JOB FILE

Applicant:
Connolly Brothers, Inc.
152 Conant Street
Beverly, MA 01915

Hayes Engineering, Inc

Mitigative Drainage Analysis:
#102 Cherry Hill Drive
Beverly, Massachusetts 01915

COMMONWEALTH OF MASSACHUSETTS
ERIC B. LANE
CIVIL
No. 45469
REGISTERED PROFESSIONAL ENGINEER

3-3-2016

February 23, 2016

MITIGATIVE DRAINAGE ANALYSIS
102 CHERRY HILL DRIVE
BEVERLY, MASSACHUSETTS

February 23, 2016

The following Mitigative Drainage Analysis has been prepared in conjunction with designing the drainage system for the proposed building and parking at 102 Cherry Hill Drive in Beverly, Massachusetts.

PROJECT DESCRIPTION

The scope of the project includes a new 40,000 square-foot office/light manufacturing building with associated parking areas to accommodate 220 vehicles. The parking can be expanded to accommodate up to 260 vehicles in the future. These drainage calculations are based upon the larger 260 space parking configuration. The drainage system has been designed to comply with the relevant section of DEP's Stormwater Management Standards.

PROJECT COMPLIANACE WITH STORMWATER STANDARDS

Standard 1: No New Untreated Discharges

The outlet from the rear of the site is to discharge into a special subsurface dispersion device (see detail on plan), which will prevent any erosion. The drainage from the front of the site is directed into the existing storm drain system in Cherry Hill Drive.

Standard 2: Peak Rate Attenuation

Refer to the attached calculations for peak rate runoff analysis. To comply with the DEP Stormwater Management Policy and local requirements, the 2, 10, 25 and 100-year, Type III, 24-hour storms have been studied.

The subject site is divided into two principal watersheds. The geometry of the watersheds will change from the existing to the proposed condition. This is accomplished by regrading in the area of the new improvements in order to direct all of the runoff from paved areas toward the BMPs.

The runoff computations for this project were all conducted utilizing the HydroCAD Stormwater Modeling System by HydroCAD Software Solutions, LLC. The methodology used is based on TR-55 and TR-20 as developed by the Soil Conservation Service of the USDA.

Runoff curve numbers and concentration times were calculated for each sub-watershed in the existing and proposed condition. A computer model for both conditions was then created using the software program. Schematics of the models are included at the beginning of the respective (existing vs. proposed) sections of this report. Included in the proposed design are catch basins and two Vortsentry hydrodynamic separator treatment units through which the runoff from all of the paved areas will be directed.

A surface detention basin will be constructed on the rear (northeast) corner of the property mitigate the total runoff rate from the site. The outlet from the basin ultimately ties into the wetlands on abutting property.

Runoff from the front (south) portion of the site will discharge to the street drainage.

There are two sets of calculations: the existing and the proposed. Each calculation set includes: 1) summary sheets for each watershed and link; and 2) detailed summary sheets including graphical flood routing for the stormwater management basins for the 2-year design storm. For the 10, 25 and 100-year storms, a summary of each watershed, link, and pond is included.

The results of the calculations indicate that, although there is an increase in peak rate of runoff from the rear of the site, there is a substantial decrease towards the front of the site. Consequently, there is a net decrease in rate of runoff from the total site.

Standard 3: Recharge

The Massachusetts Department of Environmental Protection Stormwater Management Policy also requires projects to be designed such that the annual groundwater recharge after development approximates pre-development recharge. Because of the low permeability of the existing soils, it is not practical to infiltrate the required volume of runoff. The surface basin to the rear of the site should encourage some degree of infiltration.

Standard 4: Water Quality

In order to address the issue of water quality, the drainage system has been designed to conform to the Department of Environmental Protection's Stormwater Management Policy. The system includes deep sump catch basins with gas traps, and a two Vortsentry units.

The DEP has assigned presumed total suspended solids (TSS) removal rates for the deep sump catch basins which are rated to remove 25%. The Vortsentry has been rated by the manufacturer to remove 80%. For the purpose of the TSS calculations, a removal rate of 77% was used.

The surface detention pond does not receive credit for TSS.

Standard 5: Land Use with Higher Potential Pollutant Loads

The project does not include any uses with Higher Potential Pollutant Loads.

Standard 6: Critical Areas

The stormwater system does not discharge into any critical areas.

Standard 7: Redevelopment

The project does not meet the definition of Redevelopment since there is to be an increase in impervious area.

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

The disturbed portions of the site will be enclosed with an acceptable erosion barrier such as silt fence and a silt sock. There will be a crushed stone tracking pad constructed at the entrance that will be utilized during construction and replaced as necessary.

Standard 9: Operation and Maintenance Plan

An Operation and Maintenance Plan is included in this report.

Standard 10: Prohibition of Illicit Discharges

The inspections and maintenance requirements of the Operation and Maintenance Plan will help to prevent illicit discharges.

Runoff Comparison
#102 Cherry Hill Drive
Beverly, MA

Watershed	Storm	Existing Q (C.F.S.)	Proposed Q (C.F.S.)
Front	2 Year	4.96	3.85
	10 Year	9.80	6.83
	25 Year	12.52	8.47
	100 Year	16.32	10.75
Rear	2 Year	2.77	4.63
	10 Year	5.49	8.09
	25 Year	7.01	11.45
	100 Year	9.15	15.79
Total	2 Year	7.73	7.67
	10 Year	15.29	13.40
	25 Year	19.53	18.14
	100 Year	25.47	25.38

2/24/2016

BMP Performance
#102 Cherry Hill Drive
Beverly, MA

Storm	Q in (C.F.S.)	Q out (C.F.S.)	Water Level
2 Year	7.99	4.43	104.04
10 Year	12.32	7.62	104.70
25 Year	14.63	10.73	104.91
100 Year	17.81	14.75	105.10

2/24/2016

25 Year Storm Pipe Flow Calculations
#102 Cherry Hill
Beverly, Massachusetts

Input					Results				
Description	Slope (ft/ft)	Discharge (cfs)	Pipe Dia. (ft)	Manning's Coefficient	Sc (ft/ft)	Velocity (fps)	Vc (fps)	Depth (ft)	Dc (ft)
CB1 to DMH4	0.0197	3.44	1	0.011	0.0070	7.82	5.11	0.55	0.80
CB2 to DMH4	0.0808	5.68	1	0.011	0.0157	15.07	7.37	0.48	0.95
DMH4 to Vort HS48	0.1273	9.12	1.25	0.011	0.0123	20.03	7.66	0.50	1.16
Vort HS48 to DMH3	0.1273	9.12	1.25	0.011	0.0123	20.03	7.66	0.50	1.16
DMH3 to Outlet	0.3703	13.86	1.5	0.011	0.0107	32.63	8.13	0.43	1.38
CB3 to DMH1	0.285	1.9	1	0.011	0.0046	17.45	3.90	0.20	0.60
CB4 to DMH1	0.065	1.39	1	0.011	0.0042	9.44	3.49	0.24	0.51
CB5 to DMH1	0.714	0.96	1	0.011	0.0040	19.67	3.11	0.11	0.42
DMH1 to DMH5	0.049	4.25	1	0.011	0.0092	11.62	5.83	0.47	0.87
CB7 to DMH2	0.012	1.14	1	0.011	0.0040	4.88	3.28	0.34	0.46
CB6 to DMH2	0.032	0.2	1	0.011	0.0029	4.14	1.78	0.11	0.20
DMH2 to DMH5	0.015	1.34	1	0.011	0.0042	5.53	3.45	0.35	0.50
DMH5 to Vort HS36	0.017	5.59	1.25	0.011	0.0060	8.36	5.49	0.67	0.97
Vort HS36 to EXDMH	0.017	5.59	1.25	0.011	0.0060	8.36	5.49	0.67	0.97
Roof	0.0208	4.74	1	0.011	0.011	8.57	6.33	0.66	0.91

100 Year Storm Pipe Flow Calculations
#102 Cherry Hill
Beverly, Massachusetts

Input					Results				
Description	Slope (ft/ft)	Discharge (cfs)	Pipe Dia. (ft)	Manning's Coefficient	Sc (ft/ft)	Velocity (fps)	Vc (fps)	Depth (ft)	Dc (ft)
CB1 to DMH4	0.0197	4.17	1	0.011	0.0089	8.17	5.76	0.62	0.87
CB2 to DMH4	0.0808	6.19	1	0.011	0.0188	15.40	7.98	0.51	0.96
DMH4 to Vort HS48	0.1273	10.36	1.25	0.011	0.0159	20.72	8.57	0.53	1.20
Vort HS48 to DMH3	0.1273	10.36	1.25	0.011	0.0159	20.72	8.57	0.53	1.20
DMH3 to Outlet	0.3703	16.08	1.5	0.011	0.0145	34.04	9.25	0.47	1.43
CB3 to DMH1	0.285	2.29	1	0.011	0.0050	18.44	4.20	0.22	0.65
CB4 to DMH1	0.065	1.74	1	0.011	0.0045	10.07	3.77	0.27	0.57
CB5 to DMH1	0.714	1.12	1	0.011	0.0040	20.60	3.26	0.12	0.45
DMH1 to DMH5	0.049	5.15	1	0.011	0.0129	12.19	6.77	0.53	0.93
CB7 to DMH2	0.012	1.45	1	0.011	0.0042	5.21	3.54	0.38	0.52
CB6 to DMH2	0.032	0.24	1	0.011	0.0031	4.38	1.94	0.12	0.21
DMH2 to DMH5	0.015	1.69	1	0.011	0.0044	5.89	3.74	0.39	0.56
DMH5 to Vort HS36	0.017	6.84	1.25	0.011	0.0076	8.76	6.18	0.76	1.06
Vort HS36 to EXDMH	0.017	6.84	1.25	0.011	0.0076	8.76	6.18	0.76	1.06
Roof	0.0208	4.74	1	0.011	0.011	8.57	6.33	0.66	0.91

2/23/2016

Required Head for 100 Year Storm
#102 Cherry Hill
Beverly, Massachusetts

Description	Discharge (cfs)	Pipe Dia (ft)	C	Req. Head (ft) Inv to rim
CB1	4.17	1	0.6	1.72
CB2	6.19	1	0.6	3.18
Vort HS48	10.36	1.25	0.6	3.70
DMH3	16.08	1.5	0.6	4.32
CB3	2.29	1	0.6	0.87
CB4	1.74	1	0.6	0.71
CB5	1.2	1	0.6	0.60
DMH1	5.15	1	0.6	2.35
CB7	1.45	1	0.6	0.65
CB6	0.24	1	0.6	0.50
DMH2	1.69	1	0.6	0.70
DMH5	6.84	1.25	0.6	1.96
DMH4	10.36	1.25	0.6	3.70
Vort HS36	6.84	1.25	0.6	1.96

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: #102 Cherry Hill Drive, Beverly, MA

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
Proprietary Treatment Practice	0.77	0.75	0.58	0.17
	0.00	0.17	0.00	0.17
	0.00	0.17	0.00	0.17
	0.00	0.17	0.00	0.17

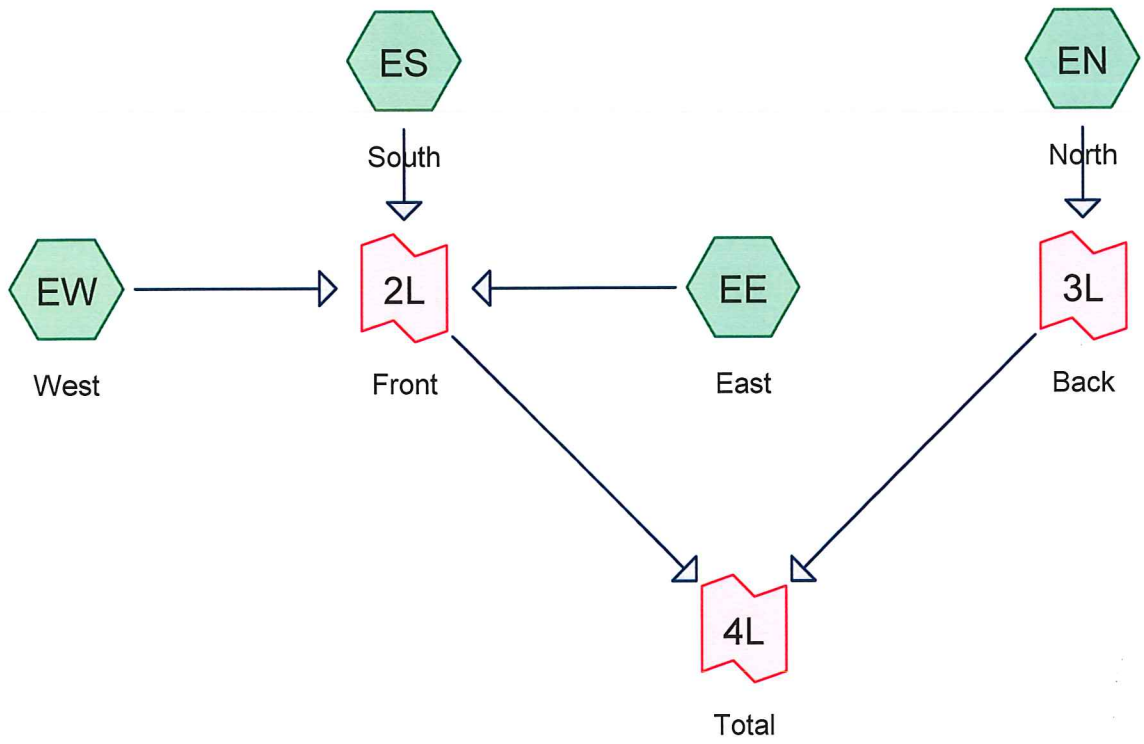
Total TSS Removal = 83%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: BEV-0171A
Prepared By: EBL
Date: 24-Feb-16

