Stormwater Management Evaluation and Design

Chatham Estates
Mr. Stephen Doyle
Off Woodbridge Street
South Hadley, MA 01075

16 May 2012

Preliminary – for Planning Board Review Only
Not for Construction

Analytical Engineering, Inc.
Consulting Engineers
Granby, MA 0103

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- Structural and Applied Mechanics
- Geotechnical
- Environmental
- Geohydrology
- Earth Resources

Town Hadley Planning Board
Town Hall
125 Main Street
South Hadley, MA 01075
Attn: Mr. Richard Harris, Administator

16 May 2012
File: EC-1-12

Dear Mr. Harris:

As requested by the Town of South Hadley, Analytical Engineering, Inc. ("AEI") presents a stormwater management evaluation report pursuant to the proposed four lot subdivision by Mr. Stephen Doyle.

It is understood that the project is subject to the Town of South Hadley Stormwater By-Law and the technical provisions of the Massachusetts Department of Environmental Protection.

Please feel free to call me at (413) 467-3141 with any questions or clarifications.

Very truly yours,

William A. Shaheen Ph.D.,P.E.
Analytical Engineering, Inc.

cc: Mr. E. Chapdelaine, RLS, Durkee, White, Towne and Chapdelaine, Chicopee, MA
Mr. Stephen Doyle, Owner, South Hadley, MA

I. Introduction

Presented is a discussion and analysis for the proposed stormwater management system for Chatham Estates in South Hadley. The property is owned by Mr. Stephen Doyle who has proposed a four lot site development designed and coordinated through Durkee, Towne, White, and Chapdelaine Land Surveyors and Engineers of Chicopee, MA.

The proposed Chatham Estates is to be located west of Woodbridge Street approximately 500 feet south of the junction with Pearl Street in the northern part of South Hadley.

II. Site Description

The general site topography consists of nearly level rolling plains situated on former farmland with natural drainage patterns trending to the west. The terrain was formed as a glacial outwash plain during the draining of glacial Lake Hitchcock following the last ice age. The USDA/NRCS soil survey of Hampshire County, Central maps the site as a hydrologic soil group A, Windsor soil. Area topography and soil mapping are shown in Figures 2 and 3 [1], [2].

