5.9	6.4
"BRISTOL"	2.5	3.4	4.3	4.8	5.6	6.3	7.0
"DUKES"	2.5	3.6	4.6	4.9	5.8	6.5	7.2
"ESSEX"	2.5	3.1	3.9	4.5	5.4	5.9	6.5
"FRANKLIN"	2.5	2.9	3.8	4.3	5.1	5.8	6.2
"HAMPDEN"	2.5	3.0	4.0	4.6	5.3	6.0	6.5
"HAMPSHIRE"	2.5	3.0	3.9	4.5	5.2	5.9	6.4
"MIDDLESEX"	2.5	3.1	4.0	4.5	5.3	5.9	6.5
"NANTUCKET"	2.5	3.6	4.6	4.9	5.8	6.5	7.2
"NORFOLK"	2.5	3.2	4.1	4.7	5.5	6.1	6.7
"PLYMOUTH"	2.5	3.4	4.3	4.7	5.6	6.2	7.0
"SUFFOLK"	2.5	3.2	4.0	4.6	5.5	6.0	6.6
"WORCESTER"	2.5	3.0	4.0	4.5	5.3	5.9	6.5





Drainage Diagram for TRB Acton 6-24-13
Prepared by Bohler Engineering, Printed 6/24/2013
HydroCAD® 9.00 s/n 02612 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.547	71	Meadow, non-grazed, HSG C (P-1A, P-1C)
8.469	73	Woods, Fair, HSG C (E-1, E-2, P-1C, P-2)
2.882	74	>75% Grass cover, Good, HSG C (E-1, E-2, P-1A, P-1C, P-2, P1-D)
0.082	79	50-75% Grass cover, Fair, HSG C (E-1A)
5.243	98	Paved parking & roofs (E-1, E-1A, E-2, P-1A, P-1B, P-1C, P-2, P1-D)
18.222		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Stormwater Runoff to Runoff Area=310,012 sf 26.15% Impervious Runoff Depth>1.32"
Flow Length=848' Tc=20.2 min CN=80 Runoff=7.30 cfs 0.782 af

Subcatchment E-1A: to wetlands via Mass Runoff Area=5,430 sf 34.44% Impervious Runoff Depth>1.75"
Tc=6.0 min CN=86 Runoff=0.26 cfs 0.018 af

Subcatchment E-2: Offsite to South Abutter Runoff Area=81,486 sf 16.40% Impervious Runoff Depth>1.14"
Tc=6.0 min CN=77 Runoff=2.43 cfs 0.178 af

Subcatchment P-1A: Developed Site Runoff Area=65,255 sf 65.10% Impervious Runoff Depth>1.99"
Flow Length=673' Tc=6.1 min CN=89 Runoff=3.46 cfs 0.248 af

Subcatchment P-1B: CVS Building Runoff Area=13,602 sf 100.00% Impervious Runoff Depth>2.87"
Tc=6.0 min CN=98 Runoff=0.94 cfs 0.075 af

Subcatchment P-1C: Undeveloped Site Runoff Area=232,975 sf 24.32% Impervious Runoff Depth>1.26"
Flow Length=887' Tc=14.5 min CN=79 Runoff=5.93 cfs 0.561 af

Subcatchment P-2: Offsite to South Abutter Runoff Area=72,164 sf 18.52% Impervious Runoff Depth>1.20"
Tc=6.0 min CN=78 Runoff=2.28 cfs 0.166 af

Subcatchment P1-D: to wetlands via Mass Runoff Area=12,845 sf 46.43% Impervious Runoff Depth>1.67"
Tc=6.0 min CN=85 Runoff=0.58 cfs 0.041 af

Reach DPE1: TO WETLANDS Inflow=7.42 cfs 0.801 af
Outflow=7.42 cfs 0.801 af

Reach DPE2: OFFSITE Inflow=2.43 cfs 0.178 af
Outflow=2.43 cfs 0.178 af

Reach DPP1: TO WETLANDS Inflow=6.99 cfs 0.916 af
Outflow=6.99 cfs 0.916 af

Reach DPP2: OFFSITE Inflow=2.28 cfs 0.166 af
Outflow=2.28 cfs 0.166 af

Pond UG: Underground Detention System Peak Elev=183.38' Storage=5,368 cf Inflow=4.40 cfs 0.323 af
Outflow=0.78 cfs 0.314 af

Total Runoff Area = 18.222 ac Runoff Volume = 2.068 af Average Runoff Depth = 1.36"
71.23% Pervious = 12.980 ac 28.77% Impervious = 5.243 ac

Summary for Subcatchment E-1: Stormwater Runoff to Wetlands

Runoff = 7.30 cfs @ 12.28 hrs, Volume= 0.782 af, Depth> 1.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
81,067	98	Paved parking & roofs
57,707	74	>75% Grass cover, Good, HSG C
171,238	73	Woods, Fair, HSG C
310,012	80	Weighted Average
228,945		73.85% Pervious Area
81,067		26.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0400	0.05		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.10"
2.4	538	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.6	160	0.0750	4.41		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
20.2	848	Total			

Summary for Subcatchment E-1A: to wetlands via Mass Ave drainage

Runoff = 0.26 cfs @ 12.09 hrs, Volume= 0.018 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
1,870	98	Paved parking & roofs
3,560	79	50-75% Grass cover, Fair, HSG C
5,430	86	Weighted Average
3,560		65.56% Pervious Area
1,870		34.44% Impervious Area

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

Summary for Subcatchment E-2: Offsite to South Abutter

Runoff = 2.43 cfs @ 12.09 hrs, Volume= 0.178 af, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,854	74	>75% Grass cover, Good, HSG C
60,266	73	Woods, Fair, HSG C
81,486	77	Weighted Average
68,120		83.60% Pervious Area
13,366		16.40% Impervious Area

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

Summary for Subcatchment P-1A: Developed Site

Runoff = 3.46 cfs @ 12.09 hrs, Volume= 0.248 af, Depth> 1.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
42,483	98	Paved parking & roofs
9,005	74	>75% Grass cover, Good, HSG C
13,767	71	Meadow, non-grazed, HSG C
65,255	89	Weighted Average
22,772		34.90% Pervious Area
42,483		65.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.5000	0.24		**Sheet Flow, A1 - B1**
					Grass: Bermuda n= 0.410 P2= 3.10"
1.3	344	0.0700	4.26		**Shallow Concentrated Flow, B1 -C1**
					Unpaved Kv= 16.1 fps
0.8	182	0.0380	3.96		**Shallow Concentrated Flow, C1 - D1**
					Paved Kv= 20.3 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, E1 -F1**
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
6.1	673	Total			

Summary for Subcatchment P-1B: CVS Building

Runoff = 0.94 cfs @ 12.08 hrs, Volume= 0.075 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
13,602	98	Paved parking & roofs
13,602		100.00% Impervious Area

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

Summary for Subcatchment P-1C: Undeveloped Site

Runoff = 5.93 cfs @ 12.20 hrs, Volume= 0.561 af, Depth> 1.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
56,652	98	Paved parking & roofs
36,205	74	>75% Grass cover, Good, HSG C
86,491	73	Woods, Fair, HSG C
53,627	71	Meadow, non-grazed, HSG C
232,975	79	Weighted Average
176,323		75.68% Pervious Area
56,652		24.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	180	0.0360	3.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	50	0.5000	11.38		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
3.3	452	0.0200	2.28		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
0.6	155	0.0770	4.47		**Shallow Concentrated Flow, E- F** Unpaved Kv= 16.1 fps
14.5	887	Total			

Summary for Subcatchment P-2: Offsite to South Abutter

Runoff = 2.28 cfs @ 12.09 hrs, Volume= 0.166 af, Depth> 1.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,901	74	>75% Grass cover, Good, HSG C
50,897	73	Woods, Fair, HSG C
72,164	78	Weighted Average
58,798		81.48% Pervious Area
13,366		18.52% Impervious Area

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

Summary for Subcatchment P1-D: to wetlands via Mass Ave drainage

Runoff = 0.58 cfs @ 12.09 hrs, Volume= 0.041 af, Depth> 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.10"

Area (sf)	CN	Description
5,964	98	Paved parking & roofs
6,881	74	>75% Grass cover, Good, HSG C
12,845	85	Weighted Average
6,881		53.57% Pervious Area
5,964		46.43% Impervious Area

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

Summary for Reach DPE1: TO WETLANDS

Inflow Area = 7.242 ac, 26.29% Impervious, Inflow Depth > 1.33" for 2-yr event
Inflow = 7.42 cfs @ 12.28 hrs, Volume= 0.801 af
Outflow = 7.42 cfs @ 12.28 hrs, Volume= 0.801 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPE2: OFFSITE

Inflow Area = 1.871 ac, 16.40% Impervious, Inflow Depth > 1.14" for 2-yr event
Inflow = 2.43 cfs @ 12.09 hrs, Volume= 0.178 af
Outflow = 2.43 cfs @ 12.09 hrs, Volume= 0.178 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP1: TO WETLANDS

Inflow Area = 7.454 ac, 36.56% Impervious, Inflow Depth > 1.47" for 2-yr event
Inflow = 6.99 cfs @ 12.20 hrs, Volume= 0.916 af
Outflow = 6.99 cfs @ 12.20 hrs, Volume= 0.916 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP2: OFFSITE

Inflow Area = 1.657 ac, 18.52% Impervious, Inflow Depth > 1.20" for 2-yr event
Inflow = 2.28 cfs @ 12.09 hrs, Volume= 0.166 af
Outflow = 2.28 cfs @ 12.09 hrs, Volume= 0.166 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond UG: Underground Detention System

Inflow Area = 1.810 ac, 71.12% Impervious, Inflow Depth > 2.14" for 2-yr event
Inflow = 4.40 cfs @ 12.09 hrs, Volume= 0.323 af
Outflow = 0.78 cfs @ 12.55 hrs, Volume= 0.314 af, Atten= 82%, Lag= 27.8 min
Primary = 0.78 cfs @ 12.55 hrs, Volume= 0.314 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 183.38' @ 12.55 hrs Surf.Area= 6,300 sf Storage= 5,368 cf
Flood Elev= 186.00' Surf.Area= 6,300 sf Storage= 13,909 cf

Plug-Flow detention time= 88.9 min calculated for 0.314 af (97% of inflow)
Center-of-Mass det. time= 73.1 min (872.1 - 799.0)

Volume	Invert	Avail.Storage	Storage Description
#1	181.75'	8,176 cf	**42.00'W x 150.00'L x 4.00'H Prismatoid**
			25,200 cf Overall - 5,733 cf Embedded = 19,467 cf x 42.0% Voids
#2	182.50'	5,733 cf	**30.0" D x 146.0'L Pipe Storage** x 8 Inside #1
		13,909 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	**12.0" Round Culvert**
			L= 67.0' CMP, projecting, no headwall, Ke= 0.900
			Outlet Invert= 181.52' S= 0.0034 '/' Cc= 0.900
			n= 0.013 Concrete sewer w/manholes & inlets
#2	Device 1	181.75'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	183.85'	**38.0 deg Sharp-Crested Vee/Trap Weir** C= 2.58

Primary OutFlow Max=0.78 cfs @ 12.55 hrs HW=183.38' (Free Discharge)
- **1=Culvert** (Passes 0.78 cfs of 2.92 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.78 cfs @ 5.75 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Controls 0.00 cfs)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Stormwater Runoff to Runoff Area=310,012 sf 26.15% Impervious Runoff Depth>2.45"
Flow Length=848' Tc=20.2 min CN=80 Runoff=13.80 cfs 1.454 af

Subcatchment E-1A: to wetlands via Mass Runoff Area=5,430 sf 34.44% Impervious Runoff Depth>3.00"
Tc=6.0 min CN=86 Runoff=0.43 cfs 0.031 af

Subcatchment E-2: Offsite to South Abutter Runoff Area=81,486 sf 16.40% Impervious Runoff Depth>2.21"
Tc=6.0 min CN=77 Runoff=4.84 cfs 0.344 af