*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



Subcat Reach Pond Link

Routing Diagram for EX-102cherryhill
Prepared by Microsoft, Printed 2/23/2016
HydroCAD® 10.00-13 s/n 03206 © 2014 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
234,040	79	Pasture/grassland/range, Fair, HSG C (EE, EN, ES, EW)
654	98	Paved parking, HSG C (EW)
234,694	**79**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
234,694	HSG C	EE, EN, ES, EW
0	HSG D	
0	Other	
234,694		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	234,040	0	0	234,040	Pasture/grassland/range, Fair
0	0	654	0	0	654	Paved parking
0	**0**	**234,694**	**0**	**0**	**234,694**	**TOTAL AREA**

Summary for Subcatchment EE: East

Runoff = 1.01 cfs @ 12.10 hrs, Volume= 2,984 cf, Depth> 1.16"

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

Area (sf)	CN	Description
30,807	79	Pasture/grassland/range, Fair, HSG C
30,807		100.00% Pervious Area

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

Summary for Subcatchment EN: North

Runoff = 2.77 cfs @ 12.10 hrs, Volume= 8,183 cf, Depth> 1.16"

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

Area (sf)	CN	Description
84,496	79	Pasture/grassland/range, Fair, HSG C
84,496		100.00% Pervious Area

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

Summary for Subcatchment ES: South

Runoff = 3.24 cfs @ 12.10 hrs, Volume= 9,573 cf, Depth> 1.16"

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

Area (sf)	CN	Description
98,845	79	Pasture/grassland/range, Fair, HSG C
98,845		100.00% Pervious Area

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

Summary for Subcatchment EW: West

Runoff = 0.71 cfs @ 12.10 hrs, Volume= 2,094 cf, Depth> 1.22"

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

Area (sf)	CN	Description
19,892	79	Pasture/grassland/range, Fair, HSG C
654	98	Paved parking, HSG C
20,546	80	Weighted Average
19,892		96.82% Pervious Area
654		3.18% Impervious Area

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

Summary for Link 2L: Front

Inflow Area = 150,198 sf, 0.44% Impervious, Inflow Depth > 1.17" for 2 Year event
Inflow = 4.96 cfs @ 12.10 hrs, Volume= 14,651 cf
Primary = 4.96 cfs @ 12.10 hrs, Volume= 14,651 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Back

Inflow Area = 84,496 sf, 0.00% Impervious, Inflow Depth > 1.16" for 2 Year event
Inflow = 2.77 cfs @ 12.10 hrs, Volume= 8,183 cf
Primary = 2.77 cfs @ 12.10 hrs, Volume= 8,183 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 4L: Total

Inflow Area = 234,694 sf, 0.28% Impervious, Inflow Depth > 1.17" for 2 Year event
Inflow = 7.73 cfs @ 12.10 hrs, Volume= 22,834 cf
Primary = 7.73 cfs @ 12.10 hrs, Volume= 22,834 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EE: East

Runoff = 2.00 cfs @ 12.09 hrs, Volume= 5,882 cf, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.60"

Area (sf)	CN	Description
30,807	79	Pasture/grassland/range, Fair, HSG C
30,807		100.00% Pervious Area

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

Summary for Subcatchment EN: North

Runoff = 5.49 cfs @ 12.09 hrs, Volume= 16,133 cf, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.60"

Area (sf)	CN	Description
84,496	79	Pasture/grassland/range, Fair, HSG C
84,496		100.00% Pervious Area

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

Summary for Subcatchment ES: South

Runoff = 6.42 cfs @ 12.09 hrs, Volume= 18,873 cf, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.60"

Area (sf)	CN	Description
98,845	79	Pasture/grassland/range, Fair, HSG C
98,845		100.00% Pervious Area

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

Summary for Subcatchment EW: West

Runoff = 1.38 cfs @ 12.09 hrs, Volume= 4,066 cf, Depth> 2.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 Year Rainfall=4.60"

Area (sf)	CN	Description
19,892	79	Pasture/grassland/range, Fair, HSG C
654	98	Paved parking, HSG C
20,546	80	Weighted Average
19,892		96.82% Pervious Area
654		3.18% Impervious Area

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

Summary for Link 2L: Front

Inflow Area = 150,198 sf, 0.44% Impervious, Inflow Depth > 2.30" for 10 Year event
Inflow = 9.80 cfs @ 12.09 hrs, Volume= 28,822 cf
Primary = 9.80 cfs @ 12.09 hrs, Volume= 28,822 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Back

Inflow Area = 84,496 sf, 0.00% Impervious, Inflow Depth > 2.29" for 10 Year event
Inflow = 5.49 cfs @ 12.09 hrs, Volume= 16,133 cf
Primary = 5.49 cfs @ 12.09 hrs, Volume= 16,133 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 4L: Total

Inflow Area = 234,694 sf, 0.28% Impervious, Inflow Depth > 2.30" for 10 Year event
Inflow = 15.29 cfs @ 12.09 hrs, Volume= 44,955 cf
Primary = 15.29 cfs @ 12.09 hrs, Volume= 44,955 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EE: East

Runoff = 2.56 cfs @ 12.09 hrs, Volume= 7,554 cf, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Rainfall=5.40"

Area (sf)	CN	Description
30,807	79	Pasture/grassland/range, Fair, HSG C
30,807		100.00% Pervious Area

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

Summary for Subcatchment EN: North

Runoff = 7.01 cfs @ 12.09 hrs, Volume= 20,719 cf, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Rainfall=5.40"

Area (sf)	CN	Description
84,496	79	Pasture/grassland/range, Fair, HSG C
84,496		100.00% Pervious Area

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

Summary for Subcatchment ES: South

Runoff = 8.20 cfs @ 12.09 hrs, Volume= 24,238 cf, Depth> 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Rainfall=5.40"

Area (sf)	CN	Description
98,845	79	Pasture/grassland/range, Fair, HSG C
98,845		100.00% Pervious Area

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

Summary for Subcatchment EW: West

Runoff = 1.75 cfs @ 12.09 hrs, Volume= 5,197 cf, Depth> 3.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 Year Rainfall=5.40"

Area (sf)	CN	Description
19,892	79	Pasture/grassland/range, Fair, HSG C
654	98	Paved parking, HSG C
20,546	80	Weighted Average
19,892		96.82% Pervious Area
654		3.18% Impervious Area

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

Summary for Link 2L: Front

Inflow Area = 150,198 sf, 0.44% Impervious, Inflow Depth > 2.96" for 25 Year event
Inflow = 12.52 cfs @ 12.09 hrs, Volume= 36,989 cf
Primary = 12.52 cfs @ 12.09 hrs, Volume= 36,989 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Back

Inflow Area = 84,496 sf, 0.00% Impervious, Inflow Depth > 2.94" for 25 Year event
Inflow = 7.01 cfs @ 12.09 hrs, Volume= 20,719 cf
Primary = 7.01 cfs @ 12.09 hrs, Volume= 20,719 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 4L: Total

Inflow Area = 234,694 sf, 0.28% Impervious, Inflow Depth > 2.95" for 25 Year event
Inflow = 19.53 cfs @ 12.09 hrs, Volume= 57,708 cf
Primary = 19.53 cfs @ 12.09 hrs, Volume= 57,708 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment EE: East

Runoff = 3.34 cfs @ 12.09 hrs, Volume= 9,940 cf, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (sf)	CN	Description
30,807	79	Pasture/grassland/range, Fair, HSG C
30,807		100.00% Pervious Area

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

Summary for Subcatchment EN: North

Runoff = 9.15 cfs @ 12.09 hrs, Volume= 27,264 cf, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (sf)	CN	Description
84,496	79	Pasture/grassland/range, Fair, HSG C
84,496		100.00% Pervious Area

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

Summary for Subcatchment ES: South

Runoff = 10.71 cfs @ 12.09 hrs, Volume= 31,894 cf, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (sf)	CN	Description
98,845	79	Pasture/grassland/range, Fair, HSG C
98,845		100.00% Pervious Area

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

Summary for Subcatchment EW: West

Runoff = 2.28 cfs @ 12.09 hrs, Volume= 6,807 cf, Depth> 3.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 Year Rainfall=6.50"

Area (sf)	CN	Description
19,892	79	Pasture/grassland/range, Fair, HSG C
654	98	Paved parking, HSG C
20,546	80	Weighted Average
19,892		96.82% Pervious Area
654		3.18% Impervious Area

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

Summary for Link 2L: Front

Inflow Area = 150,198 sf, 0.44% Impervious, Inflow Depth > 3.89" for 100 Year event
Inflow = 16.32 cfs @ 12.09 hrs, Volume= 48,641 cf
Primary = 16.32 cfs @ 12.09 hrs, Volume= 48,641 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Back

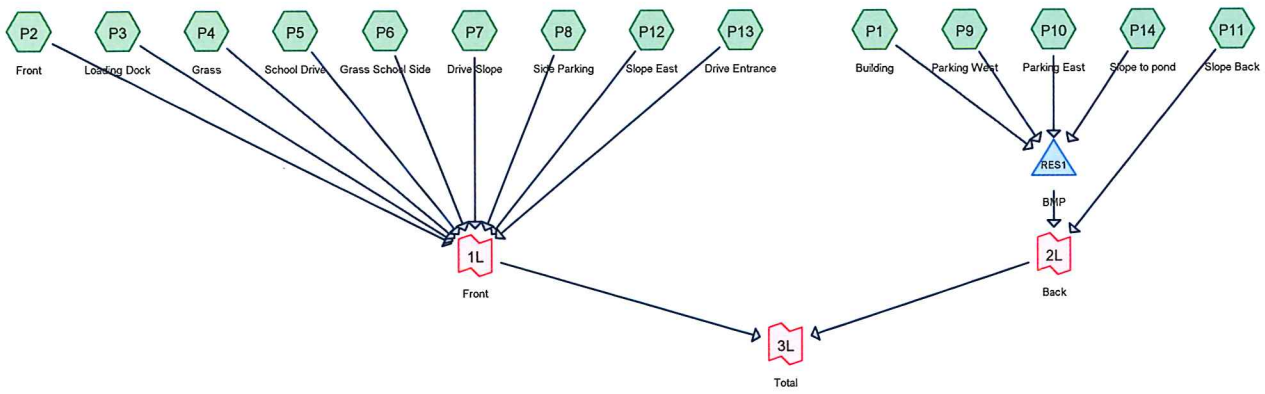
Inflow Area = 84,496 sf, 0.00% Impervious, Inflow Depth > 3.87" for 100 Year event
Inflow = 9.15 cfs @ 12.09 hrs, Volume= 27,264 cf
Primary = 9.15 cfs @ 12.09 hrs, Volume= 27,264 cf, Atten= 0%, Lag= 0.0 min

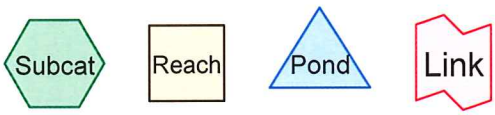
Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 4L: Total

Inflow Area = 234,694 sf, 0.28% Impervious, Inflow Depth > 3.88" for 100 Year event
Inflow = 25.47 cfs @ 12.09 hrs, Volume= 75,905 cf
Primary = 25.47 cfs @ 12.09 hrs, Volume= 75,905 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs





Routing Diagram for PR-102cherryhill
Prepared by Microsoft, Printed 2/23/2016
HydroCAD® 10.00-13 s/n 03206 © 2014 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
88,289	74	>75% Grass cover, Good, HSG C (P10, P11, P12, P14, P2, P3, P4, P5, P6, P7, P9)
106,281	98	Paved parking, HSG C (P10, P13, P3, P5, P6, P7, P8, P9)
40,000	98	Roofs, HSG C (P1)
234,570	**89**	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
234,570	HSG C	P1, P10, P11, P12, P13, P14, P2, P3, P4, P5, P6, P7, P8, P9
0	HSG D	
0	Other	
234,570		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	88,289	0	0	88,289	>75% Grass cover, Good
0	0	106,281	0	0	106,281	Paved parking
0	0	40,000	0	0	40,000	Roofs
0	**0**	**234,570**	**0**	**0**	**234,570**	**TOTAL AREA**

Summary for Subcatchment P1: Building

Runoff = 2.70 cfs @ 12.09 hrs, Volume= 9,554 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
40,000	98	Roofs, HSG C
40,000		100.00% Impervious Area

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

Summary for Subcatchment P10: Parking East

Runoff = 3.12 cfs @ 12.09 hrs, Volume= 10,418 cf, Depth> 2.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
42,289	98	Paved parking, HSG C
6,828	74	>75% Grass cover, Good, HSG C
49,117	95	Weighted Average
6,828		13.90% Pervious Area
42,289		86.10% Impervious Area

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

Summary for Subcatchment P11: Slope Back

Runoff = 0.33 cfs @ 12.10 hrs, Volume= 1,095 cf, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
13,532	74	>75% Grass cover, Good, HSG C
13,532		100.00% Pervious Area

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

Summary for Subcatchment P12: Slope East

Runoff = 0.58 cfs @ 12.10 hrs, Volume= 1,922 cf, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
23,751	74	>75% Grass cover, Good, HSG C
23,751		100.00% Pervious Area

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

Summary for Subcatchment P13: Drive Entrance

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 405 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
1,694	98	Paved parking, HSG C
1,694		100.00% Impervious Area

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

Summary for Subcatchment P14: Slope to pond

Runoff = 0.26 cfs @ 12.10 hrs, Volume= 880 cf, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
10,872	74	>75% Grass cover, Good, HSG C
10,872		100.00% Pervious Area

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

Summary for Subcatchment P2: Front

Runoff = 0.21 cfs @ 12.10 hrs, Volume= 696 cf, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
8,604	74	>75% Grass cover, Good, HSG C
8,604		100.00% Pervious Area