Figure 1. Aerial Photo - courtesy Google Earth

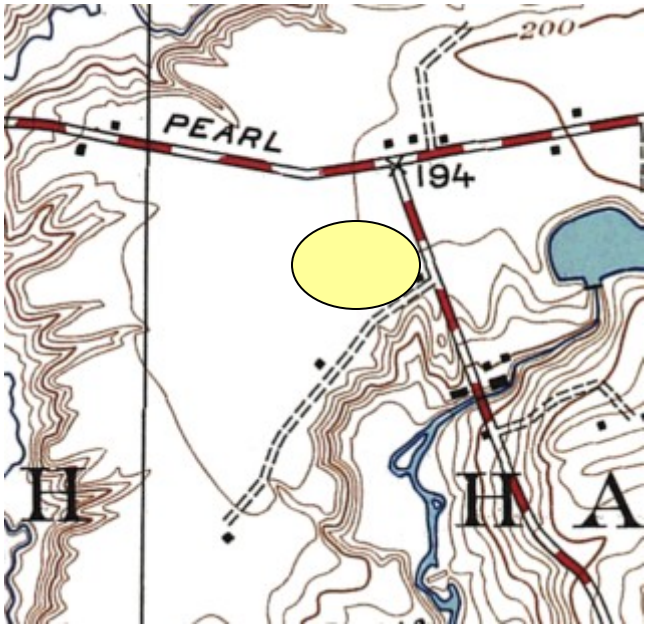


Figure 2. USGS Topographical Map Exerpt – Mt. Holyoke Quadrangle

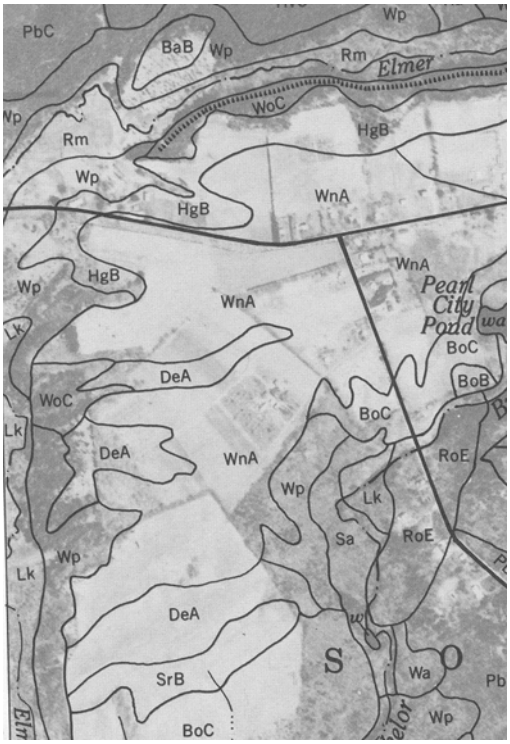
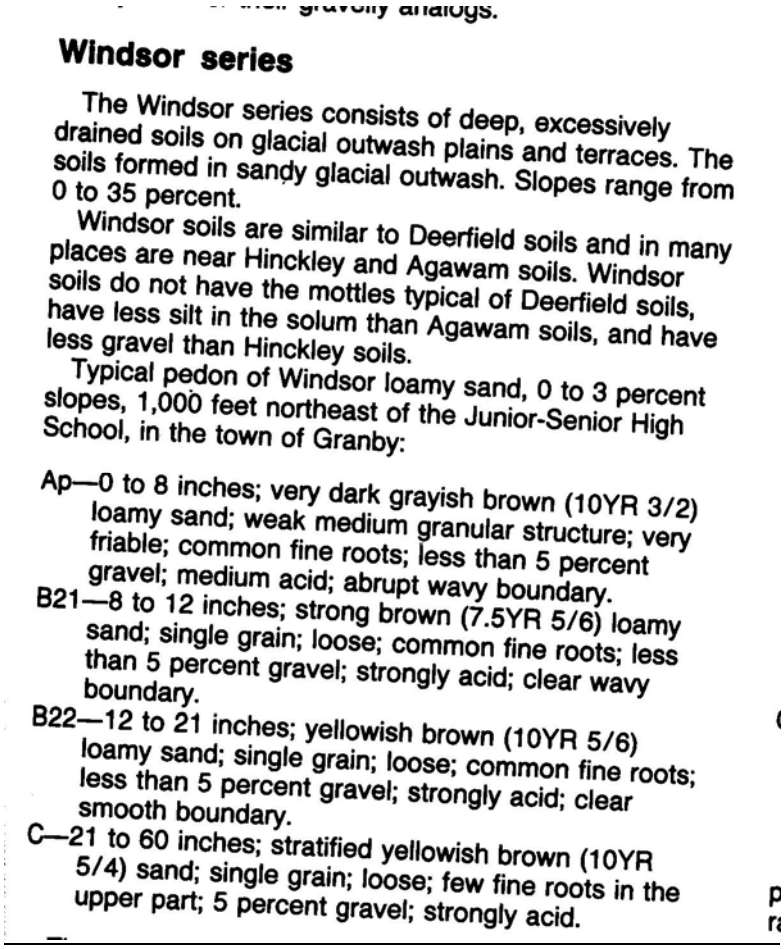


Figure 3. USDA/NRCS Soil Survey Map – Hampshire County Central



gravelly analogs.

Windsor series

The Windsor series consists of deep, excessively drained soils on glacial outwash plains and terraces. The soils formed in sandy glacial outwash. Slopes range from 0 to 35 percent.

Windsor soils are similar to Deerfield soils and in many places are near Hinckley and Agawam soils. Windsor soils do not have the mottles typical of Deerfield soils, have less silt in the solum than Agawam soils, and have less gravel than Hinckley soils.

Typical pedon of Windsor loamy sand, 0 to 3 percent slopes, 1,000 feet northeast of the Junior-Senior High School, in the town of Granby:

Ap—0 to 8 inches; very dark grayish brown (10YR 3/2) loamy sand; weak medium granular structure; very friable; common fine roots; less than 5 percent gravel; medium acid; abrupt wavy boundary.