Subcatchment P-1A: Developed Site Runoff Area=65,255 sf 65.10% Impervious Runoff Depth>3.29"
Flow Length=673' Tc=6.1 min CN=89 Runoff=5.64 cfs 0.411 af

Subcatchment P-1B: CVS Building Runoff Area=13,602 sf 100.00% Impervious Runoff Depth>4.26"
Tc=6.0 min CN=98 Runoff=1.37 cfs 0.111 af

Subcatchment P-1C: Undeveloped Site Runoff Area=232,975 sf 24.32% Impervious Runoff Depth>2.37"
Flow Length=887' Tc=14.5 min CN=79 Runoff=11.42 cfs 1.056 af

Subcatchment P-2: Offsite to South Abutter Runoff Area=72,164 sf 18.52% Impervious Runoff Depth>2.29"
Tc=6.0 min CN=78 Runoff=4.45 cfs 0.316 af

Subcatchment P1-D: to wetlands via Mass Runoff Area=12,845 sf 46.43% Impervious Runoff Depth>2.91"
Tc=6.0 min CN=85 Runoff=1.00 cfs 0.071 af

Reach DPE1: TO WETLANDS Inflow=14.00 cfs 1.485 af
Outflow=14.00 cfs 1.485 af

Reach DPE2: OFFSITE Inflow=4.84 cfs 0.344 af
Outflow=4.84 cfs 0.344 af

Reach DPP1: TO WETLANDS Inflow=12.90 cfs 1.639 af
Outflow=12.90 cfs 1.639 af

Reach DPP2: OFFSITE Inflow=4.45 cfs 0.316 af
Outflow=4.45 cfs 0.316 af

Pond UG: Underground Detention System Peak Elev=184.25' Storage=9,114 cf Inflow=7.01 cfs 0.522 af
Outflow=1.09 cfs 0.511 af

Total Runoff Area = 18.222 ac Runoff Volume = 3.795 af Average Runoff Depth = 2.50"
71.23% Pervious = 12.980 ac 28.77% Impervious = 5.243 ac

Summary for Subcatchment E-1: Stormwater Runoff to Wetlands

Runoff = 13.80 cfs @ 12.28 hrs, Volume= 1.454 af, Depth> 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
81,067	98	Paved parking & roofs
57,707	74	>75% Grass cover, Good, HSG C
171,238	73	Woods, Fair, HSG C
310,012	80	Weighted Average
228,945		73.85% Pervious Area
81,067		26.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0400	0.05		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.10"
2.4	538	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.6	160	0.0750	4.41		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
20.2	848	Total			

Summary for Subcatchment E-1A: to wetlands via Mass Ave drainage

Runoff = 0.43 cfs @ 12.09 hrs, Volume= 0.031 af, Depth> 3.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
1,870	98	Paved parking & roofs
3,560	79	50-75% Grass cover, Fair, HSG C
5,430	86	Weighted Average
3,560		65.56% Pervious Area
1,870		34.44% Impervious Area

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

Summary for Subcatchment E-2: Offsite to South Abutter

Runoff = 4.84 cfs @ 12.09 hrs, Volume= 0.344 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,854	74	>75% Grass cover, Good, HSG C
60,266	73	Woods, Fair, HSG C
81,486	77	Weighted Average
68,120		83.60% Pervious Area
13,366		16.40% Impervious Area

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

Summary for Subcatchment P-1A: Developed Site

Runoff = 5.64 cfs @ 12.09 hrs, Volume= 0.411 af, Depth> 3.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
42,483	98	Paved parking & roofs
9,005	74	>75% Grass cover, Good, HSG C
13,767	71	Meadow, non-grazed, HSG C
65,255	89	Weighted Average
22,772		34.90% Pervious Area
42,483		65.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.5000	0.24		**Sheet Flow, A1 - B1**
					Grass: Bermuda n= 0.410 P2= 3.10"
1.3	344	0.0700	4.26		**Shallow Concentrated Flow, B1 -C1**
					Unpaved Kv= 16.1 fps
0.8	182	0.0380	3.96		**Shallow Concentrated Flow, C1 - D1**
					Paved Kv= 20.3 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, E1 -F1**
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
6.1	673	Total			

Summary for Subcatchment P-1B: CVS Building

Runoff = 1.37 cfs @ 12.08 hrs, Volume= 0.111 af, Depth> 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
13,602	98	Paved parking & roofs
13,602		100.00% Impervious Area

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

Summary for Subcatchment P-1C: Undeveloped Site

Runoff = 11.42 cfs @ 12.20 hrs, Volume= 1.056 af, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
56,652	98	Paved parking & roofs
36,205	74	>75% Grass cover, Good, HSG C
86,491	73	Woods, Fair, HSG C
53,627	71	Meadow, non-grazed, HSG C
232,975	79	Weighted Average
176,323		75.68% Pervious Area
56,652		24.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	180	0.0360	3.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	50	0.5000	11.38		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
3.3	452	0.0200	2.28		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
0.6	155	0.0770	4.47		**Shallow Concentrated Flow, E- F** Unpaved Kv= 16.1 fps
14.5	887	Total			

Summary for Subcatchment P-2: Offsite to South Abutter

Runoff = 4.45 cfs @ 12.09 hrs, Volume= 0.316 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,901	74	>75% Grass cover, Good, HSG C
50,897	73	Woods, Fair, HSG C
72,164	78	Weighted Average
58,798		81.48% Pervious Area
13,366		18.52% Impervious Area

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

Summary for Subcatchment P1-D: to wetlands via Mass Ave drainage

Runoff = 1.00 cfs @ 12.09 hrs, Volume= 0.071 af, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

Area (sf)	CN	Description
5,964	98	Paved parking & roofs
6,881	74	>75% Grass cover, Good, HSG C
12,845	85	Weighted Average
6,881		53.57% Pervious Area
5,964		46.43% Impervious Area

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

Summary for Reach DPE1: TO WETLANDS

Inflow Area = 7.242 ac, 26.29% Impervious, Inflow Depth > 2.46" for 10-yr event
Inflow = 14.00 cfs @ 12.28 hrs, Volume= 1.485 af
Outflow = 14.00 cfs @ 12.28 hrs, Volume= 1.485 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPE2: OFFSITE

Inflow Area = 1.871 ac, 16.40% Impervious, Inflow Depth > 2.21" for 10-yr event
Inflow = 4.84 cfs @ 12.09 hrs, Volume= 0.344 af
Outflow = 4.84 cfs @ 12.09 hrs, Volume= 0.344 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP1: TO WETLANDS

Inflow Area = 7.454 ac, 36.56% Impervious, Inflow Depth > 2.64" for 10-yr event
Inflow = 12.90 cfs @ 12.20 hrs, Volume= 1.639 af
Outflow = 12.90 cfs @ 12.20 hrs, Volume= 1.639 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP2: OFFSITE

Inflow Area = 1.657 ac, 18.52% Impervious, Inflow Depth > 2.29" for 10-yr event
Inflow = 4.45 cfs @ 12.09 hrs, Volume= 0.316 af
Outflow = 4.45 cfs @ 12.09 hrs, Volume= 0.316 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond UG: Underground Detention System

Inflow Area = 1.810 ac, 71.12% Impervious, Inflow Depth > 3.46" for 10-yr event
Inflow = 7.01 cfs @ 12.09 hrs, Volume= 0.522 af
Outflow = 1.09 cfs @ 12.57 hrs, Volume= 0.511 af, Atten= 84%, Lag= 29.2 min
Primary = 1.09 cfs @ 12.57 hrs, Volume= 0.511 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 184.25' @ 12.57 hrs Surf.Area= 6,300 sf Storage= 9,114 cf
Flood Elev= 186.00' Surf.Area= 6,300 sf Storage= 13,909 cf

Plug-Flow detention time= 105.0 min calculated for 0.511 af (98% of inflow)
Center-of-Mass det. time= 92.7 min (880.0 - 787.3)

Volume	Invert	Avail.Storage	Storage Description
#1	181.75'	8,176 cf	**42.00'W x 150.00'L x 4.00'H Prismatoid** 25,200 cf Overall - 5,733 cf Embedded = 19,467 cf x 42.0% Voids
#2	182.50'	5,733 cf	**30.0" D x 146.0'L Pipe Storage** x 8 Inside #1
		13,909 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	**12.0" Round Culvert** L= 67.0' CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 181.52' S= 0.0034 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets
#2	Device 1	181.75'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	183.85'	**38.0 deg Sharp-Crested Vee/Trap Weir** C= 2.58

Primary OutFlow Max=1.09 cfs @ 12.57 hrs HW=184.25' (Free Discharge)
- **1=Culvert** (Passes 0.99 cfs of 4.15 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.99 cfs @ 7.29 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.09 cfs @ 1.64 fps)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Stormwater Runoff to Runoff Area=310,012 sf 26.15% Impervious Runoff Depth>3.14"
Flow Length=848' Tc=20.2 min CN=80 Runoff=17.70 cfs 1.864 af

Subcatchment E-1A: to wetlands via Mass Runoff Area=5,430 sf 34.44% Impervious Runoff Depth>3.74"
Tc=6.0 min CN=86 Runoff=0.54 cfs 0.039 af

Subcatchment E-2: Offsite to South Abutter Runoff Area=81,486 sf 16.40% Impervious Runoff Depth>2.87"
Tc=6.0 min CN=77 Runoff=6.31 cfs 0.448 af

Subcatchment P-1A: Developed Site Runoff Area=65,255 sf 65.10% Impervious Runoff Depth>4.06"
Flow Length=673' Tc=6.1 min CN=89 Runoff=6.88 cfs 0.506 af

Subcatchment P-1B: CVS Building Runoff Area=13,602 sf 100.00% Impervious Runoff Depth>5.06"
Tc=6.0 min CN=98 Runoff=1.62 cfs 0.132 af

Subcatchment P-1C: Undeveloped Site Runoff Area=232,975 sf 24.32% Impervious Runoff Depth>3.05"
Flow Length=887' Tc=14.5 min CN=79 Runoff=14.73 cfs 1.361 af

Subcatchment P-2: Offsite to South Abutter Runoff Area=72,164 sf 18.52% Impervious Runoff Depth>2.96"
Tc=6.0 min CN=78 Runoff=5.77 cfs 0.409 af

Subcatchment P1-D: to wetlands via Mass Runoff Area=12,845 sf 46.43% Impervious Runoff Depth>3.64"
Tc=6.0 min CN=85 Runoff=1.24 cfs 0.090 af

Reach DPE1: TO WETLANDS Inflow=17.94 cfs 1.903 af
Outflow=17.94 cfs 1.903 af

Reach DPE2: OFFSITE Inflow=6.31 cfs 0.448 af
Outflow=6.31 cfs 0.448 af

Reach DPP1: TO WETLANDS Inflow=16.54 cfs 2.077 af
Outflow=16.54 cfs 2.077 af

Reach DPP2: OFFSITE Inflow=5.77 cfs 0.409 af
Outflow=5.77 cfs 0.409 af

Pond UG: Underground Detention System Peak Elev=184.71' Storage=10,928 cf Inflow=8.49 cfs 0.638 af
Outflow=1.69 cfs 0.626 af

Total Runoff Area = 18.222 ac Runoff Volume = 4.849 af Average Runoff Depth = 3.19"
71.23% Pervious = 12.980 ac 28.77% Impervious = 5.243 ac

Summary for Subcatchment E-1: Stormwater Runoff to Wetlands

Runoff = 17.70 cfs @ 12.28 hrs, Volume= 1.864 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
81,067	98	Paved parking & roofs
57,707	74	>75% Grass cover, Good, HSG C
171,238	73	Woods, Fair, HSG C
310,012	80	Weighted Average
228,945		73.85% Pervious Area
81,067		26.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0400	0.05		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.10"
2.4	538	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.6	160	0.0750	4.41		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
20.2	848	Total			