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

Summary for Subcatchment P3: Loading Dock

Runoff = 0.52 cfs @ 12.09 hrs, Volume= 1,641 cf, Depth> 1.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
5,405	98	Paved parking, HSG C
6,377	74	>75% Grass cover, Good, HSG C
11,782	85	Weighted Average
6,377		54.12% Pervious Area
5,405		45.88% Impervious Area

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

Summary for Subcatchment P4: Grass

Runoff = 0.04 cfs @ 12.10 hrs, Volume= 140 cf, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
1,734	74	>75% Grass cover, Good, HSG C
1,734		100.00% Pervious Area

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

Summary for Subcatchment P5: School Drive

Runoff = 0.22 cfs @ 12.09 hrs, Volume= 694 cf, Depth> 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
2,452	98	Paved parking, HSG C
2,114	74	>75% Grass cover, Good, HSG C
4,566	87	Weighted Average
2,114		46.30% Pervious Area
2,452		53.70% Impervious Area

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

Summary for Subcatchment P6: Grass School Side

Runoff = 0.64 cfs @ 12.09 hrs, Volume= 2,032 cf, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
6,763	98	Paved parking, HSG C
7,198	74	>75% Grass cover, Good, HSG C
13,961	86	Weighted Average
7,198		51.56% Pervious Area
6,763		48.44% Impervious Area

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

Summary for Subcatchment P7: Drive Slope

Runoff = 0.46 cfs @ 12.09 hrs, Volume= 1,441 cf, Depth> 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
4,944	98	Paved parking, HSG C
4,531	74	>75% Grass cover, Good, HSG C
9,475	87	Weighted Average
4,531		47.82% Pervious Area
4,944		52.18% Impervious Area

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

Summary for Subcatchment P8: Side Parking

Runoff = 1.08 cfs @ 12.09 hrs, Volume= 3,826 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
16,019	98	Paved parking, HSG C
16,019		100.00% Impervious Area

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

Summary for Subcatchment P9: Parking West

Runoff = 1.92 cfs @ 12.09 hrs, Volume= 6,503 cf, Depth> 2.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 Year Rainfall=3.10"

Area (sf)	CN	Description
26,715	98	Paved parking, HSG C
2,748	74	>75% Grass cover, Good, HSG C
29,463	96	Weighted Average
2,748		9.33% Pervious Area
26,715		90.67% Impervious Area

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

Summary for Pond RES1: BMP

Inflow Area = 129,452 sf, 84.20% Impervious, Inflow Depth > 2.54" for 2 Year event
Inflow = 7.99 cfs @ 12.09 hrs, Volume= 27,355 cf
Outflow = 4.43 cfs @ 12.22 hrs, Volume= 26,850 cf, Atten= 45%, Lag= 7.9 min
Primary = 4.43 cfs @ 12.22 hrs, Volume= 26,850 cf

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 104.04' @ 12.22 hrs Surf.Area= 3,646 sf Storage= 6,472 cf

Plug-Flow detention time= 48.3 min calculated for 26,794 cf (98% of inflow)
Center-of-Mass det. time= 36.9 min (810.7 - 773.8)

Volume	Invert	Avail.Storage	Storage Description
#1	102.00'	12,328 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
102.00	2,716	0	0
103.00	3,163	2,940	2,940
104.00	3,628	3,396	6,335
105.00	4,103	3,866	10,201
105.50	4,405	2,127	12,328

Device	Routing	Invert	Outlet Devices
#1	Primary	104.50'	**6.0' long x 5.0' breadth Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Primary	102.00'	**8.0" Round 8"** L= 5.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 102.00' / 101.95' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf
#3	Primary	103.20'	**10.0" Round 10" X 2.00** L= 2.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 103.20' / 103.10' S= 0.0500 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf

Primary OutFlow Max=4.40 cfs @ 12.22 hrs HW=104.03' (Free Discharge)
- **1=Spillway** (Controls 0.00 cfs)
- **2=8"** (Inlet Controls 1.73 cfs @ 4.95 fps)
- **3=10"** (Inlet Controls 2.67 cfs @ 2.45 fps)

Summary for Link 1L: Front

Inflow Area = 91,586 sf, 40.70% Impervious, Inflow Depth > 1.68" for 2 Year event
Inflow = 3.85 cfs @ 12.09 hrs, Volume= 12,798 cf
Primary = 3.85 cfs @ 12.09 hrs, Volume= 12,798 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link 2L: Back

Inflow Area = 142,984 sf, 76.24% Impervious, Inflow Depth > 2.35" for 2 Year event
Inflow = 4.63 cfs @ 12.21 hrs, Volume= 27,945 cf
Primary = 4.63 cfs @ 12.21 hrs, Volume= 27,945 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Summary for Link 3L: Total

Inflow Area =	234,570 sf,	62.36% Impervious,	Inflow Depth >	2.08"	for 2 Year event
Inflow =	7.67 cfs @	12.13 hrs, Volume=	40,743 cf		
Primary =	7.67 cfs @	12.13 hrs, Volume=	40,743 cf,	Atten= 0%,	Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=40,000 sf 100.00% Impervious Runoff Depth>2.87"
Tc=6.0 min CN=98 Runoff=2.70 cfs 9,554 cf

Subcatchment P10: Parking East Runoff Area=49,117 sf 86.10% Impervious Runoff Depth>2.55"
Tc=6.0 min CN=95 Runoff=3.12 cfs 10,418 cf

Subcatchment P11: Slope Back Runoff Area=13,532 sf 0.00% Impervious Runoff Depth>0.97"
Tc=6.0 min CN=74 Runoff=0.33 cfs 1,095 cf

Subcatchment P12: Slope East Runoff Area=23,751 sf 0.00% Impervious Runoff Depth>0.97"
Tc=6.0 min CN=74 Runoff=0.58 cfs 1,922 cf

Subcatchment P13: Drive Entrance Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>2.87"
Tc=6.0 min CN=98 Runoff=0.11 cfs 405 cf

Subcatchment P14: Slope to pond Runoff Area=10,872 sf 0.00% Impervious Runoff Depth>0.97"
Tc=6.0 min CN=74 Runoff=0.26 cfs 880 cf

Subcatchment P2: Front Runoff Area=8,604 sf 0.00% Impervious Runoff Depth>0.97"
Tc=6.0 min CN=74 Runoff=0.21 cfs 696 cf

Subcatchment P3: Loading Dock Runoff Area=11,782 sf 45.88% Impervious Runoff Depth>1.67"
Tc=6.0 min CN=85 Runoff=0.52 cfs 1,641 cf

Subcatchment P4: Grass Runoff Area=1,734 sf 0.00% Impervious Runoff Depth>0.97"
Tc=6.0 min CN=74 Runoff=0.04 cfs 140 cf

Subcatchment P5: School Drive Runoff Area=4,566 sf 53.70% Impervious Runoff Depth>1.83"
Tc=6.0 min CN=87 Runoff=0.22 cfs 694 cf

Subcatchment P6: Grass School Side Runoff Area=13,961 sf 48.44% Impervious Runoff Depth>1.75"
Tc=6.0 min CN=86 Runoff=0.64 cfs 2,032 cf

Subcatchment P7: Drive Slope Runoff Area=9,475 sf 52.18% Impervious Runoff Depth>1.83"
Tc=6.0 min CN=87 Runoff=0.46 cfs 1,441 cf

Subcatchment P8: Side Parking Runoff Area=16,019 sf 100.00% Impervious Runoff Depth>2.87"
Tc=6.0 min CN=98 Runoff=1.08 cfs 3,826 cf

Subcatchment P9: Parking West Runoff Area=29,463 sf 90.67% Impervious Runoff Depth>2.65"
Tc=6.0 min CN=96 Runoff=1.92 cfs 6,503 cf

Pond RES1: BMP Peak Elev=104.04' Storage=6,472 cf Inflow=7.99 cfs 27,355 cf
Outflow=4.43 cfs 26,850 cf

Link 1L: Front Inflow=3.85 cfs 12,798 cf
Primary=3.85 cfs 12,798 cf

Link 2L: Back Inflow=4.63 cfs 27,945 cf
Primary=4.63 cfs 27,945 cf

Link 3L: Total Inflow=7.67 cfs 40,743 cf
Primary=7.67 cfs 40,743 cf

Total Runoff Area = 234,570 sf Runoff Volume = 41,248 cf Average Runoff Depth = 2.11"
37.64% Pervious = 88,289 sf 62.36% Impervious = 146,281 sf

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=40,000 sf 100.00% Impervious Runoff Depth>4.36"
Tc=6.0 min CN=98 Runoff=4.03 cfs 14,537 cf

Subcatchment P10: Parking East Runoff Area=49,117 sf 86.10% Impervious Runoff Depth>4.02"
Tc=6.0 min CN=95 Runoff=4.80 cfs 16,458 cf

Subcatchment P11: Slope Back Runoff Area=13,532 sf 0.00% Impervious Runoff Depth>2.05"
Tc=6.0 min CN=74 Runoff=0.73 cfs 2,309 cf

Subcatchment P12: Slope East Runoff Area=23,751 sf 0.00% Impervious Runoff Depth>2.05"
Tc=6.0 min CN=74 Runoff=1.27 cfs 4,053 cf

Subcatchment P13: Drive Entrance Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>4.36"
Tc=6.0 min CN=98 Runoff=0.17 cfs 616 cf

Subcatchment P14: Slope to pond Runoff Area=10,872 sf 0.00% Impervious Runoff Depth>2.05"
Tc=6.0 min CN=74 Runoff=0.58 cfs 1,855 cf

Subcatchment P2: Front Runoff Area=8,604 sf 0.00% Impervious Runoff Depth>2.05"
Tc=6.0 min CN=74 Runoff=0.46 cfs 1,468 cf

Subcatchment P3: Loading Dock Runoff Area=11,782 sf 45.88% Impervious Runoff Depth>3.00"
Tc=6.0 min CN=85 Runoff=0.92 cfs 2,943 cf

Subcatchment P4: Grass Runoff Area=1,734 sf 0.00% Impervious Runoff Depth>2.05"
Tc=6.0 min CN=74 Runoff=0.09 cfs 296 cf

Subcatchment P5: School Drive Runoff Area=4,566 sf 53.70% Impervious Runoff Depth>3.19"
Tc=6.0 min CN=87 Runoff=0.38 cfs 1,214 cf

Subcatchment P6: Grass School Side Runoff Area=13,961 sf 48.44% Impervious Runoff Depth>3.09"
Tc=6.0 min CN=86 Runoff=1.13 cfs 3,598 cf

Subcatchment P7: Drive Slope Runoff Area=9,475 sf 52.18% Impervious Runoff Depth>3.19"
Tc=6.0 min CN=87 Runoff=0.79 cfs 2,519 cf

Subcatchment P8: Side Parking Runoff Area=16,019 sf 100.00% Impervious Runoff Depth>4.36"
Tc=6.0 min CN=98 Runoff=1.61 cfs 5,822 cf

Subcatchment P9: Parking West Runoff Area=29,463 sf 90.67% Impervious Runoff Depth>4.13"
Tc=6.0 min CN=96 Runoff=2.91 cfs 10,146 cf

Pond RES1: BMP Peak Elev=104.70' Storage=8,993 cf Inflow=12.32 cfs 42,997 cf
Outflow=7.62 cfs 42,360 cf

Link 1L: Front Inflow=6.83 cfs 22,528 cf
Primary=6.83 cfs 22,528 cf

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=40,000 sf 100.00% Impervious Runoff Depth>5.16"
Tc=6.0 min CN=98 Runoff=4.74 cfs 17,198 cf

Subcatchment P10: Parking East Runoff Area=49,117 sf 86.10% Impervious Runoff Depth>4.81"
Tc=6.0 min CN=95 Runoff=5.68 cfs 19,700 cf

Subcatchment P11: Slope Back Runoff Area=13,532 sf 0.00% Impervious Runoff Depth>2.68"
Tc=6.0 min CN=74 Runoff=0.96 cfs 3,027 cf

Subcatchment P12: Slope East Runoff Area=23,751 sf 0.00% Impervious Runoff Depth>2.68"
Tc=6.0 min CN=74 Runoff=1.68 cfs 5,314 cf

Subcatchment P13: Drive Entrance Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>5.16"
Tc=6.0 min CN=98 Runoff=0.20 cfs 728 cf

Subcatchment P14: Slope to pond Runoff Area=10,872 sf 0.00% Impervious Runoff Depth>2.68"
Tc=6.0 min CN=74 Runoff=0.77 cfs 2,432 cf

Subcatchment P2: Front Runoff Area=8,604 sf 0.00% Impervious Runoff Depth>2.68"
Tc=6.0 min CN=74 Runoff=0.61 cfs 1,925 cf

Subcatchment P3: Loading Dock Runoff Area=11,782 sf 45.88% Impervious Runoff Depth>3.74"
Tc=6.0 min CN=85 Runoff=1.14 cfs 3,669 cf

Subcatchment P4: Grass Runoff Area=1,734 sf 0.00% Impervious Runoff Depth>2.68"
Tc=6.0 min CN=74 Runoff=0.12 cfs 388 cf

Subcatchment P5: School Drive Runoff Area=4,566 sf 53.70% Impervious Runoff Depth>3.94"
Tc=6.0 min CN=87 Runoff=0.46 cfs 1,500 cf

Subcatchment P6: Grass School Side Runoff Area=13,961 sf 48.44% Impervious Runoff Depth>3.84"
Tc=6.0 min CN=86 Runoff=1.39 cfs 4,466 cf

Subcatchment P7: Drive Slope Runoff Area=9,475 sf 52.18% Impervious Runoff Depth>3.94"
Tc=6.0 min CN=87 Runoff=0.96 cfs 3,113 cf

Subcatchment P8: Side Parking Runoff Area=16,019 sf 100.00% Impervious Runoff Depth>5.16"
Tc=6.0 min CN=98 Runoff=1.90 cfs 6,887 cf