B21—8 to 12 inches; strong brown (7.5YR 5/6) loamy sand; single grain; loose; common fine roots; less than 5 percent gravel; strongly acid; clear wavy boundary.

B22—12 to 21 inches; yellowish brown (10YR 5/6) loamy sand; single grain; loose; common fine roots; less than 5 percent gravel; strongly acid; clear smooth boundary.

C—21 to 60 inches; stratified yellowish brown (10YR 5/4) sand; single grain; loose; few fine roots in the upper part; 5 percent gravel; strongly acid.

Figure 4. Scan from USDA Soil Survey

Windsor soils are formed on glacial outwash plains and are typically characterized by clean sands in the C horizon. These soils are of high permeability. Numerous local sand and gravel operations are founded in these deposits.

A site investigation by Cold Spring Environmental confirms the Windsor soil series. An independent soil investigation by Analytical Engineering was conducted at the proposed soil detention basin location and concurred with previous information.

III. Stormwater Management Concept and Design Criteria

The proposed stormwater management system at Chatham Estates has been detailed to substantially conform to the Massachusetts Department of Environmental Protection design standards 1 thru 10 as shown in 310 CMR 10.05(6)(k) contents of which as listed below [5].

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

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

3. Loss of annual recharge to ground water shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type.

   This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

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

   a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan and thereafter are implemented and maintained;

   b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with Massachusetts Stormwater Handbook; and

   c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention, all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such use as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26 through 53, and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply and stormwater discharges near or to any other critical area require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such area as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area, if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1. or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited, unless essential to the operation of the public water supply.

7. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural stormwater best management practice requirements of Standards 4, 5 and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

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

9. A long-term operation and maintenance plan shall be developed and implemented to ensure that the stormwater management system functions as designed.

10. All illicit discharges to the stormwater management system are prohibited.

Proposed Management System

The stormwater management system design consists of a berm-protected paved area draining into a system of discrete hooded catch basins. The stormwaters are then conveyed to a grit separation basin afterwhich to a shallow detention/infiltration basin. Peak stormwater flows are controlled using the hydraulic cushioning effect of the basin volume together with a sharp-edged contracted weir at the outfall of the basin. The overflow feeds a depressed level spreader to encourage uniform water discharge to the earth. Soil infiltration during basin wetting has been considered and utilized for post-construction analysis. The design described further in Appendices A and B.

It is anticipated the overflow weir will need some design refinement in the field to meet the required stage/discharge curve due to the high aspect ratio of the weir geometry.

The basin is designed to contain the 100 year, 24 hour storm at pre-construction site discharge flowrates.

IV. Hydrologic and Hydraulic Modeling

Components of the stormwater system are modeled using standard analytical tools. Pipe flows were modeled using Manning's equation as an open channel, the stormwater hydrologic generation model used the NRCS Win-TR55 software and soil infiltration modeling used soil permeability and Darcy's Law [3].

A pre and post construction peak flow rate comparison is required to comply with DEP Standard 2.

Both pre and post construction runoff calculations are based on a watershed area of 7 acres together with hydrologic soil group A for the Windsor type soil.
The existing agricultural field is classified as fallow for pre-construction modeling purposes and was modified to accommodate proposed lawn areas. A maximum of 100 feet of sheet flow was used afterwhich was modeled as shallow concentrated flow. A single subarea discharges to an outlet.

A post construction impervious region encompassing over 28,500 sqft is conveyed directly to the pipe network. The impervious areas in include one-half of each dwellings roof area, the paved roadway and paved driveways. A runoff curve Number ("CN") equal to 98 was used. Here, two subareas feed two reaches one of which is the detention structure. They then parallel flow to the outlet.

Based on available soils information a conservative soil permeability of 0.001 cm/sec was assigned to the soils beneath the proposed basin [4]. Darcy's Law, $Q = k\ i\ A$, is used to compute the quantity of flow infiltrated (discarded) during the flow simulation

procedure. A conservation assumption for the hydraulic gradient i=1 was used. As Win-TR55 does not internally incorporate means to consider soil infiltration, the net flow rate comparisons do require an extra calculation to demonstrate Standard 2 compliance.

A series of compiled numerical output from the various modeling steps are shown in Appendix A.