Summary for Subcatchment E-1A: to wetlands via Mass Ave drainage

Runoff = 0.54 cfs @ 12.09 hrs, Volume= 0.039 af, Depth> 3.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
1,870	98	Paved parking & roofs
3,560	79	50-75% Grass cover, Fair, HSG C
5,430	86	Weighted Average
3,560		65.56% Pervious Area
1,870		34.44% Impervious Area

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

Summary for Subcatchment E-2: Offsite to South Abutter

Runoff = 6.31 cfs @ 12.09 hrs, Volume= 0.448 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,854	74	>75% Grass cover, Good, HSG C
60,266	73	Woods, Fair, HSG C
81,486	77	Weighted Average
68,120		83.60% Pervious Area
13,366		16.40% Impervious Area

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

Summary for Subcatchment P-1A: Developed Site

Runoff = 6.88 cfs @ 12.09 hrs, Volume= 0.506 af, Depth> 4.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
42,483	98	Paved parking & roofs
9,005	74	>75% Grass cover, Good, HSG C
13,767	71	Meadow, non-grazed, HSG C
65,255	89	Weighted Average
22,772		34.90% Pervious Area
42,483		65.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.5000	0.24		**Sheet Flow, A1 - B1**
					Grass: Bermuda n= 0.410 P2= 3.10"
1.3	344	0.0700	4.26		**Shallow Concentrated Flow, B1 -C1**
					Unpaved Kv= 16.1 fps
0.8	182	0.0380	3.96		**Shallow Concentrated Flow, C1 - D1**
					Paved Kv= 20.3 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, E1 -F1**
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
6.1	673	Total			

Summary for Subcatchment P-1B: CVS Building

Runoff = 1.62 cfs @ 12.08 hrs, Volume= 0.132 af, Depth> 5.06"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
13,602	98	Paved parking & roofs
13,602		100.00% Impervious Area

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

Summary for Subcatchment P-1C: Undeveloped Site

Runoff = 14.73 cfs @ 12.20 hrs, Volume= 1.361 af, Depth> 3.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
56,652	98	Paved parking & roofs
36,205	74	>75% Grass cover, Good, HSG C
86,491	73	Woods, Fair, HSG C
53,627	71	Meadow, non-grazed, HSG C
232,975	79	Weighted Average
176,323		75.68% Pervious Area
56,652		24.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	180	0.0360	3.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	50	0.5000	11.38		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
3.3	452	0.0200	2.28		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
0.6	155	0.0770	4.47		**Shallow Concentrated Flow, E- F** Unpaved Kv= 16.1 fps
14.5	887	Total			

Summary for Subcatchment P-2: Offsite to South Abutter

Runoff = 5.77 cfs @ 12.09 hrs, Volume= 0.409 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,901	74	>75% Grass cover, Good, HSG C
50,897	73	Woods, Fair, HSG C
72,164	78	Weighted Average
58,798		81.48% Pervious Area
13,366		18.52% Impervious Area

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

Summary for Subcatchment P1-D: to wetlands via Mass Ave drainage

Runoff = 1.24 cfs @ 12.09 hrs, Volume= 0.090 af, Depth> 3.64"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-yr Rainfall=5.30"

Area (sf)	CN	Description
5,964	98	Paved parking & roofs
6,881	74	>75% Grass cover, Good, HSG C
12,845	85	Weighted Average
6,881		53.57% Pervious Area
5,964		46.43% Impervious Area

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

Summary for Reach DPE1: TO WETLANDS

Inflow Area = 7.242 ac, 26.29% Impervious, Inflow Depth > 3.15" for 25-yr event
Inflow = 17.94 cfs @ 12.28 hrs, Volume= 1.903 af
Outflow = 17.94 cfs @ 12.28 hrs, Volume= 1.903 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPE2: OFFSITE

Inflow Area = 1.871 ac, 16.40% Impervious, Inflow Depth > 2.87" for 25-yr event
Inflow = 6.31 cfs @ 12.09 hrs, Volume= 0.448 af
Outflow = 6.31 cfs @ 12.09 hrs, Volume= 0.448 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP1: TO WETLANDS

Inflow Area = 7.454 ac, 36.56% Impervious, Inflow Depth > 3.34" for 25-yr event
Inflow = 16.54 cfs @ 12.20 hrs, Volume= 2.077 af
Outflow = 16.54 cfs @ 12.20 hrs, Volume= 2.077 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP2: OFFSITE

Inflow Area = 1.657 ac, 18.52% Impervious, Inflow Depth > 2.96" for 25-yr event
Inflow = 5.77 cfs @ 12.09 hrs, Volume= 0.409 af
Outflow = 5.77 cfs @ 12.09 hrs, Volume= 0.409 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond UG: Underground Detention System

Inflow Area = 1.810 ac, 71.12% Impervious, Inflow Depth > 4.23" for 25-yr event
Inflow = 8.49 cfs @ 12.09 hrs, Volume= 0.638 af
Outflow = 1.69 cfs @ 12.52 hrs, Volume= 0.626 af, Atten= 80%, Lag= 25.9 min
Primary = 1.69 cfs @ 12.52 hrs, Volume= 0.626 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 184.71' @ 12.52 hrs Surf.Area= 6,300 sf Storage= 10,928 cf
Flood Elev= 186.00' Surf.Area= 6,300 sf Storage= 13,909 cf

Plug-Flow detention time= 104.8 min calculated for 0.626 af (98% of inflow)
Center-of-Mass det. time= 93.6 min (876.1 - 782.5)

Volume	Invert	Avail.Storage	Storage Description
#1	181.75'	8,176 cf	**42.00'W x 150.00'L x 4.00'H Prismatoid** 25,200 cf Overall - 5,733 cf Embedded = 19,467 cf x 42.0% Voids
#2	182.50'	5,733 cf	**30.0" D x 146.0'L Pipe Storage** x 8 Inside #1
		13,909 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	**12.0" Round Culvert** L= 67.0' CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 181.52' S= 0.0034 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets
#2	Device 1	181.75'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	183.85'	**38.0 deg Sharp-Crested Vee/Trap Weir** C= 2.58

Primary OutFlow Max=1.69 cfs @ 12.52 hrs HW=184.71' (Free Discharge)
- **1=Culvert** (Passes 1.09 cfs of 4.66 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.09 cfs @ 7.98 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Weir Controls 0.60 cfs @ 2.39 fps)

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment E-1: Stormwater Runoff to Runoff Area=310,012 sf 26.15% Impervious Runoff Depth>4.22"
Flow Length=848' Tc=20.2 min CN=80 Runoff=23.66 cfs 2.502 af

Subcatchment E-1A: to wetlands via Mass Runoff Area=5,430 sf 34.44% Impervious Runoff Depth>4.88"
Tc=6.0 min CN=86 Runoff=0.69 cfs 0.051 af

Subcatchment E-2: Offsite to South Abutter Runoff Area=81,486 sf 16.40% Impervious Runoff Depth>3.91"
Tc=6.0 min CN=77 Runoff=8.58 cfs 0.610 af

Subcatchment P-1A: Developed Site Runoff Area=65,255 sf 65.10% Impervious Runoff Depth>5.22"
Flow Length=673' Tc=6.1 min CN=89 Runoff=8.72 cfs 0.651 af

Subcatchment P-1B: CVS Building Runoff Area=13,602 sf 100.00% Impervious Runoff Depth>6.26"
Tc=6.0 min CN=98 Runoff=1.99 cfs 0.163 af

Subcatchment P-1C: Undeveloped Site Runoff Area=232,975 sf 24.32% Impervious Runoff Depth>4.12"
Flow Length=887' Tc=14.5 min CN=79 Runoff=19.81 cfs 1.835 af

Subcatchment P-2: Offsite to South Abutter Runoff Area=72,164 sf 18.52% Impervious Runoff Depth>4.02"
Tc=6.0 min CN=78 Runoff=7.79 cfs 0.555 af

Subcatchment P1-D: to wetlands via Mass Runoff Area=12,845 sf 46.43% Impervious Runoff Depth>4.77"
Tc=6.0 min CN=85 Runoff=1.61 cfs 0.117 af

Reach DPE1: TO WETLANDS Inflow=23.96 cfs 2.553 af
Outflow=23.96 cfs 2.553 af

Reach DPE2: OFFSITE Inflow=8.58 cfs 0.610 af
Outflow=8.58 cfs 0.610 af

Reach DPP1: TO WETLANDS Inflow=22.97 cfs 2.754 af
Outflow=22.97 cfs 2.754 af

Reach DPP2: OFFSITE Inflow=7.79 cfs 0.555 af
Outflow=7.79 cfs 0.555 af

Pond UG: Underground Detention System Peak Elev=185.30' Storage=12,718 cf Inflow=10.71 cfs 0.814 af
Outflow=3.45 cfs 0.801 af

Total Runoff Area = 18.222 ac Runoff Volume = 6.485 af Average Runoff Depth = 4.27"
71.23% Pervious = 12.980 ac 28.77% Impervious = 5.243 ac

Summary for Subcatchment E-1: Stormwater Runoff to Wetlands

Runoff = 23.66 cfs @ 12.28 hrs, Volume= 2.502 af, Depth> 4.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
81,067	98	Paved parking & roofs
57,707	74	>75% Grass cover, Good, HSG C
171,238	73	Woods, Fair, HSG C
310,012	80	Weighted Average
228,945		73.85% Pervious Area
81,067		26.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0400	0.05		**Sheet Flow, A-B** Woods: Dense underbrush n= 0.800 P2= 3.10"
2.4	538	0.0560	3.81		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.7	100	0.0200	2.28		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
0.6	160	0.0750	4.41		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
20.2	848	Total			

Summary for Subcatchment E-1A: to wetlands via Mass Ave drainage

Runoff = 0.69 cfs @ 12.09 hrs, Volume= 0.051 af, Depth> 4.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
1,870	98	Paved parking & roofs
3,560	79	50-75% Grass cover, Fair, HSG C
5,430	86	Weighted Average
3,560		65.56% Pervious Area
1,870		34.44% Impervious Area

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

Summary for Subcatchment E-2: Offsite to South Abutter

Runoff = 8.58 cfs @ 12.09 hrs, Volume= 0.610 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,854	74	>75% Grass cover, Good, HSG C
60,266	73	Woods, Fair, HSG C
81,486	77	Weighted Average
68,120		83.60% Pervious Area
13,366		16.40% Impervious Area

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

Summary for Subcatchment P-1A: Developed Site

Runoff = 8.72 cfs @ 12.09 hrs, Volume= 0.651 af, Depth> 5.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
42,483	98	Paved parking & roofs
9,005	74	>75% Grass cover, Good, HSG C
13,767	71	Meadow, non-grazed, HSG C
65,255	89	Weighted Average
22,772		34.90% Pervious Area
42,483		65.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	50	0.5000	0.24		**Sheet Flow, A1 - B1**
					Grass: Bermuda n= 0.410 P2= 3.10"
1.3	344	0.0700	4.26		**Shallow Concentrated Flow, B1 -C1**
					Unpaved Kv= 16.1 fps
0.8	182	0.0380	3.96		**Shallow Concentrated Flow, C1 - D1**
					Paved Kv= 20.3 fps
0.5	97	0.0050	3.21	2.52	**Pipe Channel, E1 -F1**
					12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.013
6.1	673	Total			

Summary for Subcatchment P-1B: CVS Building

Runoff = 1.99 cfs @ 12.08 hrs, Volume= 0.163 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
13,602	98	Paved parking & roofs
13,602		100.00% Impervious Area