Subcatchment P9: Parking West Runoff Area=29,463 sf 90.67% Impervious Runoff Depth>4.93"
Tc=6.0 min CN=96 Runoff=3.44 cfs 12,097 cf

Pond RES1: BMP Peak Elev=104.91' Storage=9,828 cf Inflow=14.63 cfs 51,428 cf
Outflow=10.73 cfs 50,728 cf

Link 1L: Front Inflow=8.47 cfs 27,990 cf
Primary=8.47 cfs 27,990 cf

Link 2L: Back Inflow=11.45 cfs 53,756 cf
Primary=11.45 cfs 53,756 cf

Link 3L: Total Inflow=18.14 cfs 81,746 cf
Primary=18.14 cfs 81,746 cf

Total Runoff Area = 234,570 sf Runoff Volume = 82,445 cf Average Runoff Depth = 4.22"
37.64% Pervious = 88,289 sf 62.36% Impervious = 146,281 sf

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P1: Building Runoff Area=40,000 sf 100.00% Impervious Runoff Depth>6.26"
Tc=6.0 min CN=98 Runoff=5.72 cfs 20,859 cf

Subcatchment P10: Parking East Runoff Area=49,117 sf 86.10% Impervious Runoff Depth>5.90"
Tc=6.0 min CN=95 Runoff=6.90 cfs 24,168 cf

Subcatchment P11: Slope Back Runoff Area=13,532 sf 0.00% Impervious Runoff Depth>3.61"
Tc=6.0 min CN=74 Runoff=1.29 cfs 4,067 cf

Subcatchment P12: Slope East Runoff Area=23,751 sf 0.00% Impervious Runoff Depth>3.61"
Tc=6.0 min CN=74 Runoff=2.26 cfs 7,138 cf

Subcatchment P13: Drive Entrance Runoff Area=1,694 sf 100.00% Impervious Runoff Depth>6.26"
Tc=6.0 min CN=98 Runoff=0.24 cfs 883 cf

Subcatchment P14: Slope to pond Runoff Area=10,872 sf 0.00% Impervious Runoff Depth>3.61"
Tc=6.0 min CN=74 Runoff=1.04 cfs 3,267 cf

Subcatchment P2: Front Runoff Area=8,604 sf 0.00% Impervious Runoff Depth>3.61"
Tc=6.0 min CN=74 Runoff=0.82 cfs 2,586 cf

Subcatchment P3: Loading Dock Runoff Area=11,782 sf 45.88% Impervious Runoff Depth>4.77"
Tc=6.0 min CN=85 Runoff=1.45 cfs 4,686 cf

Subcatchment P4: Grass Runoff Area=1,734 sf 0.00% Impervious Runoff Depth>3.61"
Tc=6.0 min CN=74 Runoff=0.17 cfs 521 cf

Subcatchment P5: School Drive Runoff Area=4,566 sf 53.70% Impervious Runoff Depth>4.99"
Tc=6.0 min CN=87 Runoff=0.58 cfs 1,900 cf

Subcatchment P6: Grass School Side Runoff Area=13,961 sf 48.44% Impervious Runoff Depth>4.88"
Tc=6.0 min CN=86 Runoff=1.74 cfs 5,680 cf

Subcatchment P7: Drive Slope Runoff Area=9,475 sf 52.18% Impervious Runoff Depth>4.99"
Tc=6.0 min CN=87 Runoff=1.20 cfs 3,943 cf

Subcatchment P8: Side Parking Runoff Area=16,019 sf 100.00% Impervious Runoff Depth>6.26"
Tc=6.0 min CN=98 Runoff=2.29 cfs 8,353 cf

Subcatchment P9: Parking West Runoff Area=29,463 sf 90.67% Impervious Runoff Depth>6.02"
Tc=6.0 min CN=96 Runoff=4.17 cfs 14,785 cf

Pond RES1: BMP Peak Elev=105.10' Storage=10,611 cf Inflow=17.81 cfs 63,079 cf
Outflow=14.75 cfs 62,300 cf

Link 1L: Front Inflow=10.75 cfs 35,690 cf
Primary=10.75 cfs 35,690 cf

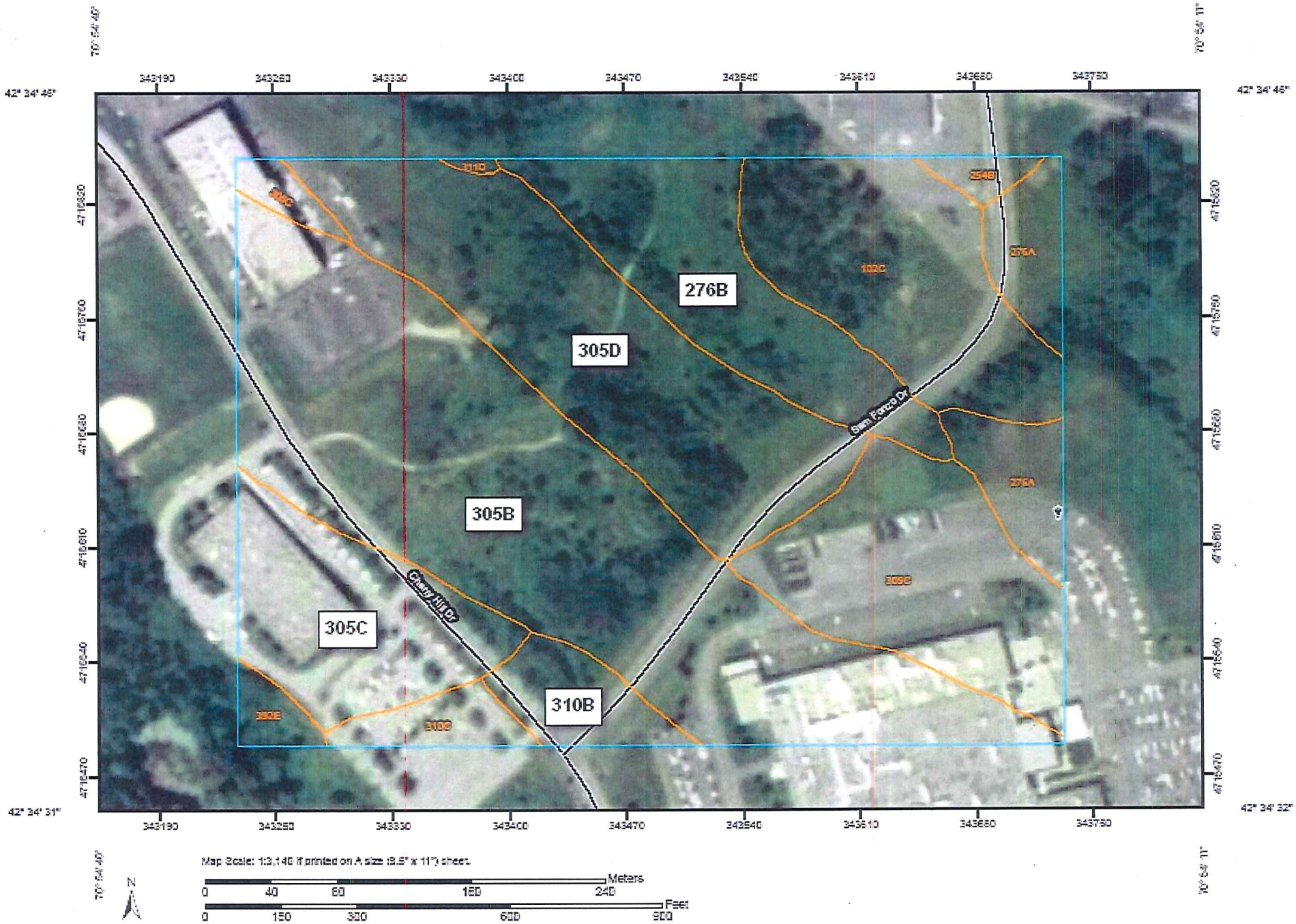
Link 2L: Back

Inflow=15.79 cfs 66,366 cf
Primary=15.79 cfs 66,366 cf

Link 3L: Total

Inflow=25.38 cfs 102,057 cf
Primary=25.38 cfs 102,057 cf

Total Runoff Area = 234,570 sf Runoff Volume = 102,836 cf Average Runoff Depth = 5.26"
37.64% Pervious = 88,289 sf 62.36% Impervious = 146,281 sf


70° 54' 46"
70° 54' 11"
42° 34' 46"
42° 34' 31"
42° 34' 32"
343190
343260
343330
343400
343470
343540
343610
343680
343750
4716820
4716700
4716620
4716610
4716540
4716470
276B
305D
305B
305C
310B
Sam Fonzo Dr
Chalky Hill Dr
310D
254B
276A
102C
309B
N
Map Scale: 1:3,140 if printed on A size (8.5" x 11") sheet.
Meters
0
40
80
160
240
Feet
0
150
300
600
900

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: 1:3,140 if printed on A size (8.5" × 11") sheet.

The soil surveys that comprise your AOI were mapped at 1:15,840.

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: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 9, Feb 26, 2010

Date(s) aerial images were photographed: 7/31/2003

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

Essex County, Massachusetts, Southern Part (MA606)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
102C	Chatfield-Hollis-Rock outcrop complex, 3 to 15 percent slopes	4.8	10.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	0.3	0.8%
276A	Ninigret fine sandy loam, 0 to 3 percent slopes	2.1	4.9%
276B	Ninigret fine sandy loam, 3 to 8 percent slopes	4.1	9.4%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	14.0	31.7%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	8.8	20.1%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	7.4	16.8%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	1.2	2.8%
310C	Woodbridge fine sandy loam, 8 to 15 percent slopes	0.8	1.7%
311D	Woodbridge fine sandy loam, 15 to 25 percent slopes, very stony	0.1	0.1%
392E	Paxton and Montauk fine sandy loams, 25 to 45 percent slopes, extremely stony	0.4	1.0%
Totals for Area of Interest		**44.1**	**100.0%**

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Essex County, Massachusetts, Southern Part (MA606)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	D	0.1	0.3%
102C	Chatfield-Hollis-Rock outcrop complex, 3 to 15 percent slopes	B	5.0	9.4%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	A	1.5	2.8%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	0.6	1.1%
276A	Ninigret fine sandy loam, 0 to 3 percent slopes	B	0.7	1.2%
276B	Ninigret fine sandy loam, 3 to 8 percent slopes	B	7.2	13.4%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	15.5	28.9%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	8.4	15.8%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	C	8.5	15.9%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C	2.3	4.4%
310C	Woodbridge fine sandy loam, 8 to 15 percent slopes	C	2.0	3.7%
311D	Woodbridge fine sandy loam, 15 to 25 percent slopes, very stony	C	0.9	1.7%
392E	Paxton and Montauk fine sandy loams, 25 to 45 percent slopes, extremely stony	C	0.8	1.4%
Totals for Area of Interest			**53.5**	**100.0%**

Essex County, Massachusetts, Southern Part

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

Landscape: Uplands
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Paxton and similar soils: 90 percent
Minor components: 10 percent

Description of Paxton

Setting

Landform: Hills
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Head slope, nose slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 15 to 38 inches to dense material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: C

Typical profile

0 to 9 inches: Fine sandy loam
9 to 23 inches: Fine sandy loam
23 to 60 inches: Gravelly fine sandy loam

Minor Components

Woodbridge

Percent of map unit: 7 percent

Ridgebury

Percent of map unit: 3 percent

Landform: Depressions

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 9, Feb 26, 2010

Essex County, Massachusetts, Southern Part

305D—Paxton fine sandy loam, 15 to 25 percent slopes

Map Unit Setting

Landscape: Uplands
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Paxton and similar soils: 85 percent
Minor components: 15 percent

Description of Paxton

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: 15 to 38 inches to dense material
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Farmland classification: Not prime farmland
Land capability (nonirrigated): 4e
Hydrologic Soil Group: C

Typical profile

0 to 9 inches: Fine sandy loam
9 to 23 inches: Fine sandy loam
23 to 60 inches: Gravelly fine sandy loam

Minor Components

Woodbridge
Percent of map unit: 15 percent

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 9, Feb 26, 2010

Essex County, Massachusetts, Southern Part

310B—Woodbridge fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

Landscape: Uplands
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Woodbridge and similar soils: 85 percent
Minor components: 15 percent

Description of Woodbridge

Setting

Landform: Flats
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from granite and gneiss

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 20 to 38 inches to dense material
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.4 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: C

Typical profile

0 to 6 inches: Fine sandy loam
6 to 25 inches: Fine sandy loam
25 to 60 inches: Gravelly fine sandy loam

Minor Components

Ridgebury

Percent of map unit: 10 percent
Landform: Depressions

Whitman

Percent of map unit: 5 percent

Landform: Depressions

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 9, Feb 26, 2010

Essex County, Massachusetts, Southern Part

276B—Ninigret fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

Landscape: Outwash plains
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days

Map Unit Composition

Ninigret and similar soils: 85 percent
Minor components: 15 percent

Description of Ninigret

Setting

Landform: Terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable loamy glaciofluvial deposits derived from granite and gneiss over loose sandy and gravelly glaciofluvial deposits derived from granite and gneiss

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 34 inches to strongly contrasting textural stratification
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 6.00 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Moderate (about 6.1 inches)

Interpretive groups

Farmland classification: All areas are prime farmland
Land capability (nonirrigated): 2e
Hydrologic Soil Group: B

Typical profile

0 to 9 inches: Fine sandy loam
9 to 33 inches: Fine sandy loam
33 to 60 inches: Stratified very gravelly coarse sand to loamy fine sand

Minor Components

Windsor

Percent of map unit: 12 percent

Walpole

Percent of map unit: 3 percent
Landform: Terraces

Data Source Information

Soil Survey Area: Essex County, Massachusetts, Southern Part
Survey Area Data: Version 9, Feb 26, 2010

OPERATION AND MAINTENANCE PLAN
HIGH RES BIOSOLUTIONS
#102 CHERRY HILL DRIVE
BEVERLY, MASSACHUSETTS

February 23, 2016

GENERAL

Stormwater management facilities necessary to control runoff from the proposed project located at #102 Cherry Hill Drive, Beverly accomplish the multiple goals of mitigating peak runoff rates from the project that would otherwise occur, as well as mitigating the water quality of the associated runoff prior to that runoff reaching wetland resource areas.