V. Recharge and Water Quality Evaluation

DEP Standard 3 and 4 require a volumetric calculation to demonstrate compliance of the subject site. Standard 3 mandates a minimum on-site recharge volume and a 72 hr maximum drawtime period to mitigate insect infestation, while Standard 4 provides for the settling of soil fines and turbidity enhancements.

A minimum specified basin size together with a representative minimum soil permeability is necessary to meet Standard 3. A minimum specified water retention volume will meet Standard 4.

Review of available soils information in Appendix C suggests a nominal four foot water table offset from the bottom of the basin to the water table is present.

The computational analysis of the Standards are shown in spreadsheet from in Appendix B.

VI. Evaluation of Standards 5 and 6

It is understood that Standard 5 and 6 do not apply to this project as the site is not subject to higher potential pollutant loads nor is the site in a Zone II of a public water supply.

Accordingly, the latest MassGIS public water supply protection map is shown below for reference [5].

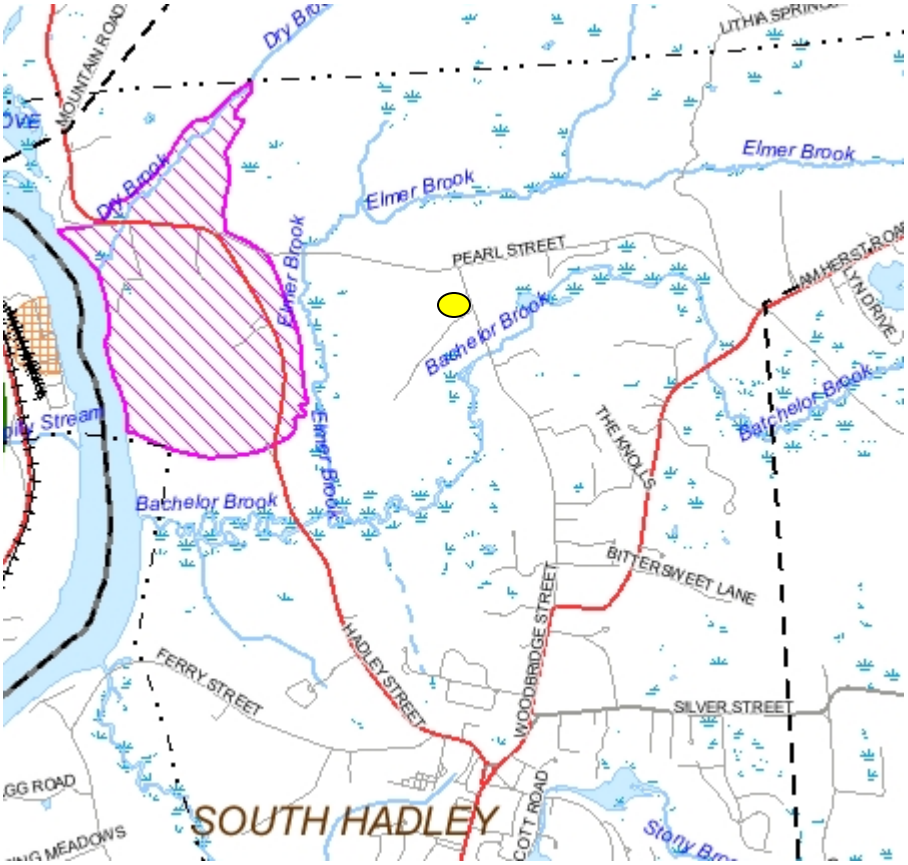


Figure 4. MassGIS Public Water Supply Map

VII. Evaluation of Standards 7 and 8

As the proposed project is not redevelopment, Standard 7 is not applicable. However, Standard 8 will require a Stormwater Pollution Prevention Plan ("SWPPP") to the filed by the general contractor before the commencement of construction. This permit will be filed through the EPA, Boston office and must be posted on-site during the lifetime of the project.

The SWPPP will detail the construction site showing proposed earth storage locations, mitigating measures and a heavy rainfall cleanup plan. The purpose of the SWPPP is to have an approved action plan in place prior to project commencement.