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

Summary for Subcatchment P-1C: Undeveloped Site

Runoff = 19.81 cfs @ 12.20 hrs, Volume= 1.835 af, Depth> 4.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
56,652	98	Paved parking & roofs
36,205	74	>75% Grass cover, Good, HSG C
86,491	73	Woods, Fair, HSG C
53,627	71	Meadow, non-grazed, HSG C
232,975	79	Weighted Average
176,323		75.68% Pervious Area
56,652		24.32% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.5	50	0.0400	0.09		**Sheet Flow, A-B** Woods: Light underbrush n= 0.400 P2= 3.10"
1.0	180	0.0360	3.05		**Shallow Concentrated Flow, B-C** Unpaved Kv= 16.1 fps
0.1	50	0.5000	11.38		**Shallow Concentrated Flow, C-D** Unpaved Kv= 16.1 fps
3.3	452	0.0200	2.28		**Shallow Concentrated Flow, D-E** Unpaved Kv= 16.1 fps
0.6	155	0.0770	4.47		**Shallow Concentrated Flow, E- F** Unpaved Kv= 16.1 fps
14.5	887	Total			

Summary for Subcatchment P-2: Offsite to South Abutter

Runoff = 7.79 cfs @ 12.09 hrs, Volume= 0.555 af, Depth> 4.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
13,366	98	Paved parking & roofs
7,901	74	>75% Grass cover, Good, HSG C
50,897	73	Woods, Fair, HSG C
72,164	78	Weighted Average
58,798		81.48% Pervious Area
13,366		18.52% Impervious Area

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

Summary for Subcatchment P1-D: to wetlands via Mass Ave drainage

Runoff = 1.61 cfs @ 12.09 hrs, Volume= 0.117 af, Depth> 4.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=6.50"

Area (sf)	CN	Description
5,964	98	Paved parking & roofs
6,881	74	>75% Grass cover, Good, HSG C
12,845	85	Weighted Average
6,881		53.57% Pervious Area
5,964		46.43% Impervious Area

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

Summary for Reach DPE1: TO WETLANDS

Inflow Area = 7.242 ac, 26.29% Impervious, Inflow Depth > 4.23" for 100-yr event
Inflow = 23.96 cfs @ 12.28 hrs, Volume= 2.553 af
Outflow = 23.96 cfs @ 12.28 hrs, Volume= 2.553 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPE2: OFFSITE

Inflow Area = 1.871 ac, 16.40% Impervious, Inflow Depth > 3.91" for 100-yr event
Inflow = 8.58 cfs @ 12.09 hrs, Volume= 0.610 af
Outflow = 8.58 cfs @ 12.09 hrs, Volume= 0.610 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP1: TO WETLANDS

Inflow Area = 7.454 ac, 36.56% Impervious, Inflow Depth > 4.43" for 100-yr event
Inflow = 22.97 cfs @ 12.20 hrs, Volume= 2.754 af
Outflow = 22.97 cfs @ 12.20 hrs, Volume= 2.754 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach DPP2: OFFSITE

Inflow Area = 1.657 ac, 18.52% Impervious, Inflow Depth > 4.02" for 100-yr event
Inflow = 7.79 cfs @ 12.09 hrs, Volume= 0.555 af
Outflow = 7.79 cfs @ 12.09 hrs, Volume= 0.555 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond UG: Underground Detention System

Inflow Area = 1.810 ac, 71.12% Impervious, Inflow Depth > 5.40" for 100-yr event
Inflow = 10.71 cfs @ 12.09 hrs, Volume= 0.814 af
Outflow = 3.45 cfs @ 12.38 hrs, Volume= 0.801 af, Atten= 68%, Lag= 17.9 min
Primary = 3.45 cfs @ 12.38 hrs, Volume= 0.801 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 185.30' @ 12.38 hrs Surf.Area= 6,300 sf Storage= 12,718 cf
Flood Elev= 186.00' Surf.Area= 6,300 sf Storage= 13,909 cf

Plug-Flow detention time= 97.1 min calculated for 0.801 af (98% of inflow)
Center-of-Mass det. time= 87.2 min (863.9 - 776.7)

Volume	Invert	Avail.Storage	Storage Description
#1	181.75'	8,176 cf	**42.00'W x 150.00'L x 4.00'H Prismatoid** 25,200 cf Overall - 5,733 cf Embedded = 19,467 cf x 42.0% Voids
#2	182.50'	5,733 cf	**30.0" D x 146.0'L Pipe Storage** x 8 Inside #1
		13,909 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	181.75'	**12.0" Round Culvert** L= 67.0' CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 181.52' S= 0.0034 '/' Cc= 0.900 n= 0.013 Concrete sewer w/manholes & inlets
#2	Device 1	181.75'	**5.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	183.85'	**38.0 deg Sharp-Crested Vee/Trap Weir** C= 2.58

Primary OutFlow Max=3.45 cfs @ 12.38 hrs HW=185.30' (Free Discharge)
- **1=Culvert** (Passes 1.20 cfs of 5.21 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 1.20 cfs @ 8.80 fps)
- **3=Sharp-Crested Vee/Trap Weir** (Weir Controls 2.25 cfs @ 3.11 fps)

APPENDIX 5
OPERATION & MAINTENANCE PLAN

LONG TERM STORMWATER SYSTEM OPERATION AND MAINTENANCE PLAN

The Stormwater Management Standards

Standard 9: A Long –Term Operation and Maintenance (O&M) Plan shall be developed and implemented to ensure that stormwater management systems function as designed.

The Long-term Operation and Maintenance Plan shall at a minimum identify:

1. Stormwater management system(s) owners;
2. The party or parties responsible for operation and maintenance, including how future property owners will be notified of the presence of the stormwater management system and the requirement for proper operation and maintenance;
3. The routine and non-routine maintenance tasks to be undertaken after construction is complete and a schedule for implementing those tasks;
4. Plan that is drawn to scale and shows the location of all stormwater BMPs in each treatment train along with the discharge point;
5. Description and delineation of public safety features; and
6. Estimated operations and maintenance budget.

The Operation and Maintenance Plan shall identify best management practices for implementing maintenance activities in a manner that minimizes impacts to wetland resource areas.

The Proposal is for a private development.

Stormwater Management System

Property Owner:
Lot 118-2 -N/F Parker Lane Investment Trust
Lot 128 -N/F Mustard Seed Properties, LLC

Lessee: CVS (during lease term)

General Contractor: TBD

The General Contractor shall have all logs and reports as stated within the Stormwater Pollution Prevention Plan readily available at all times for inspection by the Town of Acton.

Method of recording for future Owners

- ☐ Deed
- ☐ Order of Conditions
- ☐ Other: _____

DRAINAGE SYSTEM

The following components shall be inspected:

- Inspection during or immediately following initial installation of sediment controls.
- Inspection following severe rainstorms to check for damage to controls.
- Inspection prior to seeding deadlines, particularly in the fall.
- Final inspection of projects nearing completion to ensure that temporary controls have been removed, stabilization is complete, drainage ways are in proper condition, and the final contours agree with the proposed contours on the approved plan.

Storm Events
2 year storm= 3.1 inches
10 year storm=4.5 inches
25 year storm=5.3 inches
100 year storm=6.5 inches

After the occurrence of any of the storm events noted above, or any other heavy rainfall that may have affected stormwater management facilities, the designated inspector shall inspect the components listed below for evidence of scouring or erosion, excessive sediment deposits, clogging of stormwater structures, or any other condition that may adversely affect stormwater management operations. The storage of snow, fertilizer, or pesticides shall be prohibited within the 100 foot wetlands buffer.

If any of these conditions are observed, then appropriate actions should be taken to restore the stormwater management facility so that it operates as intended.

COMPONENT: Underground Detention Basin, Catch Basins

RESPONSIBILITY:
During Construction: General Contractor - TBD
Post Construction: CVS (for duration of lease term)

ACTION: Inspection / cleaning

FREQUENCY: Once per six months or when 6" or more of sediment accumulation is observed.

DESCRIPTION: The underground detention basin and catch basins shall be inspected bi-yearly to ensure that they are operating as intended and that all components are stable and in working order. Inspections shall be by qualified personnel assigned by the owner. Sediment collecting in the bottom of the structure shall be inspected twice a year, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin / inlets. Sediments removed shall be disposed of in accordance with the latest DEP guidelines for stormwater sediment disposal.
Inspections:

- Inlet and Outlet condition
- Sediment Accumulation
- Oil/Gas Sheen in water
- Condition of outlet pipe
- General Inspection of basin

BUDGET: Inspection/cleaning- $1,000/ yr based on inspections and cleaning twice a year or as necessary.

COMPONENT: Stormwater Quality Unit (Stormceptor)

RESPONSIBILITY:
During Construction: General Contractor - TBD
Post Construction: CVS (for duration of lease term)

ACTION: Inspection / cleaning

FREQUENCY: Per Manufacturer's Maintenance Guidelines or at least once per six months whichever is more restrictive depending on the rate of sediment accumulation.

DESCRIPTION: See attached Manufacturer's Maintenance Guidelines. All accumulated materials shall be disposed of in accordance to DEP regulations.

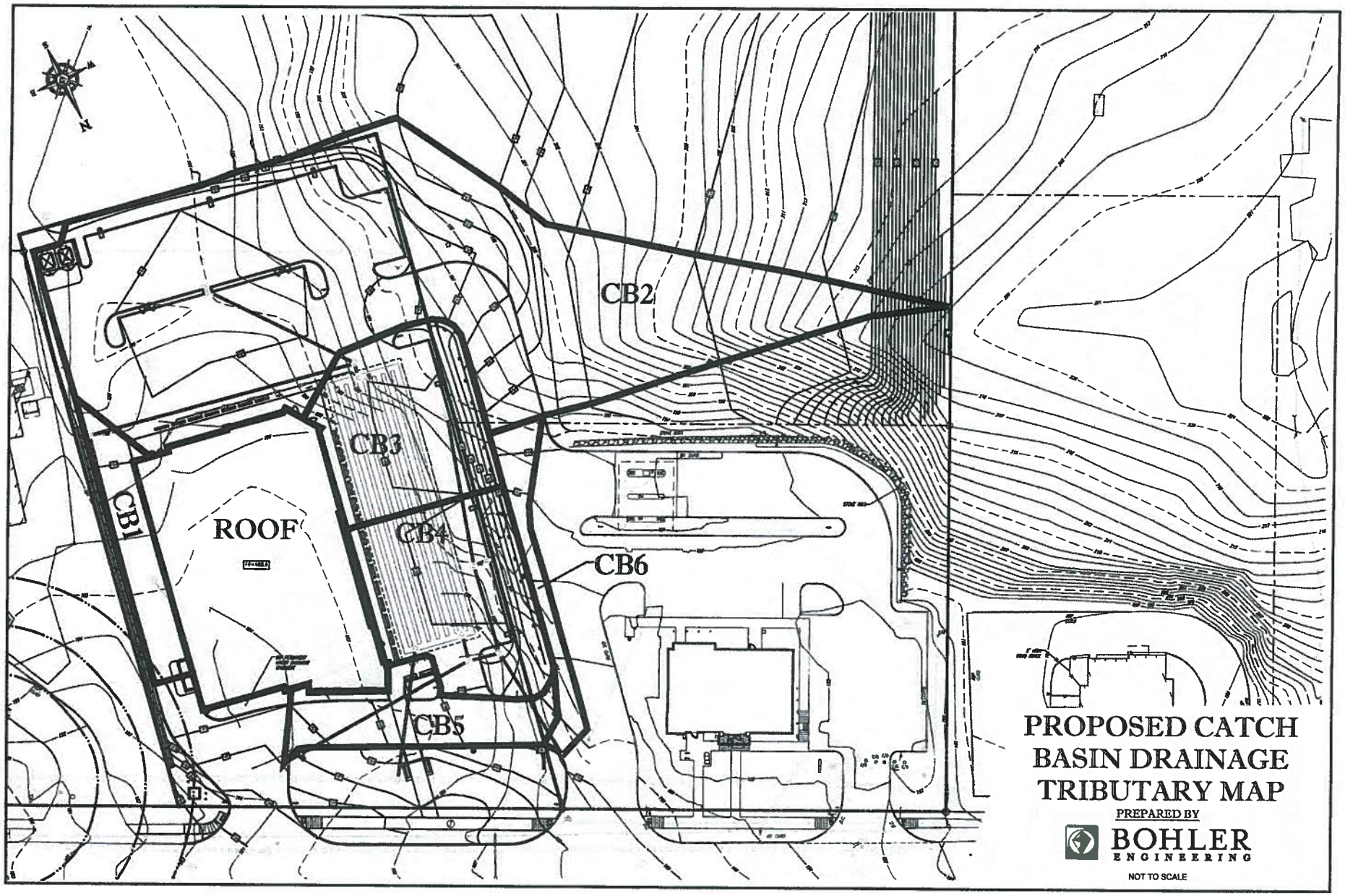
BUDGET: Inspection/cleaning- $1,000/ yr based on inspections and cleanings of twice a year.