The management plan incorporates a combination of three of the following chain of structural best management practices to improve water quality of the stormwater runoff from the proposed parking area and other impervious surfaces.

1. Deep Sump Catch Basins with gas traps
2. A surface detention basin
3. A Vorstentry HS36 and a Vorstentry HS48

Each of these facilities has unique characteristics, uses, planning considerations and maintenance requirements. The maintenance requirements, as suggested by the Massachusetts Department of Environmental Protection (DEP) in "Chapter 2: Structural BMP Specifications for the Massachusetts Stormwater Handbook" and the manufacturer's suggested schedules, are summarized in the following sections. It is suggested that the following guidelines be adhered to for a one-year cycle following completion of the project, then adjusted, as necessary, based on the results of the required inspections, unless otherwise stated.

Deep Sump Catch Basins

The catch basins must be inspected at least four (4) times a year, including inspections in April and November. Inspections shall consist of two (2) tasks: measuring and recording depth of sediment deposits contained within the basin, and inspecting structural basin, hood and sump components for damage. The inspection frequency may need to be increased if catch basins are regularly found to contain a significant amount of trash and sediment.

- Basins shall be cleaned using a vacuum truck when they are found to contain a significant amount of deposits (whenever the deposit depth is greater than or equal to one-half the depth from the bottom of the lowest invert) and there is a significant amount of trash, as specified in the MADEP Stormwater Handbook, Volume 2, Chapter 2, pages 3 through 5. All inspections and all necessary sediment cleaning repair actions shall be documented in a maintenance log kept by the property owner.

- Damaged basin components shall be repaired as soon after discovery as possible to ensure that the catch basin functions properly.

- Removed basin deposits must be handled as specified in the attached page (Structural BMPs – Volume 2\Chapter 2, page 5 & 6) from the MADEP Stormwater Handbook.

"Surface Detention Basin

- The basin is to be inspected immediately after construction and every 6 months for the first year of operation to ascertain if sediment has accumulated in the basin, and to ensure that proper function has been achieved. Thereafter, the basin will be inspected at least annually (inspection frequency to be adjusted based upon rate of observed sediment accumulation.

- The basin shall be checked for erosion at both the inlet and outlet as well as the spillway. Banks should be checked for stability and erosion.

- All inspections and all necessary sediment cleaning repair actions shall be documented in a maintenance log kept by the property owner.

Based on the observations made during the inspections, the property owner shall determine if the stormwater management facilities are functioning properly and, if not, what steps are necessary to restore their functionality.

Vortsentry HS

Regulating the sediment and petroleum product input to the proposed water quality system is the priority maintenance activity. Sediments and any oil spillage should be trapped and removed before they reach the units.

- **Inspection** is key to effective maintenance and is easily performed. Pollutant deposition and transport may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (i.e. spring and fall) however more frequent inspections may be necessary in equipment washdown areas and in climates where winter sanding operations may lead to rapid accumulations of a large volume of sediment. It is useful and often required as part of a permit to keep a record of each inspection.

- The Vortsentry HS should be cleaned when the sediment has accumulated to a depth of two feet in the treatment chamber. This determination can be made by taking two measurements with a stadia rod or similar measuring device; one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurement is less than 3.6' for the HS36 and 4.7' for the HS48, then the Vorsentry HS should be maintained to ensure effective treatment.

- **Cleaning** of the Vortsentry HS should be done during dry weather conditions when no flow is entering the system. Cleanout of the Vortsentry HS with a vacuum truck is generally the most effective and convenient method of excavating pollutants from the system. Simply remove the manhole cover and insert the vacuum hose into the sump. All pollutants can be removed from this one access point from the surface with no requirements for Confined Space Entry.

- In installations where the t=risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, an oil and gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutant, it may be preferable to use absorbent pads, which solidify the oils. These are usually much easier to remove from the unit individually, and less expensive to dispose than the oil\water emulsion that may be created by vacuuming the oily layer. Floating trash can be netted out if you wish to separate it from the other pollutants.

- Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure proper safety precautions. If anyone physically enters the unit, Confined Space Entry procedures need to be followed.

- Disposal of all material removed from the Vortsentry HS should be done in accordance with local regulations. In many locations, disposal of evacuated sediments may be handled in the same manner as disposal of sediment removed from catch basins or deep sump manholes.

- See Attached Operation, Design, Performance and Maintenance Guide by Contech Engineered Solutions.

Removal of Siltation Controls

All siltation controls, including, but not limited to, hay bales and silt fence, shall be removed, as soon as practical after paving, re-vegetation and total stabilization of the site. Unvegetated areas remaining in the area of the siltation controls shall be loamed and seeded with the appropriate groundcover to insure re-vegetation as rapidly as possible after the removal of the siltation controls.

Ownership / Maintenance Responsibility

The Property Owner and any designated Property Manager shall be the owner and party responsible for ensuring proper maintenance of the proposed stormwater management system.

Deep Sump Catch Basin

Suitable Applications

- Pretreatment
- Residential subdivisions
- Office
- Retail

Design Considerations

- The contributing drainage area to any deep sump catch basin should not exceed ¼ acre of impervious cover.
- Design and construct deep sump catch basins as off-line systems.
- Size the drainage area so that the flow rate does not exceed the capacity of the inlet grate.
- Divert excess flows to another BMP intended to meet the water quantity requirements (peak rate attenuation) or to a storm drain system. An off-line design enhances pollutant removal efficiency, because it prevents the resuspension of sediments in large storms.

Make the sump depth (distance from the bottom of the outlet pipe to the bottom of the basin) at least four feet times the diameter of the outlet pipe and more if the contributing drainage area has a high sediment load. The minimum sump depth is 4 feet. Double catch basins, those with 2 inlet grates, may require deeper sumps. Install the invert of the outlet pipe at least 4 feet from the bottom of the catch basin grate.

The inlet grate serves to prevent larger debris from entering the sump. To be effective, the grate must have a separation between the grates of one square inch or less. The inlet openings must not allow flows greater than 3 cfs to enter the deep sump catch basin. If the inlet grate is designed with a curb cut, the grate must reach the back of the curb cut to prevent bypassing. The inlet grate must be constructed of a durable material and fit tightly into the frame so it won't be dislodged by automobile traffic. The inlet grate must not be welded to the frame so that sediments may be easily removed. To facilitate maintenance, the inlet grate must be placed along the road shoulder or curb line rather than a traffic lane.

Note that within parking garages, the State Plumbing Code regulates inlet grates and other stormwater management controls. Inlet grates inside parking garages are currently required to have much smaller openings than those described herein.

To receive the 25% removal credit, hoods must be used in deep sump catch basins. Hoods also help contain oil spills. MassHighway may install catch basins without hoods provided they are designed, constructed, operated, and maintained in accordance with the Mass Highway Stormwater Handbook.

Install the weep hole above the outlet pipe. Never install the weep hole in the bottom of the catch basin barrel.

Site Constraints

A proponent may not be able to install a deep sump catch basin because of:

- Depth to bedrock;
- High groundwater;
- Presence of utilities; or
- Other site conditions that limit depth of excavation because of stability.

Maintenance

Regular maintenance is essential. Deep sump catch basins remain effective at removing pollutants only if they are cleaned out frequently. One study found that once 50% of the sump volume is filled, the catch basin is not able to retain additional sediments.

Inspect or clean deep sump basins at least four times per year and at the end of the foliage and snow-removal seasons. Sediments must also be removed four times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the basin. If handling runoff from land uses with higher potential pollutant loads or discharging runoff near or to a critical area, more frequent cleaning may be necessary.

Clamshell buckets are typically used to remove sediment in Massachusetts. However, vacuum trucks are preferable, because they remove more trapped sediment and supernatant than clamshells. Vacuuming is also a speedier process and is less likely to snap the cast iron hood within the deep sump catch basin.

Always consider the safety of the staff cleaning deep sump catch basins. Cleaning a deep sump catch basin within a road with active traffic or even within a parking lot is dangerous, and a police detail may be necessary to safeguard workers.

Although catch basin debris often contains concentrations of oil and hazardous materials such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Unless there is evidence that they have been contaminated by a spill or other means, MassDEP does not routinely require catch basin cleanings to be tested before disposal. Contaminated catch basin cleanings must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.000, and handled as hazardous waste.

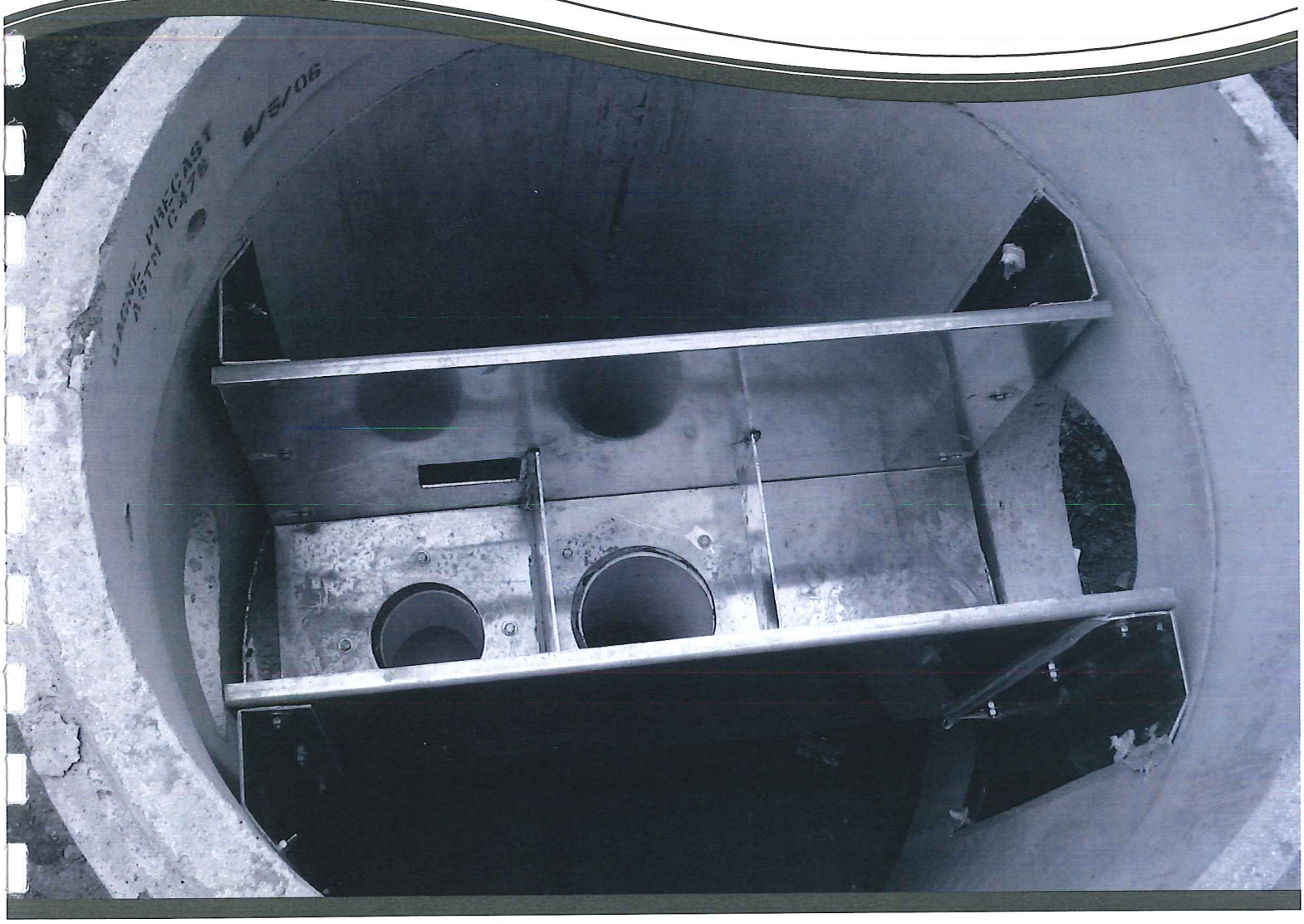
In the absence of evidence of contamination, catch basin cleanings may be taken to a landfill or other facility permitted by MassDEP to accept solid waste, without any prior approval by MassDEP. However, some landfills require catch basin cleanings to be tested before they are accepted.

With prior MassDEP approval, catch basin cleanings may be used as grading and shaping materials at landfills undergoing closure (see Revised Guidelines for Determining Closure Activities at Inactive Unlined Landfill Sites) or as daily cover at active landfills. MassDEP also encourages the beneficial reuse of catch basin cleanings whenever possible. A Beneficial Reuse Determination is required for such use.

MassDEP regulations prohibit landfills from accepting materials that contain free-draining liquids. One way to remove liquids is to use a hydraulic lift truck during cleaning operations so that the material can be decanted at the site. After loading material from several catch basins into a truck, elevate the truck so that any free-draining liquid can flow back into the structure. If there is no free water in the truck, the material may be deemed to be sufficiently dry. Otherwise the catch basin cleanings must undergo a Paint Filter Liquids Test. Go to www. Mass.gov/dep/recycle/laws/cafacts.doc for information on all of the MassDEP requirements pertaining to the disposal of catch basin cleanings.