Standard good practice typically includes encircling soil stockpiles with silt barriers, protecting catch basin inlets with filter fabric, providing filter-socks or equal inside downgradient property lines. Frequent sweeping of the Woodbridge Street access will be required as will dust control provisions. A description of any site dewatering methods must also be described. The contractor will keep a working erosion control logbook per SWPPP requirements.

Typically, the Conservation Commission may visit the site periodically to observe site activities.

VIII. Evaluation of Standards 9 and 10

Standard 9 requires the Owner to employ standard sediment management techniques over the lifetime of the project buildout. It is understood, following acceptance of the street to the Town inventory, an Owners association will be formed whose charge will be to manage the stormwater maintenance operations thereafter. Sheet 2 contains additional technical details.

Good practice shall include:

1. Clean accumulated sediment form catch basins at least once each Spring.

2. Monitor silt accumulation on the detention basin, clean when 6" sediment present or outlet structure blocked. An in-situ measurement staff rod is helpful to monitor accumulated sediments.

3. Check catch basin hoods for damage.

4. Check grit chamber for accumulated sediment. Clean when 10% full.

5. Sweep pavements of accumulated debris twice a year.

IX. Summary:

The proposed stormwater management system for Chatham Estates has been described. The design substantially meets the Town stormwater management criteria.

X. References:

[1] United States Geological Survey Quadrangle Maps, *Mt. Holyoke Quadrangle*, 1:25,000 series, 1979.

[2] United States Soil Conservation Service, *Soil Survey of Hampshire County – Central Part*, 1981

[3] United States Department of Agriculture, National Resources Conservation Service, *Win TR-55, Version 1.00.09*, Aug 2009.

[4] Cedergren, H.R, Drainage, Seepage ad Flow Nets, 3rd ed., Wiley, New York, 1989, pp 31-33.

[5] The Commonwealth of Massachusetts, 310 CMR 10.00, Wetland Protection Regulations.

[6] The Commonwealth of Massachusetts, MassGIS, Public Water Supply overlay map.

APPENDIX A

Hydrologic Modeling Studies - Standard 2

Pipe Hydraulics - Typical Approach

Soil Infiltration Analysis

Pre and Post Construction Summary

Basin Design - Detail Sketches

WinTR-55 Current Data Description

--- Identification Data ---

User: was Date: 5/15/2012
Project: Chatham Estates Units: English
SubTitle: Preconstruction Areal Units: Acres
State: Massachusetts
County: Hampshire
Filename: C:\Users\Bill Shaheen\AppData\Roaming\WinTR-55\Chatham Estates 1 pre.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Field	Former crop field	Outlet	7	49	.361

Total area: 7 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr
3.0	3.9	4.5	5.2	5.9	6.4	2.5

Storm Data Source: Hampshire County, MA (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

was Chatham Estates
Preconstruction
Hampshire County, Massachusetts

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr
3.0	3.9	4.5	5.2	5.9	6.4	2.5

Storm Data Source: Hampshire County, MA (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

was Chatham Estates
Preconstruction
Hampshire County, Massachusetts

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period ANALYSIS: 10-Yr (cfs)	100-Yr (cfs)
SUBAREAS		
Field	0.07	1.34	5.53
REACHES		
OUTLET	**0.07**	**1.34**	**5.53**

was Chatham Estates
Preconstruction
Hampshire County, Massachusetts

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
Field	0.07 14.89	1.34 12.46	5.53 12.33
REACHES		
OUTLET	0.07	1.34	5.53

was Chatham Estates
Preconstruction
Hampshire County, Massachusetts

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Field	7.00	0.361	49	Outlet	Former crop field

Total Area: 7 (ac)

was Chatham Estates
Preconstruction
Hampshire County, Massachusetts

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Travel Velocity (ft/sec)	Time (hr)
Field							
SHEET	100	0.0085	0.170			0.262	
SHALLOW	530	0.0085	0.050			0.099	
					Time of Concentration		.361

was Chatham Estates
Preconstruction
Hampshire County, Massachusetts

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Field	CN directly entered by user	-	7	49
	Total Area / Weighted Curve Number		7	49