SAMPLE BMP INSPECTION & MAINTAINENCE ACTIVITY FORM

NOTE: The owner is responsible for maintaining an accurate and complete log of inspection & maintenance activities.

BMP / Maintenance Activity	Contractor Name	Start Date	End Date	Observation / Maintenance Notes

APPENDIX 6
STORM SEWER CALCULATIONS
& BUOYANCY CALCULATIONS


CB1
CB2
CB3
CB4
CB5
CB6
ROOF
N
PROPOSED CATCH BASIN DRAINAGE TRIBUTARY MAP
PREPARED BY
BOHLER ENGINEERING
NOT TO SCALE

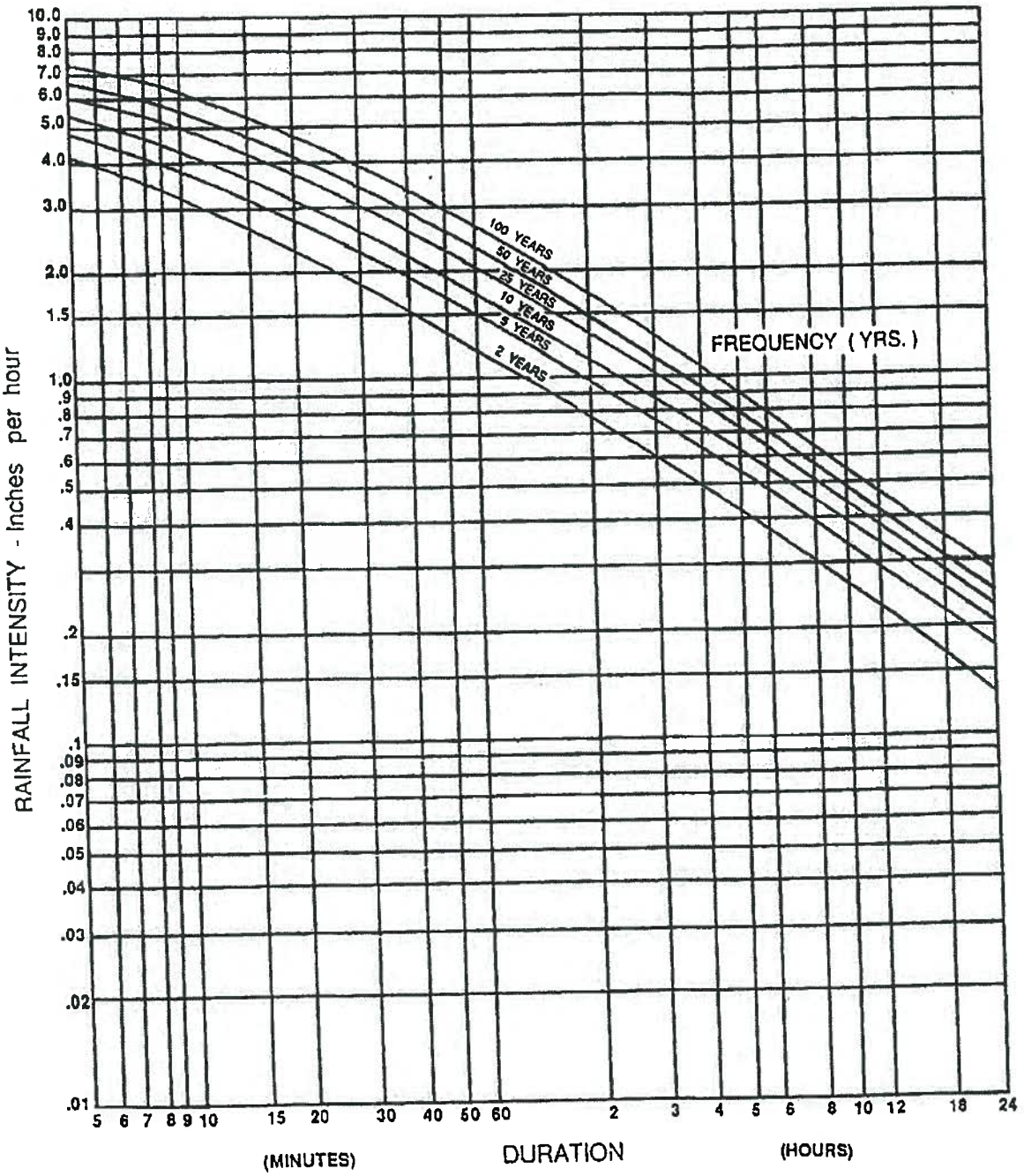


Figure 10-4. Intensity — Duration — Frequency Curve for Boston, MA

DRAINAGE COMPUTATIONS FOR 25-YEAR STORM EVENT

LOCATION		IMPERVIOUS AREA			OTHER			SUM			Q				Q
FROM	TO	A	C	CA	A	C	CA	CA	Tc	I	IxCA	D	S	n	full
		(Ac)			(Ac)				(Min)	in/hr	(cfs)	(in)	(ft/ft)		(cfs)
CB1	SWQ1	0.070	0.9	0.06	0.000	0.3	0.00	0.06	5	6.0	0.38	12	0.005	0.013	2.52
CB2	SWQ1	0.490	0.9	0.44	0.420	0.3	0.13	0.57	5	6.0	3.40	12	0.014	0.013	4.22
SWQ1	UG BASIN	0.560	0.9	0.50	0.420	0.3	0.13	0.63	5	6.0	3.78	12	0.020	0.013	5.04
CB3	DMH C	0.130	0.9	0.12	0.040	0.3	0.01	0.13	5	6.0	0.77	12	0.010	0.013	3.56
CB4	DMH C	0.130	0.9	0.12	0.060	0.3	0.02	0.14	5	6.0	0.81	12	0.020	0.013	5.04
DMH C	DMH D	0.260	0.9	0.23	0.100	0.3	0.03	0.26	5	6.0	1.58	12	0.010	0.013	3.56
CB 6	DMH D	0.050	0.9	0.05	0.000	0.3	0.00	0.05	5	6.0	0.27	12	0.020	0.013	5.04
DMH D	SWQ2	0.310	0.9	0.28	0.100	0.3	0.03	0.31	5	6.0	1.85	12	0.007	0.013	2.98
CB5	SWQ2	0.090	0.9	0.08	0.010	0.3	0.00	0.08	5	6.0	0.50	12	0.005	0.013	2.52
SWQ2	UG BASIN	0.400	0.9	0.36	0.110	0.3	0.03	0.39	5	6.0	2.36	12	0.015	0.013	4.36
ROOF	UG BASIN	0.310	0.9	0.28	0.000	0.3	0.00	0.28	5	6.0	1.67	12	0.005	0.013	2.52

Proposed CVS -400 Massachusetts Ave, Acton, MA

BOUYANCY CALCULATIONS - 150x42' Undergound Detention Basin
5/8/2013

UNDERGROUND DETENTION SYSTEM INFORMATION						
TYPE	LENGTH (ft)	WIDTH (ft)	HEIGHT (ft)	SIDE THICKNESS (ft)	TOP THICKNESS (ft)	BOTTOM THICKNESS (ft.)
HDPE Undeground Basin	150.00	42.00	4.00	2.000	0.500	0.500

BOUYANCY FORCE ON EMPTY SYSTEM			WEIGHT OF DETENTION SYSTEM					
DEPTH OF SYSTEM SUBMERGED (ft)	SUBMERGED SYSTEM VOLUME (cu ft)	WEIGHT OF DISPLACED WATER (lbs)	TOP VOLUME (cu ft)	BOTTOM VOLUME (cu ft.)	ENDS VOLUME (cu ft.)	SIDES VOLUME (cu ft)	TOTAL VOLUME (cu ft)	WEIGHT OF SYSTEM (lbs)
1.3	7875	491400	3150 00	3150 00	456 00	1800 00	8556 00	855600

REQUIRED BALLAST		WEIGHT OF SOIL ABOVE TANK				
BOUYANT FORCE (-) SYSTEM WT (lb)	(x) 1 1 SAFETY FACTOR (lb)	ELEV OF FINISH GRADE OVER SYSTEM (ft)	ELEV OF TOP OF SYSTEM (ft)	DEPTH OF SOIL OVER SYSTEM (ft)	VOLUME OF SOIL (cu ft)	WEIGHT OF SOIL (lbs.)
-364200	-400620	167.00	165.75	1.25	7875 00	787500

ADDITIONAL BALLAST REQUIRED	REQ'D BALLAST (-) WT OF SOIL (lbs.)	-1188120 (NONE REQ'D)

DENSITY OF WATER (lb /cu. ft.) = 62.4
DENSITY OF STONE (lb /cu ft) = 100.0
DENSITY OF THE SOIL (lb /cu ft) = 100.0

APPENDIX 7
TSS REMOVAL CALCULATIONS
& STORMCEPTOR CALCULATIONS

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Acton, MA Treatment Train#1 Through SWQ1

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Stormceptor	0.82	0.75	0.62	0.14
	0.00	0.14	0.00	0.14
	0.00	0.14	0.00	0.14
	0.00	0.14	0.00	0.14

Total TSS Removal = 87%

Project: CVS Acton MA
Prepared By: Bohler Engineering
Date: 6/24/2013

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

Stormceptor®

Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	5/14/2013
Project Name	CVS ACTON 1
Project Number	W121033
Location	ACTON

Designer Information

Company	BOHLER
Contact	N/A

Notes

N/A

Drainage Area

Total Area (ac)	0.98
Imperviousness (%)	57

The Stormceptor System model STC 450i achieves the water quality objective removing 82% TSS for a Fine (organics, silts and sand) particle size distribution.

Rainfall

Name	STERLING 2 NNW
State	MA
ID	8159
Years of Records	1948 to 1972
Latitude	42°27'0"N
Longitude	71°48'0"W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ac-ft)	Discharge (cfs)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 450i	82
STC 900	89
STC 1200	89
STC 1800	89
STC 2400	92
STC 3600	92
STC 4800	94
STC 6000	94
STC 7200	95
STC 11000	97
STC 13000	97
STC 16000	97

Rinker MATERIALS™

Stormceptor®

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Fine (organics, silts and sand)								
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s
20	20	1.3	0.0013					
60	20	1.8	0.0051					
150	20	2.2	0.0354					
400	20	2.65	0.2123					
2000	20	2.65	0.9417					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor.
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in.	1 in.	3 in.
Multiple inlet pipes	3 in.	3 in.	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Rinker Materials 1 (800) 909-7763 www.rinkerstormceptor.com

Rinker MATERIALS™

v

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Version 1, Automated: Mar. 4, 2008

Location: Acton, MA Treatment Train#1 Through SWQ2

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
Stormceptor	0.85	0.75	0.64	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11
	0.00	0.11	0.00	0.11

Total TSS Removal = 89%

Project: CVS Acton MA
Prepared By: Bohler Engineering
Date: 6/24/2013

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Mass. Dept. of Environmental Protection

Stormceptor®

Stormceptor Design Summary

PCSWMM for Stormceptor

Project Information

Date	5/14/2013
Project Name	CVS Acton 2
Project Number	W121033
Location	Acton

Designer Information

Company	Bohler
Contact	N/A

Notes

N/A

Drainage Area

Total Area (ac)	0.51
Imperviousness (%)	78

The Stormceptor System model STC 450i achieves the water quality objective removing 85% TSS for a Fine (organics, silts and sand) particle size distribution.