CONTECH®
ENGINEERED SOLUTIONS

VortSentry® HS Guide
Operation, Design, Performance and Maintenance



VortSentry® HS Estimated Net Annual TSS Reduction

CONTECH® ENGINEERED SOLUTIONS

HIGH RES BIOSOLUTIONS
BEVERLY, MA
Model VSHS36
System VORTSENTRY HS36

Design Ratio[1] = $\frac{\text{0.8 acres x 0.9}}{\text{27 ft3}}$ **= 0.027**

Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft^3	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.01	0.00054	10.2%	98.0%	10.0%
0.04	0.03	0.00109	9.6%	98.0%	9.5%
0.06	0.04	0.00163	9.4%	98.0%	9.3%
0.08	0.06	0.00217	7.7%	98.0%	7.6%
0.10	0.07	0.00272	8.6%	98.0%	8.4%
0.12	0.09	0.00326	6.3%	98.0%	6.2%
0.14	0.10	0.00380	4.7%	98.0%	4.6%
0.16	0.12	0.00435	4.6%	98.0%	4.5%
0.18	0.13	0.00489	3.5%	98.0%	3.5%
0.20	0.14	0.00543	4.3%	98.0%	4.3%
0.25	0.18	0.00679	8.0%	98.0%	7.8%
0.30	0.22	0.00815	5.6%	97.9%	5.5%
0.35	0.25	0.00951	4.4%	97.1%	4.2%
0.40	0.29	0.01086	2.5%	94.4%	2.4%
0.45	0.32	0.01222	2.5%	91.6%	2.3%
0.50	0.36	0.01358	1.1%	89.4%	1.0%
0.75	0.54	0.02037	3.4%	80.9%	2.7%
1.00	0.72	0.02716	0.5%	65.8%	0.3%
1.50	1.08	0.04074	0.0%	21.4%	0.0%
2.00	1.44	0.05432	0.0%	0.0%	0.0%
3.00	2.16	0.08149	0.5%	0.0%	0.0%
					93.9%
				% rain falling at >3"/hr =	2.5%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**87.4%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: CJA	Date: 02/25/16	Checked by:	Date:

VortSentry® HS Estimated Net Annual TSS Reduction

CONTECH® ENGINEERED SOLUTIONS

HIGH RES BIOSOLUTIONS
BEVERLY, MA
Model VSHS48
System VORTSENTRY HS48

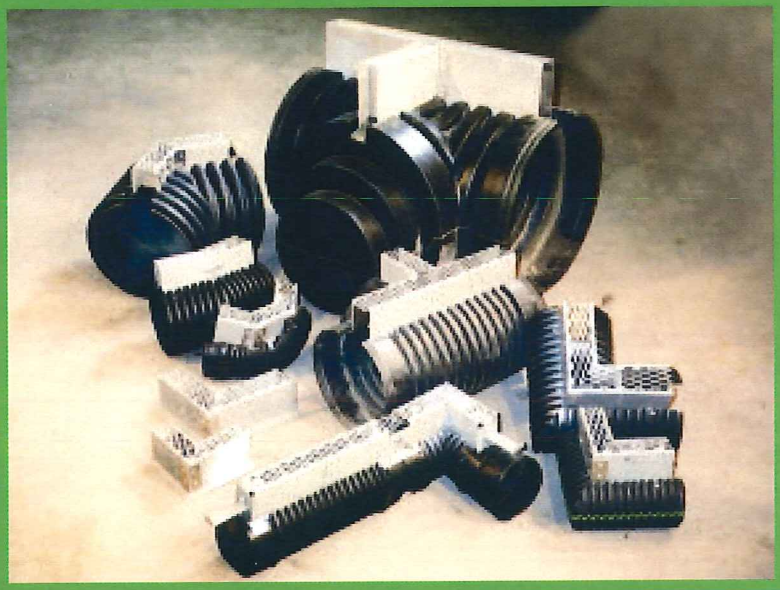
Design Ratio[1] = $\frac{\text{1.58 acres x 0.9}}{\text{63 ft3}}$ **= 0.023**

Rainfall Intensity "/hr	Flow Rate cfs	Operating Rate[2] cfs/ft^3	% Total Rainfall Depth[3]	Rmvl. Effcy[4] (%)	Rel. Effcy (%)
0.02	0.03	0.00045	10.2%	98.0%	10.0%
0.04	0.06	0.00091	9.6%	98.0%	9.5%
0.06	0.09	0.00136	9.4%	98.0%	9.3%
0.08	0.11	0.00181	7.7%	98.0%	7.6%
0.10	0.14	0.00226	8.6%	98.0%	8.4%
0.12	0.17	0.00272	6.3%	98.0%	6.2%
0.14	0.20	0.00317	4.7%	98.0%	4.6%
0.16	0.23	0.00362	4.6%	98.0%	4.5%
0.18	0.26	0.00407	3.5%	98.0%	3.5%
0.20	0.28	0.00453	4.3%	98.0%	4.3%
0.25	0.36	0.00566	8.0%	98.0%	7.8%
0.30	0.43	0.00679	5.6%	97.9%	5.5%
0.35	0.50	0.00792	4.4%	97.8%	4.3%
0.40	0.57	0.00905	2.5%	96.4%	2.4%
0.45	0.64	0.01018	2.5%	94.4%	2.4%
0.50	0.71	0.01132	1.4%	91.6%	1.3%
0.75	1.07	0.01697	5.0%	88.3%	4.5%
1.00	1.42	0.02263	0.8%	70.8%	0.6%
1.50	2.13	0.03395	0.0%	38.2%	0.0%
2.00	2.84	0.04526	0.0%	0.0%	0.0%
3.00	4.27	0.06790	0.5%	0.0%	0.0%
					96.4%
				% rain falling at >3"/hr =	0.2%
				Removal Efficiency Adjustment[4] =	6.5%
				Predicted Net Annual Load Removal Efficiency =	**89.9%**

1 - Design Ratio = (Total Drainage Area x Runoff Coefficient) / VortSentry HS Treatment Volume
= The Total Drainage Area and Runoff Coefficient are specified by the site engineer.
2 - Operating Rate (cfs/ft^3) = Rainfall Intensity ("/hr) x Design Ratio
3 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
4 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Calculated by: CJA	Date: 02/25/16	Checked by:	Date:

Duraslot® Surface Drains



Durable, economical, corrosion-resistant
collection of surface runoff

ADS®

A sensible alternative to metal and concrete

Since 1987, Duraslot® surface drains have been providing reliable storm water collection in applications ranging from residential driveways to multi-lane super highways.

The product is made from dual-wall corrugated polyethylene pipe with an aluminum slot mounted on top. It is designed to intercept sheet flows of water across paved or cleared areas. It is a cost-effective substitute for corrugated steel slotted drains, precast trench drains, or cast-in-place trench drains with steel or cast iron grates.

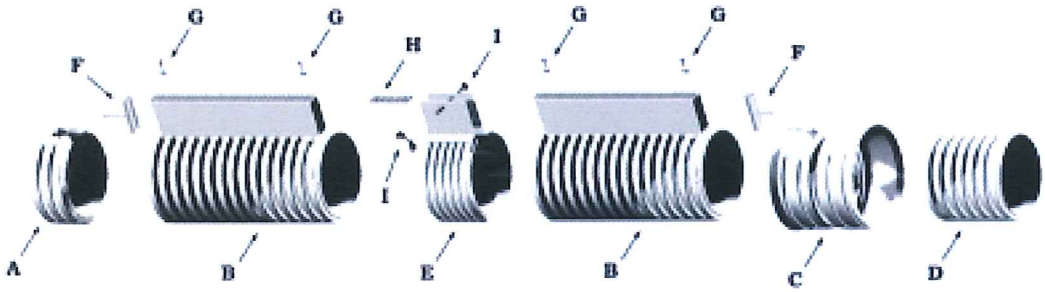
Duraslot drains use N-12® pipe, manufactured by Advanced Drainage Systems. An outer corrugated wall provides strength and durability, while the smooth interior lining gives exceptional hydraulics.

Physical details

- **Slot height:**
  - 2.5" for residential and pedestrian areas
  - 6" for H-20 loading in vehicular traffic areas
  - Taller slots are available on special order
  - Variable height slot to provide slope in the pipe invert at level grade (special order)
- **Pipe length:** 10 feet
- **Pipe diameter:** 4" through 36"
- **Slot opening:**
  - 1.25" wide in 4" diameter
  - 1.75" wide in 6" diameter and higher
- **Grate options:**
  - 1/2 - #13 galvanized steel (stock standard)
  - Open top without grate (available standard)
  - Other types of grating available on special order

System components

- **Coupler Band.** Connects Duraslot drain to Duraslot drain. A modified pipe band with angles extended up is used to clamp together the ends of the two slots being joined. A thumbscrew and wingnut fasten the band angles onto the ends of the slots. A Grate Connector is included.
- **Grate Connector.** Joins the grates at the ends of the slots, and can be easily removed to allow a hose to flush out the pipeline.
- **Pipe Adapter.** Connects Duraslot drain to N-12 pipe. A corrugated pipe coupler that is modified to accept Duraslot drain on one end and N-12 pipe on the other. A Grate Anchor is included.
- **End Cap.** Modified to close the upstream end of Duraslot drain. A Grate Anchor is included.
- **Grate Anchor.** Used at the end of each Duraslot run to close off the end of the slot, anchor the end of the grate into the concrete or asphalt surrounding the slot, and keep the grate in tension for added strength.



A - End Cap
B - Duraslot drain
C - Pipe Adapter
D - ADS N-12 pipe
E - Coupler Band
F - Grate Anchor
G - .25" SPH Screw with Washer
H - Grate Connector
I - .3125" Thumbscrew with Wingnut

Applications

Duraslot drains are linear drains designed to capture sheet flow of water from sloping paved surfaces or cleared areas. They have the same inlet as corrugated steel pipe slotted drains. A 1.75" wide opening runs the length of the pipe, and special connectors provide for a continuous slot of virtually unlimited length. For curb and gutter applications, the inlet acts as an orifice, and the AISI Handbook* method can be used to determine hydraulic capacity.

For interception of sheet flow, the inlet acts as a weir. Testing done by the Federal Highway Administration (FHWA) concluded that for inlets as narrow as one inch wide virtually all of a flow (0.04 cfs per foot of inlet) could be intercepted under most design conditions. Third party testing confirmed the FHWA conclusions, and developed "rule of thumb" capacities for 1.75" wide slots with and without grating:

1.75" open top slot => .065 cfs per foot of inlet

1.75" slot with grate => .046 cfs per foot of inlet

Typical applications for Duraslot drains include the following:

- Roadways
- Sidewalks
- Parking lots
- Plazas
- Loading docks
- Industrial floors
- Parks and athletic fields

* *American Iron and Steel Institute Handbook of Steel Drainage and Highway Construction Products, 1994, pages 218-223, "Hydraulics of Storm Water Inlets"*

Concrete floors

Residential driveways

Water treatment plant

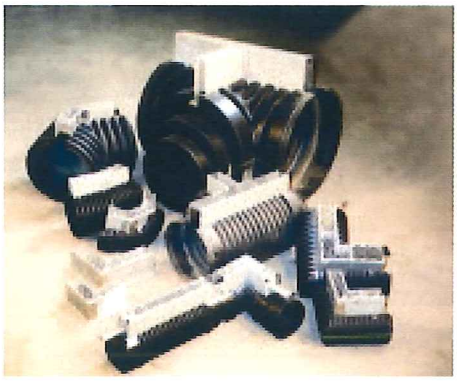
Against roadway curbs, berms and medians

Commercial parking lots

Loading docks and maintenance facilities

Fabricated Fittings

Design flexibility is enhanced with a complete line of fabricated fittings in all standard pipe sizes. Styles include elbows in virtually any angle up to 90°, tees, wyes, reducing tees, and other fittings custom fabricated to your specifications.



Competitive Benefits

Duraslot surface drains offer a number of cost and performance benefits compared to corrugated metal, polymer trench drain and cast-in-place systems:

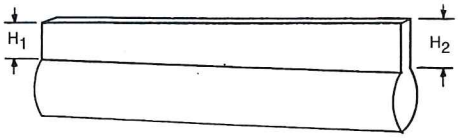
- **Reduced maintenance costs.**
- **Resilient materials.** Corrosion-resistant polyethylene and aluminum are impervious to most acids, storm water contaminants, and road salt.
- **Greater hydraulic efficiency.** Water flow through the smooth inner wall of polyethylene pipe is superior to corrugated steel pipe.
- **Lower installation costs.** Lightweight sections quickly and easily set in place with no heavy machinery or extra manpower.
- **Lower material costs.** Most cost-effective compared to other other systems that support vehicular traffic.
- **Longer lay lengths** compared to one-meter lenghts of polymer trench drain, ten foot Duraslot drains speed installation time and make it much easier to maintain constant slope.
- **Impact-resistant polyethylene** withstands storage and handling. Durable construction provides no waste due to deformation or breakage.

Heavy equipment is not required to set Duraslot drains in place. Long, lightweight sections and easy-to-use coupler bands cut installation time significantly.

Smooth inner wall N-12 pipe resists chemical attack and provides superior hydraulic flow compared to corrugated steel pipe.

Variable Height Slot

In addition to the standard fixed slot height style, Duraslot drains are available with a variable height slot to permit slope in the pipe invert when grade is level. The standard change in slot height is .625" per 10-ft. length (H_2 minus H_1 in drawing) providing an approximate 0.5% slope. Other slopes are also available and the product is delivered in sequentially numbered sections to facilitate installation. Slot heights of more than 30" have been installed. Contact ADS for complete product and installation details.



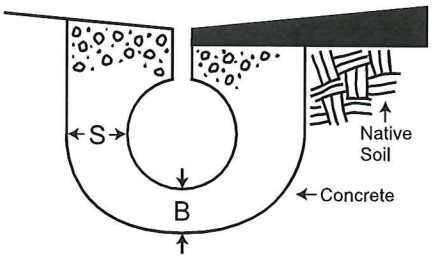
Variable height slot Duraslot drains can be ordered in sequentially numbered sections with maximum slot heights exceeding 30".