WinTR-55 Current Data Description

--- Identification Data ---

User: was Date: 5/15/2012
Project: Chatham Estates Units: English
SubTitle: Post Construction Areal Units: Acres
State: Massachusetts
County: Hampshire
Filename: C:\Users\Bill Shaheen\AppData\Roaming\WinTR-55\Chatham Estates 1 Post 7May12.w55

--- Sub-Area Data ---

Name	Description	Reach	Area(ac)	RCN	Tc
Impervious	Pavement, ect.	Reach 1	0.65	98	0.1
Field	Remainder of site	Outlet	6.35	50	.374

Total area: 7 (ac)

--- Storm Data --

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.0	3.9	4.5	5.2	5.9	6.4	2.5

Storm Data Source: Hampshire County, MA (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	1-Yr (in)
3.0	3.9	4.5	5.2	5.9	6.4	2.5

Storm Data Source: Hampshire County, MA (NRCS)
Rainfall Distribution Type: Type III
Dimensionless Unit Hydrograph: <standard>

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Watershed Peak Table

Sub-Area or Reach Identifier	Peak Flow by Rainfall Return Period ANALYSIS: 10-Yr (cfs)	100-Yr (cfs)
SUBAREAS		
Impervious	1.62	2.45	3.50
Field	0.08	1.41	5.39
REACHES		
Reach 1	1.62	2.45	3.50
Down	1.62	2.45	3.49
Reach 2	1.62	2.45	3.49
Down	0.15	0.29	0.50
OUTLET	0.22	1.69	5.84

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period ANALYSIS: 10-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS		
Impervious	1.62 12.10	2.45 12.10	3.50 12.10
Field	0.08 13.98	1.41 12.43	5.39 12.32
REACHES		
Reach 1	1.62 12.10	2.45 12.10	3.50 12.10
Down	1.62 12.12	2.45 12.12	3.49 12.13
Reach 2	1.62 12.12	2.45 12.12	3.49 12.13
Down	0.15 13.08	0.29 12.81	0.50 12.66
OUTLET	**0.22**	**1.69**	**5.84**

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Structure Output Table

Reach Identifier / Structure Identifier	Peak Flow (PF), Storage Volume (SV), Stage (STG) by Rainfall Return Period ANALYSIS:	10-Yr	100-Yr
Reach: Reach 2			
Weir : DBasin 0.1(ft)			
	PF (cfs)	0.15	0.29	0.50
	SV (ac ft)	.08	.13	.18
	STG (ft)	.73	1.14	1.63

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Sub-Area Summary Table

Sub-Area Identifier	Drainage Area (ac)	Time of Concentration (hr)	Curve Number	Receiving Reach	Sub-Area Description
Impervious	.65	0.100	98	Reach 1	Pavement, ect.
Field	6.35	0.374	50	Outlet	Remainder of site

Total Area: 7 (ac)

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Reach Summary Table

Reach Identifier	Receiving Reach Identifier	Reach Length (ft)	Routing Method
Reach 1	Reach 2	500	CHANNEL
Reach 2	Outlet		STRUCTURE(DBasin)

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Impervious							
SHEET	100	0.0100	0.011				0.028
CHANNEL	400	0.0050	0.015	2.00	4.00	4.444	0.025
					Time of Concentration		0.1
Field							
SHEET	100	0.0085	0.170				0.262
SHALLOW	600	0.0085	0.050				0.112
					Time of Concentration		.374

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use	Hydrologic Soil Group	Sub-Area (ac)	Curve Number
Impervious	CN directly entered by user	-	.65	98
	Total Area / Weighted Curve Number		.65	98
Field	Residential districts (1 acre)	A	2	51
	Pasture, grassland or range (fair)	A	4.35	49
	Total Area / Weighted Curve Number		6.35	50

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Reach Channel Rating Details

Reach Identifier	Reach Length (ft)	Reach Manning's n	Friction Slope (ft/ft)	Bottom Width (ft)	Side Slope
Reach 1	500	0.011	0.005	1	1 :1
Reach 2	(This reach is a structure: DBasin)				