Rainfall

Name	STERLING 2 NNW
State	MA
ID	8159
Years of Records	1948 to 1972
Latitude	42°27'0"N
Longitude	71°48'0"W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ac-ft)	Discharge (cfs)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 450i	85
STC 900	91
STC 1200	91
STC 1800	91
STC 2400	93
STC 3600	94
STC 4800	95
STC 6000	96
STC 7200	96
STC 11000	98
STC 13000	98
STC 16000	98

Rinker MATERIALS™

Stormceptor®

Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Fine (organics, silts and sand)								
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity ft/s
20	20	1.3	0.0013					
60	20	1.8	0.0051					
150	20	2.2	0.0354					
400	20	2.65	0.2123					
2000	20	2.65	0.9417					

Stormceptor Design Notes

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- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

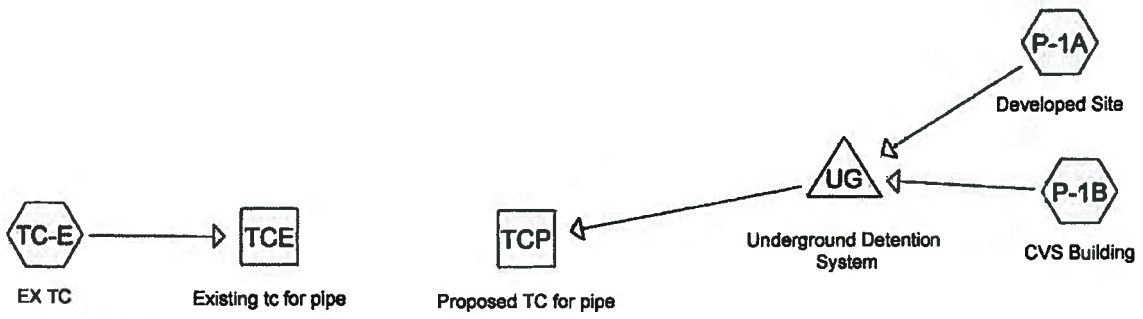
Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in.	1 in.	3 in.
Multiple inlet pipes	3 in.	3 in.	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Rinker Materials 1 (800) 909-7763 www.rinkerstormceptor.com

Rinker MATERIALS™

APPENDIX 8
PEAK RATE TIME OFFSET FOR DISCHARGE TO ACTON DRAINAGE SYSTEM



Drainage Diagram for TRB Acton 6-24-13 TC map
Prepared by Bohler Engineering, Printed 6/24/2013
HydroCAD® 9.00 s/n 02612 © 2009 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.316	71	Meadow, non-grazed, HSG C (P-1A)
0.207	74	>75% Grass cover, Good, HSG C (P-1A)
65.000	77	2 acre lots, 12% imp, HSG C (TC-E)
1.288	98	Paved parking & roofs (P-1A, P-1B)
66.810		**TOTAL AREA**

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Reach TCE: Existing tc for pipe Inflow=54.40 cfs 11.744 af
Outflow=54.40 cfs 11.744 af

Reach TCP: Proposed TC for pipe Inflow=1.09 cfs 0.511 af
Outflow=1.09 cfs 0.511 af

Summary for Reach TCE: Existing tc for pipe

Inflow Area = 65.000 ac, 12.00% Impervious, Inflow Depth > 2.17" for 10-yr event
Inflow = 54.40 cfs @ 13.11 hrs, Volume= 11.744 af
Outflow = 54.40 cfs @ 13.11 hrs, Volume= 11.744 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Reach TCP: Proposed TC for pipe

Inflow Area = 1.810 ac, 71.12% Impervious, Inflow Depth > 3.39" for 10-yr event
Inflow = 1.09 cfs @ 12.57 hrs, Volume= 0.511 af
Outflow = 1.09 cfs @ 12.57 hrs, Volume= 0.511 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

TIME OF CONCENTRATION

A-B SHEET FLOW=69.3 MIN

B-C SHALLOW CONC. FLOW=4.9 MIN.

C-D CHANNEL FLOW=4.4 MIN.

D-E PIPE FLOW= 2.2 MIN.

TOTAL=80.8 MIN.

EXISTING (TCE)

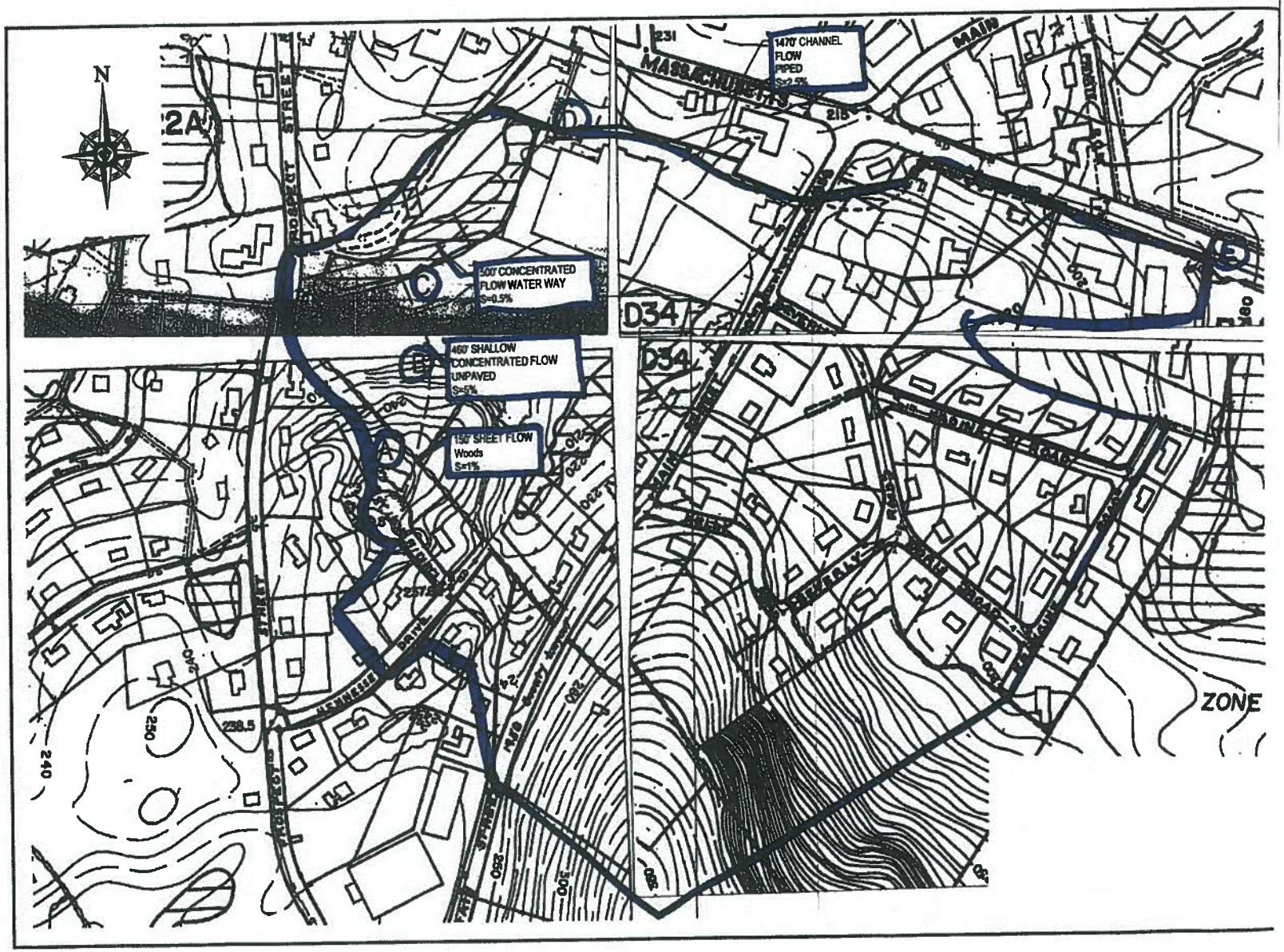
10 YR STORM PEAK TIME=13.11 HRS

PROPOSED (TCP)

10 YR STORM PEAK TIME=12.57 HRS

PEAK TIMES OFFSET BY 0.54 HRS

(32 MINS)



APPENDIX 9
WATER BALANCE CALCULATIONS

Water Balance Calculations

JOB: BVS
LOCATION: 400 Massachusetts Avenue, Acton, MA
BY: KBS

P = DRO + ET + I

P = Mean Annual Precipiation (Attached) = 44" / year
ET = Evapotranspiration Potential (Attached) = 21" / year
DRO = Direct Runoff
I = Infiltration

Existing Condition:
DRO = Direct Runoff - Calculated with Hydrocad Output - 2 yr storm frequency - Acre-feet
1.213 Af

Express DRO as % of total P for Watershed - Total Existing Drainage Area

Total runoff (Af) / {Exist. Drain Area x 2 yr rainfall, 24 hour storm (3.1")} = 1.213 / (10.8 Ac x 3.1 inch / 12)

= 0.44 Therefore 44% of rainfall will become direct runoff in existing condition

DRO = Total rainfall (44") x 43% Total P which becomes runoff
DRO = 19.36 in / yr Therefore 18.9" of direct runoff per year for existing site
ET = 21.0 in / yr Therefore 21" of evapotranspiration per year for existing site
P = 44.0 in / yr Therefore 44" per year of precipitation for existing site

I = P - DRO - ET 3.6 inches infiltrated per year in existing condition

Proposed Condition:
DRO = Direct Runoff - Calculated with Hydrocad Output - 2 yr storm frequency - Acre-feet
1.292 Af

Express DRO as % of total P for Watershed - Total Existing Drainage Area

= Total runoff (Af) / {Exist. Drain Area x 2 yr rainfall, 24 hour storm (3.1")} = 0.925 / (10.8 Ac x 3.1 inch /12)

= 0.33 Therefore 47% of rainfall will become direct runoff in proposed condition

DRO = Total rainfall (44") x 33% Total P which becomes runoff
DRO = 16 in / yr
ET = 21.0 in / yr Therefore 21" of evapotranspiration per year for proposed site
P = 44.0 in / yr Therefore 44" per year of precipitation for proposed site

I = P - DRO - ET 7.5 inches infiltrated per year in proposed condition

Greater Infiltration in Proposed Condition due to :
- Improved landcover
- Runoff collected underground detention basin