Installation Basics

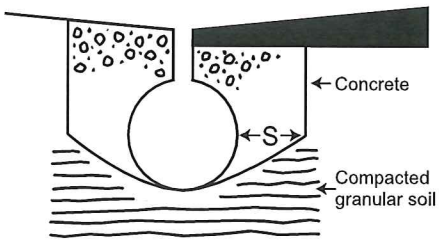
Duraslot surface drains are made from a flexible conduit designed to attain its structural strength utilizing ring compression derived from soil pressure. For this to occur, a minimum cover height of 12" is typically required with N-12 pipe in traffic applications. This cannot be achieved with Duraslot drains because the tops of the grates must be set to finish grade. Therefore, where vehicular traffic may be present, the drain must be backfilled with concrete to support the pipe and provide a non-eroding surface at the top of the slot where water enters the inlet.

Backfill requirements for the Duraslot drain depend on the type of loading on the drain:

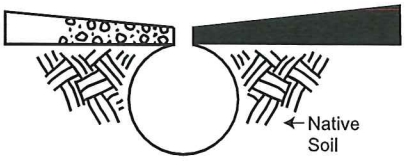
• **Heavy traffic.** Completely surround the drain with concrete for critical loading applications such as frequent H-20 traffic on a highway. The S and B dimensions are typically 3" - 6" depending on specific project conditions (design layout, traffic patterns, soil properties, etc.).



• **Moderate traffic.** Surround the drain with concrete to below the center of the pipe. Used where vehicular traffic is moderate (retail parking lots, driveways, against curbs, etc.).

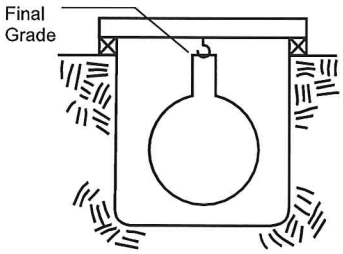


• **Residential/pedestrian traffic.** Concrete, asphalt, or soil concrete slab at grade for non-vehicular installations (patios, sidewalks, against foundations, landscaping projects, etc.).

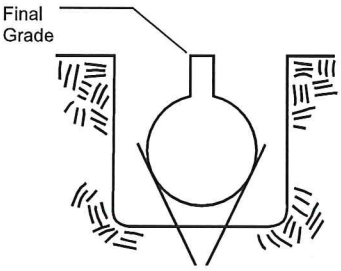


Installation Notes

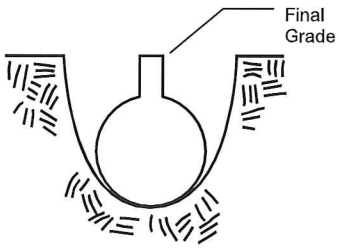
1. Duraslot drains may be set and secured in place using one of the following methods:



a. Hung from cross members on grade



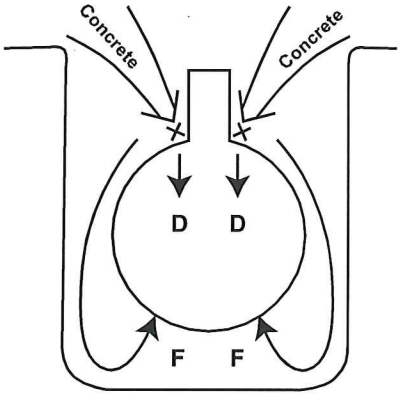
b. Set in a cradle made of rebar or wood



c. Set in the trench bottom (not for H-20 loading)

2. Cover the slot opening to prevent clogging with poured concrete or asphalt. The easiest way to protect the slot is to cover it with 2" duct tape. An alternate method is to place a 2 x 4 on the 2" edge on top of the slot.

3. When pouring concrete around Duraslot drains, especially when the pipe is sitting in a cradle, pour down on the spot where the slot meets the pipe (X), taking care to keep the slot upright. This will provide some downward force (D) that will keep the pipe from rising due to upward force (F) as the concrete fills the trench.



4. The top of the slot opening should always be set 0.25"- 0.50" below finished grade. This allows surface runoff to enter the inlet efficiently while protecting the grate and flanges from possible damage from snowplows or other traffic. A mason's tool can be used to round the edge after the protective tape or 2 x 4 is removed from the slot opening.

5. Duraslot drains are designed as a system, and it is important that the supplied fittings and hardware are used during installation. Grate connectors and anchors keep the grate in tension and tie the ends of the grate into the concrete or asphalt. Anchors and end caps or adapters should always be used at the end of a run. Use only Duraslot coupler bands to join sections of Duraslot drain (see page 2).

Duraslot Pipe Specification

Scope

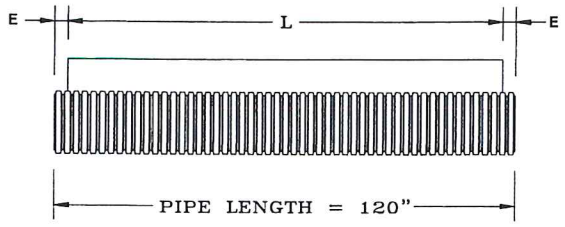
This specification describes 4" to 36" (100 to 900mm) ADS Duraslot pipe for use in surface drain applications.

Pipe Requirements

ADS Duraslot pipe shall have a smooth interior and annular exterior corrugations with an aluminum slot mounted longitudinally along the length of the pipe to accept the grate frame while maintaining the original pipe diameter.

- 4" to 10" (100 to 250mm) pipe shall meet AASHTO M252, Type S.
- 12" to 36" (300 to 900mm) pipe shall meet AASHTO M294, Type S or ASTM F2306.
- Manning's "n" value for use in design shall be 0.012.

The aluminum grate frame shall be manufactured from 0.063" tempered commercial aluminum, consisting of two parallel plates separated by spaces spanning the slot on 6" centers. The grating shall be 1/2 - #13 galvanized steel. The flange at the bottom of the aluminum grate shall be riveted to the pipe with a minimum of two rivets per linear foot.



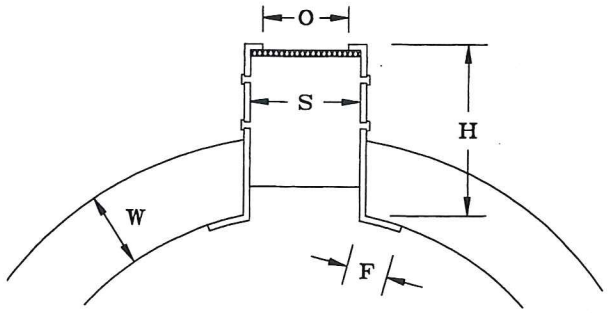
Fittings

Pipe fittings shall conform to AASHTO M252, AASHTO M294, or ASTM F2306.

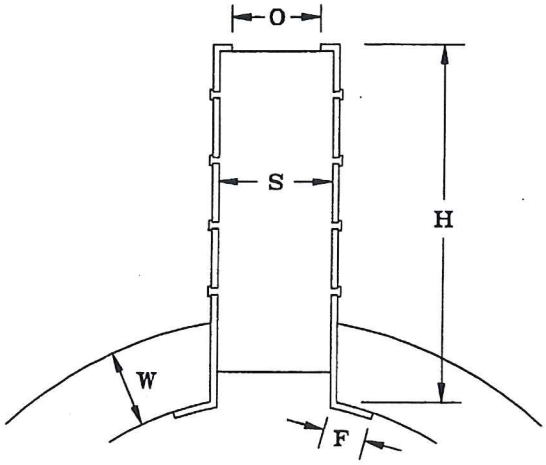
Installation

Contact your local ADS representative for a copy of the installation guidelines from Duraslot.

Physical Dimensions



2.5" Slot shown with 1/2 - #13 Galvanized Grating



6" Slot shown without Grating (Open Top)

	Pipe Diameter									
	4"	6"	8"	10"	12"	15"	18"	24"	30"	36"
H (2.5" Nominal Slot)	2.75" *	3" *	3" *	3"	3.5" *	3.75"	4"	4.75"	5"	5.25"
H (6" Slot)	6.25"	6.5" *	6.5" *	6.5"	7" *	7" *	7" *	7.25"	8.25"	8.25"
W (Corrugation Height)	0.34"	0.46"	0.61"	0.73"	1.15"	1.30"	1.57"	1.86"	2.55"	2.85"
F (Flange Length)	0.5"	0.75"	0.75"	0.75"	0.75"	0.75"	0.75"	1"	1"	1"
O (Opening Width	1.25"	1.75"	1.75"	1.75"	1.75"	1.75"	1.75"	1.75"	1.75"	1.75"
S (Slot Width)	1.75"	2.25"	2.25"	2.25"	2.25"	2.25"	2.25"	2.25"	2.25"	2.25"
L (Drain Grate Lenght)	118"	118"	118"	118"	116"	116"	116"	116"	116"	116"
E (Pipe End Lenght)	1"	1"	1"	1"	2"	2"	2"	2"	2"	2"

* In-stock standard sizes

Case Histories

Interstate Highway Median

For a construction project on I-87 in Westchester County, New York, over two miles of drainage lines were required for the temporary crossovers in the highway median. In the past, corrugated metal slot drain had always been specified for this type of project, but in this instance, Duraslot was accepted as a substitute.

New York DOT and Thruway Authority officials were persuaded that Duraslot drains could not only provide the same structural strength as metal, but the plastic pipe's superior hydraulics would create better flow in this extremely flat terrain. The installing contractors appreciated the product's lighter weight, and the easier and safer methods of connecting the sections together.

More than 11,000 ft. of 15" Duraslot drains were installed on the project. Contractors estimated that installation time was reduced by at least 20%, saving not only project costs, but also the time traffic would be backed up due to crossover construction.

Pedestrian Parkway

The city of Pembroke Pines, Florida, was building a large new park with several athletic fields. Drainage was required in the areas of heavy pedestrian traffic, and corrugated metal slotted drain was originally specified for this purpose.

After learning of the strength, superior flow, and corrosion resistance of the plastic alternative, the engineer changed not only the surface drain specification to Duraslot, but also the remainder of underground drainage to ADS N-12 pipe and Nyloplast® catch basins.

A total of 1,540 ft. of Duraslot 12" drain with a 2.5" slot height were installed.

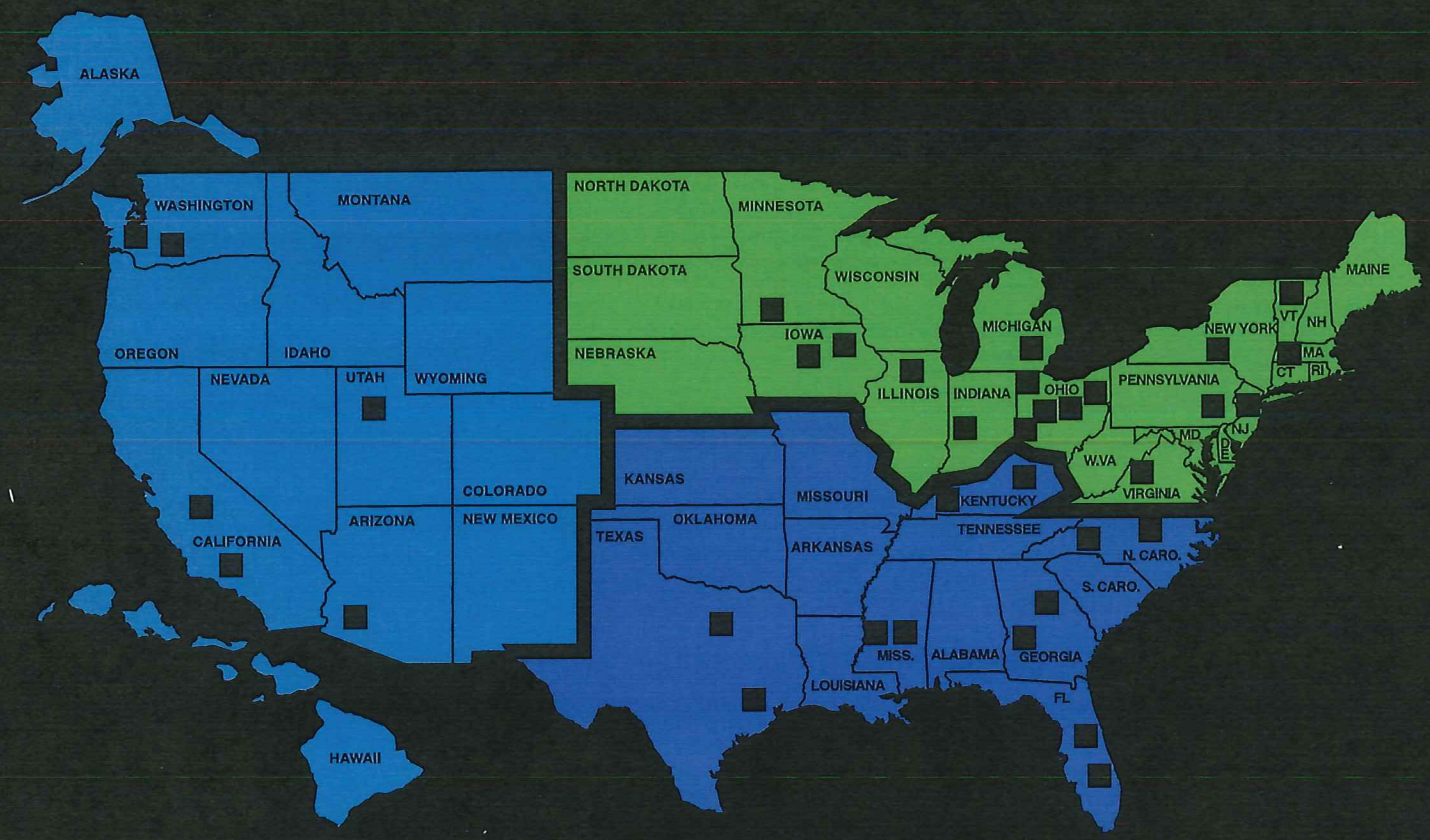
Entrance Boulevard

One of the first right-of-way plastic pipe installations allowed by the city of Chula Vista, California, occurred on the entrance to the West Coast Olympic Training Facility in that city.