Reach Identifier	Stage (ft)	End Flow (cfs)	Area (sq ft)	Top Width (ft)	Friction Slope (ft/ft)
Reach 1	0.0	0.000	0	1	0.005
	0.5	3.286	0.8	2	
	1.0	12.392	2	3	
	2.0	53.479	6	5	
	5.0	452.052	30	11	
	10.0	2539.078	110	21	
	20.0	15091.641	420	41	
Reach 2	(This reach is a structure: DBasin)				

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

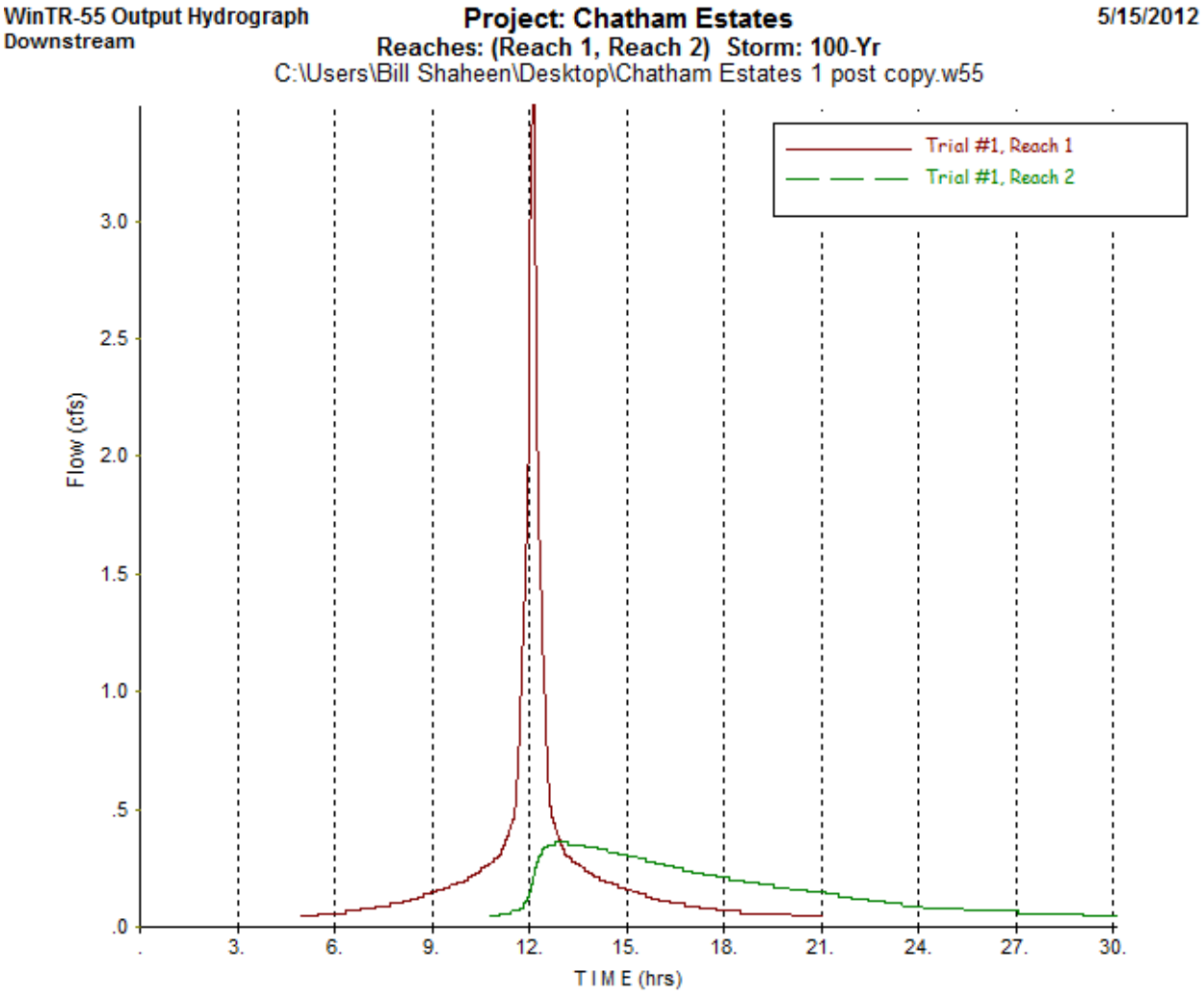
Structure Description - User Entered

Reach Identifier	Surface Area @ Crest (ac)	Height Above Crest (ft)	Surface Area @ Ht Above (ac)	Pipe Diameter (in)	Head on Pipe (ft)	Weir Length (ft)
Reach 2	0.11		0.083			