U.S. DEPARTMENT OF INTERIOR
U.S. GEOLOGICAL SURVEY

MEAN ANNUAL RUNOFF, PRECIPITATION, AND EVAPOTRANSPIRATION IN THE GLACIATED NORTHEASTERN UNITED STATES, 1951-80

by Allan D. Randall

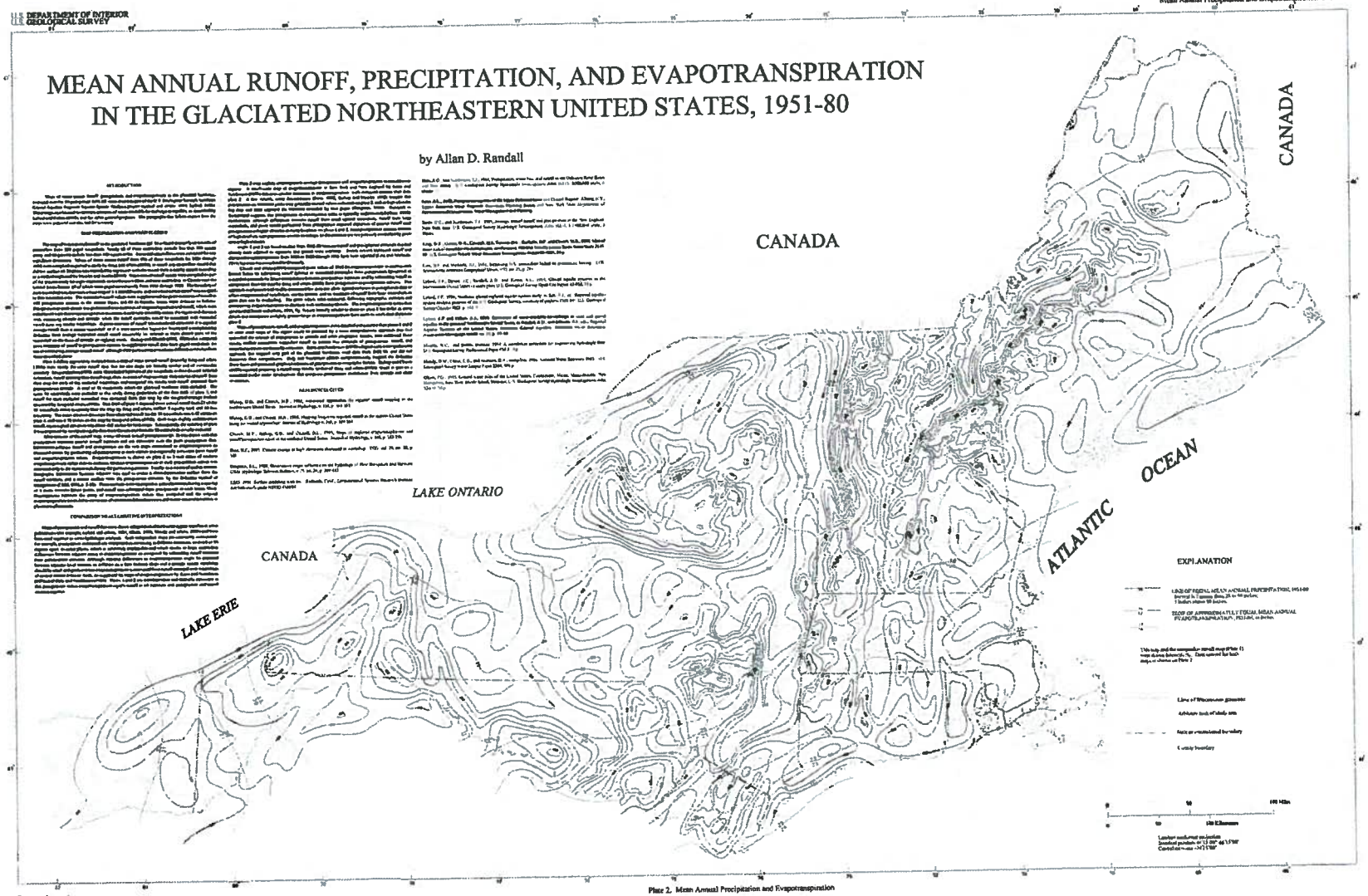
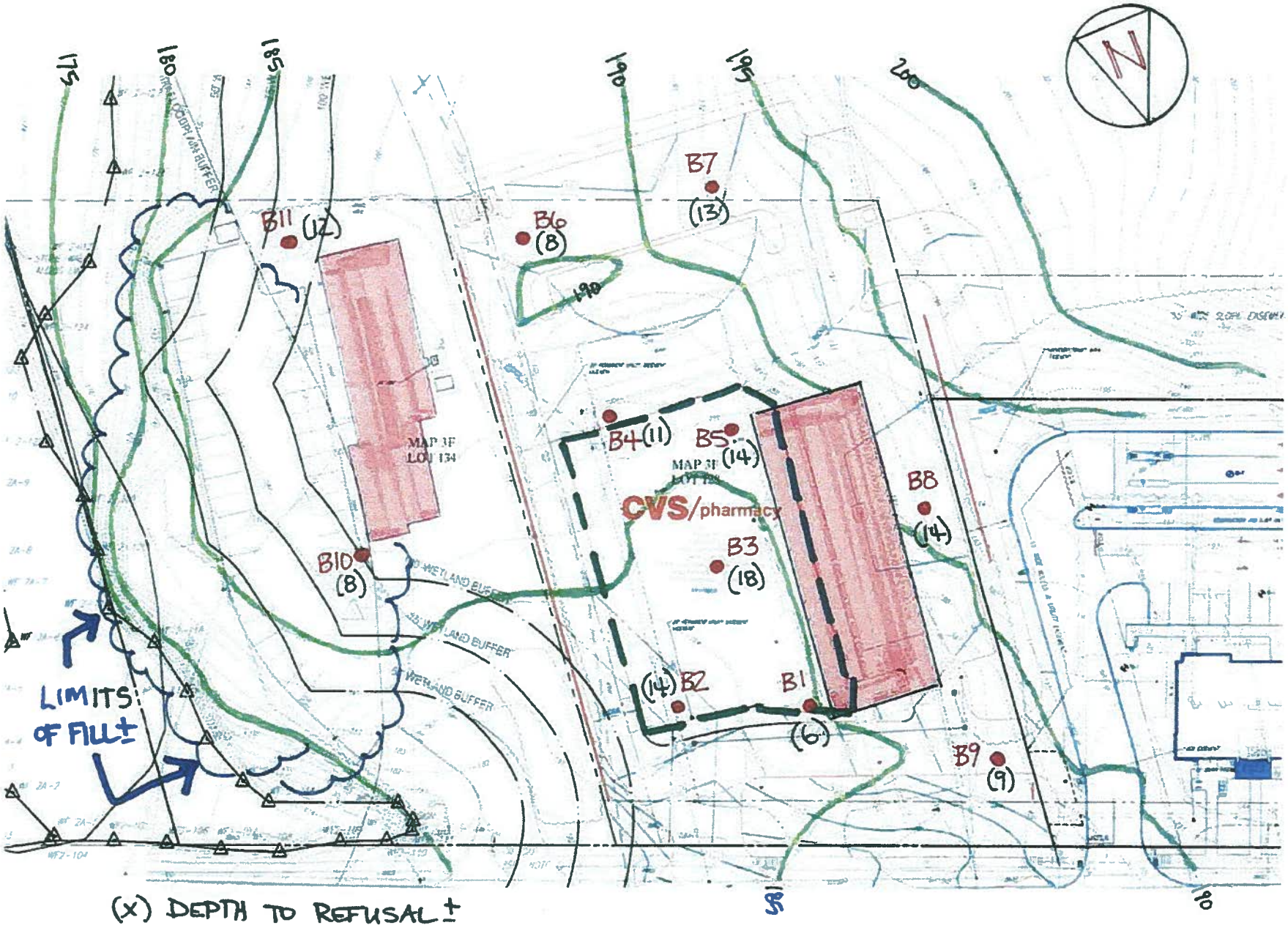


Plate 2. Mean Annual Precipitation and Evapotranspiration

APPENDIX 10
GEOTECHNICAL SUMMARY


N
175
180
185
190
195
200
B11 (12)
B6 (8)
B7 (13)
B4 (11)
B5 (14)
B8 (14)
B3 (18)
B10 (8)
(14) B2
B1 (6)
B9 (9)
CVS/pharmacy
MAP 3F LOT 134
WETLAND BUFFER
LIMITS OF FILL±
(X) DEPTH TO REFUSAL±

TEST BORING LOG

SHEET 1

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-1/1a PROJECT NO. 13-0326 DATE: March 25, 2013

Ground Elevation: 185 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/31/13	3 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
							Pavement
1		1	7"	0'6"-2'6"	7-6-7-5	2'6"	Brown, fine to medium Sand, little gravel, trace silt (FILL)
		2	6"	2'6"-3'0"	100/6"	4'	Black Organic Silt (TOPSOIL)
5						6'	Brown, silty Sand w/ gravel Refusal at 6 ft – First Attempt Refusal at 7 ft – Second Attempt
10							
15							
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 2

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-2 PROJECT NO. 13-0326 DATE: March 21, 2013

Ground Elevation: 184 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	3 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
							Pavement
		1	7"	0'6"-2'6"	10-7-6-6		Black, Sand & Gravel, trace silt (FILL)
1						2'	
		2	6"	2'6"-3'6"	7-9		Black Organic Silt, wet (TOPSOIL)
		2A	2"	3'6"-4'0"	100/6"	3'6"	
5		3	10"	5'0"-7'0"	22-27-47-51		Brown, fine to medium Sand & Gravel, little silt, cobbles Grey-Brown, fine to medium Sand & Gravel, some silt, cobbles, wet
						7'	
		4	10"	7'0"-9'0"	12-7-9-7		Grey, Fine Sand w/ Silt, wet
10		5	20"	10'0"-12'0"	8-8-9-9		Grey, Fine Sand w/ Silt, wet
						14'	
15							Refusal at 14 ft
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 3

Soil Exploration Corp.
Geotechnical Drilling
Groundwater Monitor Well
148 Pioneer Drive
Leominster, MA 01453
978 840-0391

Kelly Corner
Site: 400 Mass Avenue
Acton, MA

BORING B-3

PROJECT NO. 13-0326

DATE: March 21, 2013

Ground Elevation: 185 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	2 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						4"	Pavement
1		1	6"	0'6"-2'6"	10-6-18-4	2'	Dark Brown, loamy-organic silty Sand, little gravel (FILL)
		2	4"	2'6"-4'6"	5-7-10-10	5'	Grey-Brown, loamy silty Sand, trace roots, wet (SUBSOIL)
5		3	8"	5'0"-7'0"	6-6-10-10		Brown, fine to medium Sand, little gravel, little silt, wet
		4	5"	7'0"-9'0"	30-27-20-17		Brown, fine to medium Sand, little gravel, little silt (GLACIAL) w/ cobbles, boulders, wet
10		5	0"	10'0"-10'3"	100/3"		No recovery - Boulders
15		6	6"	15'0"-15'10"	35-100/4"		Brown-Grey, fine to medium Sand, some silt, some gravel, cobbles, wet
						18'	
20							Refusal at 18 ft
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose, 10 -30 M Dense, 30 -50 Dense, 50+ V
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M 8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.

Trace	0 to 10%
Little	10 to 20%
Some	20 to 35%
And	35% to 50%

	CASING	SAMPLE	CORE TYPE
ID SIZE (IN)		SS	
HAMMER WGT (LB)		140 lb.	
HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 4

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-4/4a PROJECT NO. 13-0326 DATE: March 21, 2013

Ground Elevation: 187 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	2 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
							Pavement
1		1	6"	0'6"-2'6"	8-12-11-8	2'6"	Brown- Dark Brown, fine to medium Sand, little gravel, little silt, dry (FILL)
		2	7"	2'6"-4'0"	14-27-100		Brown, fine to medium Sand, some silt, little gravel, cobbles, boulders
5		3	0"	5'0"-5'1"	100/1"		Boulder obstruction (GLACIAL) Occasional cobbles, boulders
10		4	4"	10'0"-10'4"	100/4"		Grey, fine to medium Sand, some silt, some gravel, cobbles, wet
						11'6"	Refusal at 5'6" – First Attempt Refusal at 11'6" – Second Attempt
15							
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 5

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-5/5a PROJECT NO. 13-0326 DATE: March 21, 2013

Ground Elevation: 186 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	2 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						4"	Pavement
1		1	2"	0'6"-2'6"	10-7-36-20		Brown, fine to medium Sand, some silt, little gravel, wet
		2	10"	2'6"-4'6"	12-27-20-31		Brown, mottled, fine to medium Sand, some silt, little gravel, wet (SANDY TILL)
5		3	8"	5'0"-7'0"	16-15-21-27		Dark Grey, fine to medium Sand & Gravel, some silt, cobbles, wet
		4	3"	7'0"-7'3"	100/3"		Grey, fine to medium Sand, some gravel, some silt, cobbles, boulders, wet
10		5	14"	10'0"-12'0"	9-9-22-27		Brown, fine to coarse Sand & Gravel, little silt, wet
						14'	
15							Refusal at 4'6" - First Attempt Refusal at 14'0" – Second Attempt
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

			CASING	SAMPLE	CORE TYPE
Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%			
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)	SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)	140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)	30"	

TEST BORING LOG

SHEET 6

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-6 PROJECT NO. 13-0326 DATE: March 21, 2013