Traditionally, bituminous-coated steel slot drain was specified for municipal roadways, but engineers for this project decided to give Duraslot drains a try. More than 1,000 ft. of 18" Duraslot drain were installed at the curb to collect sheet flow from a long sloping curve in the entrance boulevard.

The contractor was extremely pleased with the product, reporting that it cost slightly less than metal, and was lighter in weight and much cleaner to handle than the coated steel. Delivery time for Duraslot drains was noticeably quicker than for the metal pipe, as was installation time, due to the ease with which the plastic could be cut, set in place, and clamped together.

ADS Sales and Service Locations



Customer Service Centers

MIDWEST/ NORTHEAST
LONDON, OH
1-800-733-9554

SOUTHERN
FRANKLIN, TN
1-800-733-9987

WESTERN
VANCOUVER, WA
1-800-733-8523

MANUFACTURING FACILITY LOCATIONS

To learn more about Duraslot surface drains, and the complete line of ADS drainage products, log on to www.ads-pipe.com, or call 1-800-821-6710.

ADS®

THE MOST ADVANCED NAME IN DRAINAGE SYSTEMS®

CORRUGATED POLYETHYLENE PIPE ASSOCIATION CPPA

ADVANCED DRAINAGE SYSTEMS, INC.

4640 TRUEMAN BLVD., HILLIARD, OH 43026

800-821-6710 *www.ads-pipe.com*

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INSPECTION AND MAINTENANCE REPORT FORM
HIGH RES BIOSOLUTIONS, #102 CHERRY HILL DRIVE
BEVERLY MASSACHUSETTS

INSPECTION TO BE COMPLETED EVERY 14 DAYS DURING CONSTRUCTION AND WITHIN 24 HOURS OF A RAINFALL EVENT OF 0.5 INCHES OR GREATER
FOUR TIMES YEARLY THEREAFTER
CLEAN OUT WHEN SEDIMENT ACCUMULATES TO A DEPTH OF 12 INCHES OR GREATER

Inspection Date: _____

Inspected By: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____

Initial Date Catch Basin in Operation _____

Deep Sump Catch Basin

Location	L	R	Hood in Place	Sediment Build-Up / Maintenance

Remarks:

_____

_____

_____

_____

_____

_____

INSPECTION AND MAINTENANCE REPORT FORM
HIGH RES BIOSOLUTIONS, #102 CHERRY HILL DRIVE
BEVERLY MASSACHUSETTS

INSPECTION TO BE COMPLETED IMMEDIATELY AFTER CONSTRUCTION, AND AT LEAST TWICE THE FIRST YEAR OF OPERATION, AND AT LEAST ANNUALLY THEREAFTER.
CLEAN OUT CHAMBERS WHEN SEDIMENT ACCUMULATES TO A DEPTH OF 3 INCHES OR GREATER
SEE MANUFACTURER'S O & M MANUAL

Date: _____

Inspected By: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____

Initial Date Subsurface Chamber System in Operation _____

Surface Detention Basin	
Sediment Depth & General System Conditions	Observations / Maintenance Performed

Additional Remarks:

_____

_____

_____

_____

_____

INSPECTION AND MAINTENANCE REPORT FORM
HIGH RES BIOSOLUTIONS, #102 CHERRY HILL DRIVE
BEVERLY MASSACHUSETTS

INSPECTION TO BE COMPLETED SOON AFTER CONSTRUCTION, AND
AT LEAST TWICE THE FIRST YEAR IN OPERATION, AND
AT LEAST YEARLY THEREAFTER
CLEAN OUT WHEN SEDIMENT ACCUMULATES TO 15% OF STORAGE CAPACITY
SEE MANUFACTURER'S O & M MANUAL

Inspection Date: _____

Inspected By: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____

Initial Date Stormceptor Units in Operation _____

Vortsentry HS36			
Unit Location	Sediment Depth and Pollutant Type & Depth	Inlet / Sump Conditions and General Observations	Maintenance Activity Performed

Remarks:

_____

_____

_____

INSPECTION AND MAINTENANCE REPORT FORM
HIGH RES BIOSOLUTIONS, #102 CHERRY HILL DRIVE
BEVERLY MASSACHUSETTS

INSPECTION TO BE COMPLETED SOON AFTER CONSTRUCTION, AND
AT LEAST TWICE THE FIRST YEAR IN OPERATION, AND
AT LEAST YEARLY THEREAFTER
CLEAN OUT WHEN SEDIMENT ACCUMULATES TO 15% OF STORAGE CAPACITY
SEE MANUFACTURER'S O & M MANUAL

Inspection Date: _____

Inspected By: _____

Days Since Last Rainfall: _____ Amount of Last Rainfall: _____

Initial Date Stormceptor Units in Operation _____

Vortsentry HS48			
Unit Location	Sediment Depth and Pollutant Type & Depth	Inlet / Sump Conditions and General Observations	Maintenance Activity Performed

Remarks:

_____

_____

_____

Existing Watershed Plan in BEVERLY, MASS.

Hayes Engineering, Inc.
Civil Engineers & Land Surveyors
603 Salem Street
Wakefield, MA 01880

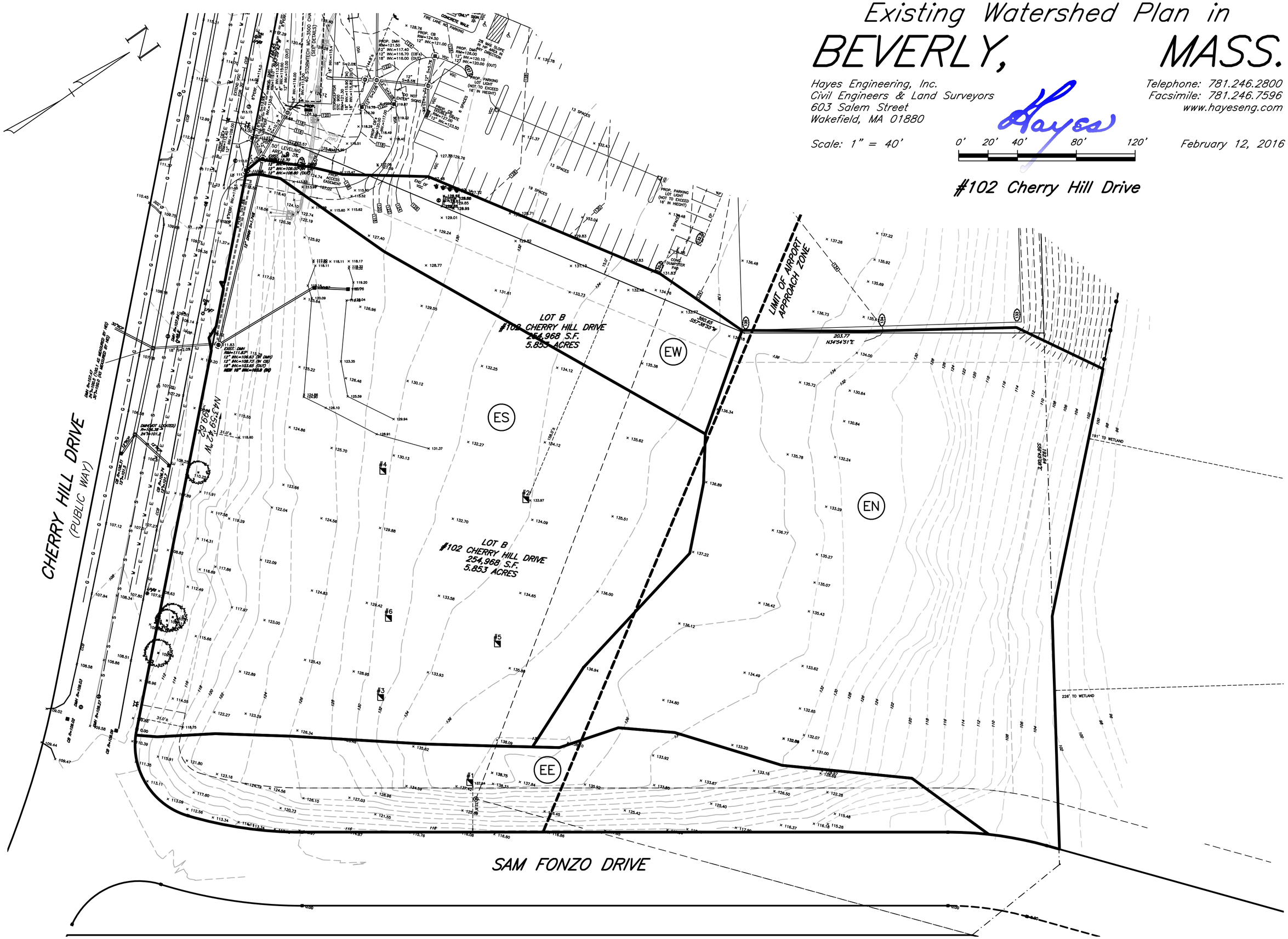
Telephone: 781.246.2800
Facsimile: 781.246.7596
www.hayeseng.com

Scale: 1" = 40'

0' 20' 40' 80' 120'

February 12, 2016

#102 Cherry Hill Drive



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Proposed Watershed Plan in BEVERLY, MASS.

Hayes Engineering, Inc.
Civil Engineers & Land Surveyors
603 Salem Street
Wakefield, MA 01880

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Facsimile: 781.246.7596
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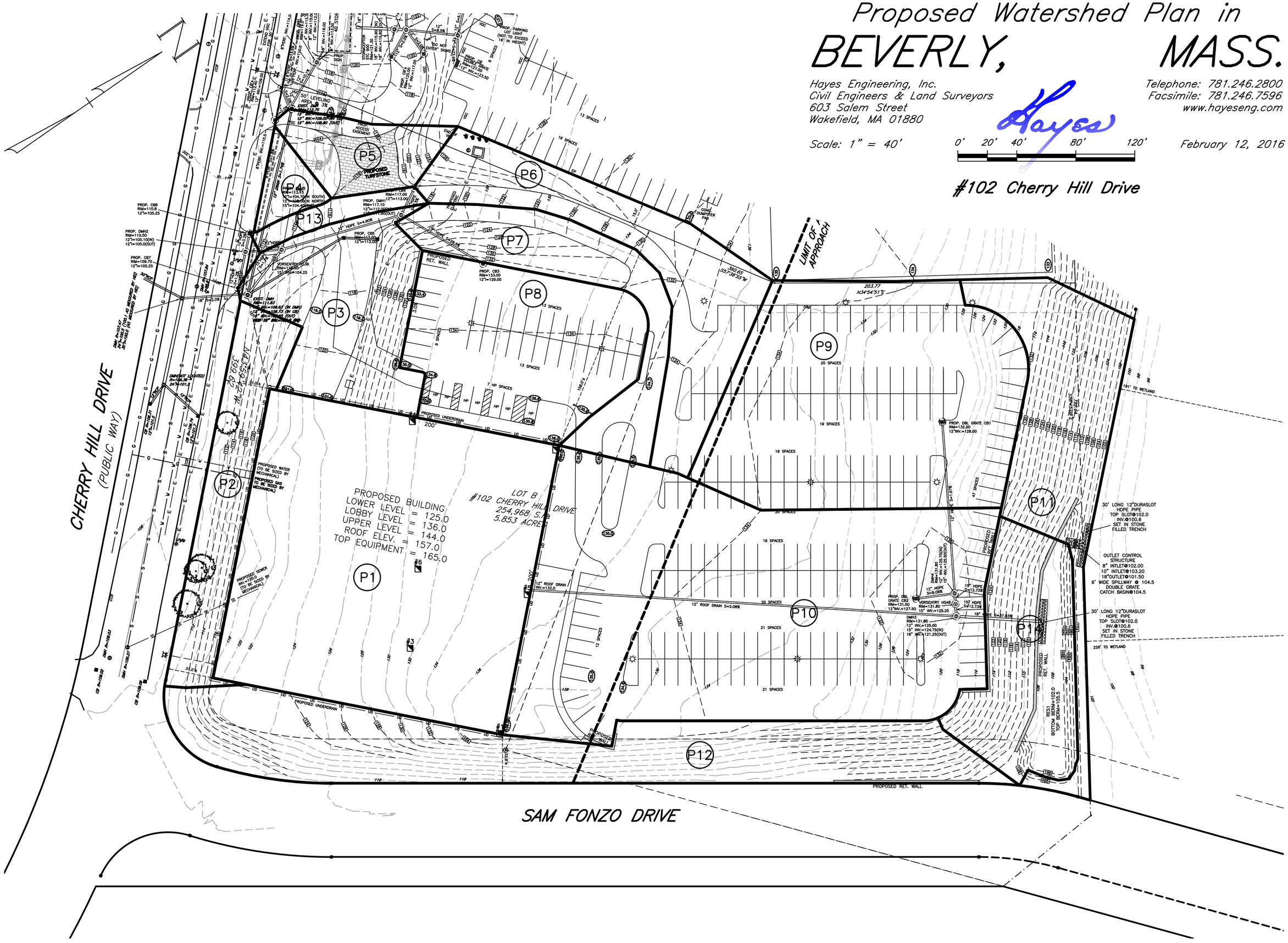
#102 Cherry Hill Drive



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