Ground Elevation: 190 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: RB
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	5 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
						6"	Forest Mat
1		1	12"	0'0"-2'0"	2-4-9-12	2'	Brown silty Sand, trace loam, roots (SUBSOIL)
		2	2"	2'0"-4'0"	14-21-24-27		Brown, fine to medium Sand, little silt, cobbles (GLACIAL)
5		3	12"	5'0"-7'0"	9-9-11-10		Brown fine to medium Sand, little gravel, little silt, wet
						8'	Refusal at 8 ft
10							
15							
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 7

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-7 PROJECT NO. 13-0326 DATE: March 21, 2013

Ground Elevation: 191 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: RB
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	7 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1	8"	0'0"-2'0"	2-2-2-4	3'	Topsoil/Subsoil (ORGANIC)
		2	10"	2'0"-4'0"	5-7-19-26		Brown, fine medium Sand, some silt, little gravel, cobbles
5		3	12"	5'0"-6'3"	24-42-50/3"		Brown, fine medium Sand, some silt, little gravel (GLACIAL) w/ cobbles and boulders
10		4	15"	10'0"-12'0"	21-43-19-30		Brown, fine medium Sand, some silt, little gravel w/ cobbles and boulders, wet
						13'	
15							Refusal at 13 ft
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 8

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-8 PROJECT NO. 13-0326 DATE: March 21, 2013

Ground Elevation: 192 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	7 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1	2"	0'0"-1'2"	2-3-50/2"	2'	Topsoil/Subsoil (ORGANIC)
		2	14"	3'0"-5'0"	15-19-24-18		Olive Brown, fine to medium Sand, some gravel, some silt, cobbles
5		3	16"	5'0"-7'0"	17-27-29-31		Olive Brown, fine to medium Sand, some gravel, some silt, cobbles (SANDY TILL)
10		4	8"	10'0"-11'3"	23-25-50/3"	13'	Olive Brown, fine to medium Sand, some gravel, some silt w/ cobbles, boulders, wet
15		5	3"	15'0"-15'4"	100/4"	15'6"	Weathered Rock Refusal at 15'6"
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 9

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-9 PROJECT NO. 13-0326 DATE: March 25, 2013

Ground Elevation: 187 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: RB
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	3-4 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1	12"	0'-2'0"	2-5-6-5		Organic Silt (TOPSOIL)
		2	0"	2'0"-2'3"	50/3"		Stumps, boulders, organics (ORGANIC)
						4'	
5		3	4"	5'0"-5'6"	15		Brown, Sand & Gravel, little gravel, cobbles, wet (GLACIAL)
		4	11"	5'6"-7'0"	37-44-57		
						6'6"	
10							Weathered Rock
						9'	
							Refusal at 9 ft
15							
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

TEST BORING LOG

SHEET 10

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-10 PROJECT NO. 13-0326 DATE: March 25, 2013

Ground Elevation: 187 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: DL
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	6 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
							Pavement
1		1	3"	6"-2'6"	10-6-5-5		Brown, fine to medium Sand, little gravel, little silt (FILL)
		2	6"	2'6"-4'6"	5-5-5-11		Same (FILL)
5		3	6"	5'0"-7'0"	6-9-10-9		Dark Brown, fine to medium Sand, little silt, little gravel, trace organic (FILL)
		4	3"	7'0"-7'4"	100/4"		
						7'	Rust Brown, silty Sand, little gravel (SUBSOIL)
10						8'	Refusal at 8 ft
15							
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

			CASING	SAMPLE	CORE TYPE
Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%			
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)	SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)	140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)	30"	

TEST BORING LOG

SHEET 11

Soil Exploration Corp. Geotechnical Drilling Groundwater Monitor Well 148 Pioneer Drive Leominster, MA 01453 978 840-0391	**Kelly Corner** **Site: 400 Mass Avenue** **Acton, MA**	BORING B-11 PROJECT NO. 13-0326 DATE: March 25, 2013

Ground Elevation: 187 ft+/-
Date Started: March 21, 2013
Date Finished: March 21, 2013
Driller: RB
Soil Engineer/Geologist: KM

GROUNDWATER OBSERVATIONS

DATE	DEPTH	CASING	STABILIZATION
3/21/13	6 ft	n/a	Upon Completion

Depth Ft.	Casing bl/ft	Sample No.	Pen/Rec	Sample Depth	Blows/6"	Strata	Visual Identification of Soil and / or Rock Sample
1		1	12"	0"-2'0"	3-5-5-6		Brown, fine to medium Sand, little gravel, little silt (FILL)
		2	14"	2'0"-4'0"	7-6-7-9		Same, dry
5		3	14"	5'0"-7'0"	5-6-5-5		Brown, fine to medium Sand, little silt, trace gravel (FILL)
		4	3"	7'0"-7'5"	50/5"	7'	Brown, fine to medium Sand, little gravel, little silt, cobbles, wet
10		5	3"	10'0"-10'10"	26-50/4"		Brown, fine to coarse Sand & Gravel, little silt, cobbles
						12'	Refusal at 12 ft
15							
20							
25							
30							
35							

Notes: Hollow Stem Auger Size - 4-1/4"

Cohesionless: 0 - 4 V. Loose, 4 - 10 Loose,	Trace	0 to 10%		CASING	SAMPLE	CORE TYPE
10 -30 M Dense, 30 -50 Dense, 50+ V	Little	10 to 20%	ID SIZE (IN)		SS	
Cohesive: 0 -2 V Soft, 2 -4 Soft, 4 -8 M	Some	20 to 35%	HAMMER WGT (LB)		140 lb.	
8 -15 Stiff, 15 -30 V. Stiff, 30 + Hard.	And	35% to 50%	HAMMER FALL (IN)		30"	

APPENDIX 11
STORMWATER REPORT CHECKLIST

Massachusetts Stormwater Report 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

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 _____

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.

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: Circle 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.
☐ 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;

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

- 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.

☐ 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.

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.
☐ 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.
☐ 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 (to be completed by contractor)

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

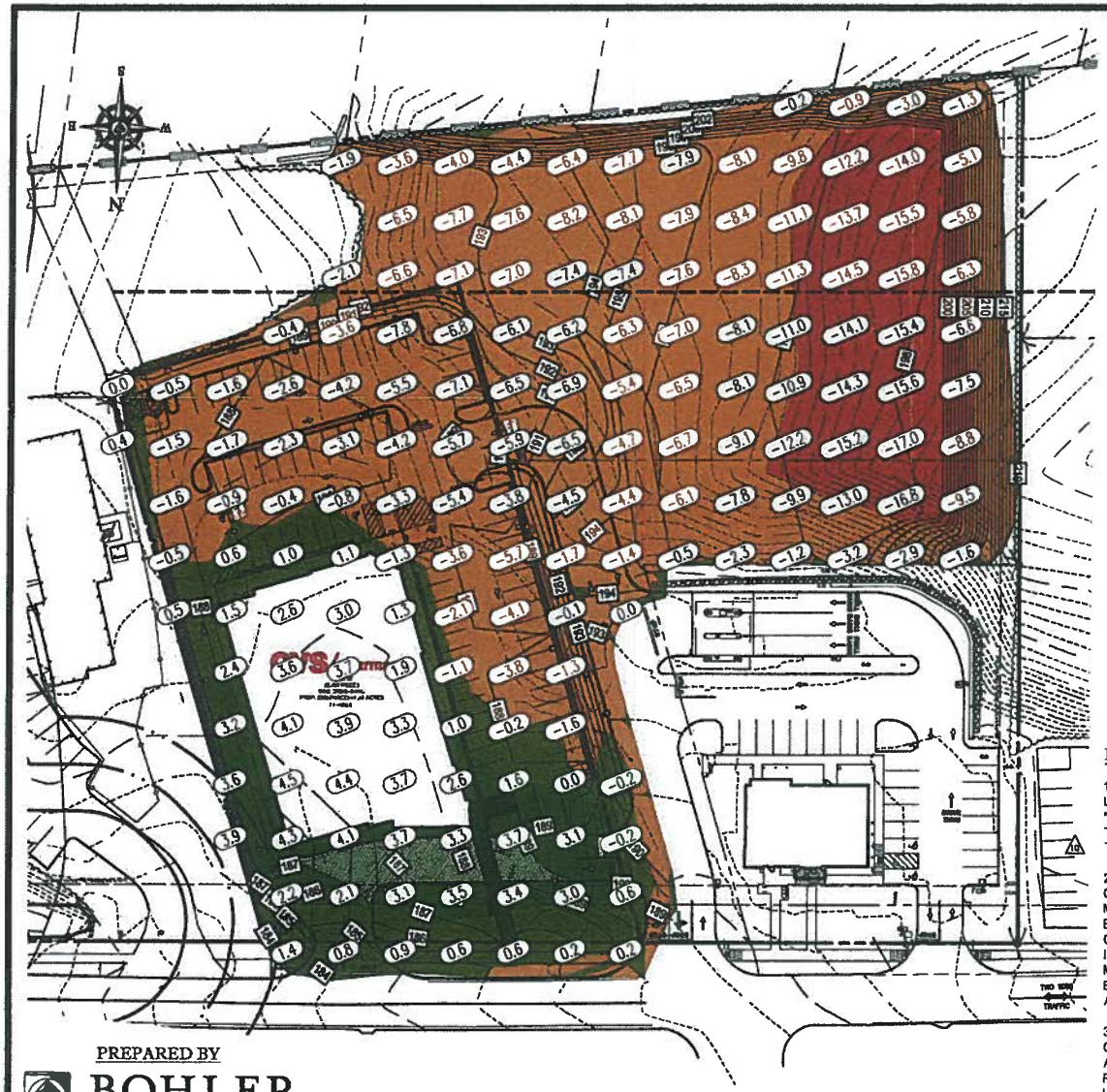
☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;

☐ 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.

APPENDIX 12
EARTHWORK DIAGRAM



Elevations Table			
Number	Minimum Elevation	Maximum Elevation	Color
1	-18.415	-10.000	
2	-10.000	0.000	
3	0.000	2.000	
4	2.000	4.500	

OVERALL EARTHWORK VOLUMES	
TOTAL CUT	24,260 CY ±
TOTAL FILL	3,590 CY ±
NET	20,670 CY (CUT)±
METHOD USED:	COMPOSITE

EARTHWORK SUMMARY NOTES:

1) THE "CUT" AND "FILL" VOLUMES SHOWN HEREIN ARE UNADJUSTED, AND REPRESENT TOTAL, COMPACTED "IN PLACE" EARTHWORK VOLUMES REQUIRED TO MEET THE PROPOSED FINISHED SITE GRADES SHOWN ON THE GRADING PLAN, RELATIVE TO EXISTING GRADES.

2) THE TERMS "CUT" AND "FILL" SHOULD NOT BE CONFUSED WITH "EXPORT" AND "IMPORT", SINCE SOME MATERIALS, SUCH AS PAVEMENT, CONCRETE, GRAVEL BASE, CRUSHED STONE AND OTHER SPECIALITY ITEMS CANNOT BE OBTAINED ONSITE, AND WILL NEED TO BE IMPORTED, AND OTHER ITEMS (DEMOLITION MATERIALS, EXCESS TOPSOIL, ETC) WILL NEED TO BE EXPORTED, THEREBY OFFSETTING THE TOTAL "CUT" AND "FILL" QUANTITIES NOTED.

3) THIS DIAGRAM IS INTENDED TO GIVE A SUMMARY OF OVERALL EARTHWORK VOLUMES. A MORE DETAILED ANALYSIS OF MATERIAL VOLUMES WILL LIKELY BE REQUIRED TO ACCOUNT FOR REMOVAL OF UNSUITABLE MATERIALS, ETC.

Earthwork Volumes Diagram

FOR

CVS/pharmacy

LOCATION OF SITE:

400 MASSACHUSETTS AVENUE (ROUTE #111)
TOWN OF ACTON
MIDDLESEX COUNTY, MASSACHUSETTS

MAP 3F- LOTS 118-2 & 128

60 30 15 0 60

1"= 60'

PREPARED BY

BOHLER ENGINEERING