was Chatham Estates
Post Construction
Hampshire County, Massachusetts

Structure Rating Details - Computed

Reach Idendifier	Pool Stage (ft)	Storage (ac ft)	Flows (cfs) @ Weir Length 0.083ft	Length #1 ft	Length #2 ft	Length #3 ft
DBasin	0	0.00	0.000			
	0.5	0.06	0.082			
	1	0.11	0.232			
	2	0.22	0.657			
	5	0.55	2.598			
	10	1.10	7.349			
	20	2.20	20.786			



Effect of Basin Attenuation (Reach 2 downstream)

PROJECT NAME: *CHATHAM ESTATES* DATE: *9-May-12*
PROJECT LOCATION: *WOODBRIDGE STREET*
SOUTH HADLEY, MA
CLIENT NAME: *STEPHEN DOYLE*
JOB No.: *131-1104*

STORM FLOW / CAPACITY -

Pipe Diameter, inches =	*24*
Slope (ft/ft) =	*0.005*
Pipe Material =	ADS N-12
Roughness Coefficient, n =	*0.012*

Pipe Radius, feet = 1.00

Maximum Flow, cfs =	*18.69*
Maximum Velocity, f/s =	*6.30*

From DMH 2 to Flared End Outlet

Angle Degrees	Pipe Flow Depth (ft)	Depth by %	Area (ft^2)	Perimiter (ft)	Hydraulic Radius	Velocity (f/s)	Capacity (c.f.s.)
0	0	0.0	0.0000	0.00000		0.0	0.00
5	0.00	0.0	0.0001	0.08727	0.00	0.1	0.00
10	0.00	0.2	0.0004	0.17453	0.00	0.2	0.00
15	0.01	0.4	0.0015	0.26180	0.01	0.3	0.00
20	0.02	0.8	0.0035	0.34907	0.01	0.4	0.00
25	0.02	1.2	0.0069	0.43633	0.02	0.6	0.00
30	0.03	1.7	0.0118	0.52360	0.02	0.7	0.01
35	0.05	2.3	0.0186	0.61087	0.03	0.9	0.02
40	0.06	3.0	0.0277	0.69813	0.04	1.0	0.03
45	0.08	3.8	0.0391	0.78540	0.05	1.2	0.05
50	0.09	4.7	0.0533	0.87266	0.06	1.4	0.07
55	0.11	5.6	0.0704	0.95993	0.07	1.5	0.11
60	0.13	6.7	0.0906	1.04720	0.09	1.7	0.16
65	0.16	7.8	0.1141	1.13446	0.10	1.9	0.22
70	0.18	9.0	0.1410	1.22173	0.12	2.1	0.29
75	0.21	10.3	0.1715	1.30900	0.13	2.3	0.39
80	0.23	11.7	0.2057	1.39626	0.15	2.4	0.50
85	0.26	13.1	0.2437	1.48353	0.16	2.6	0.64
90	0.29	14.6	0.2854	1.57080	0.18	2.8	0.80
95	0.32	16.2	0.3309	1.65806	0.20	3.0	0.99
100	0.36	17.9	0.3803	1.74533	0.22	3.2	1.21
105	0.39	19.6	0.4333	1.83260	0.24	3.4	1.45
110	0.43	21.3	0.4901	1.91986	0.26	3.5	1.73
115	0.46	23.1	0.5504	2.00713	0.27	3.7	2.04
120	0.50	25.0	0.6142	2.09440	0.29	3.9	2.38
125	0.54	26.9	0.6813	2.18166	0.31	4.0	2.75
130	0.58	28.9	0.7514	2.26893	0.33	4.2	3.16
135	0.62	30.9	0.8245	2.35619	0.35	4.4	3.60
140	0.66	32.9	0.9003	2.44346	0.37	4.5	4.06
145	0.70	35.0	0.9786	2.53073	0.39	4.7	4.56
150	0.74	37.1	1.0590	2.61799	0.40	4.8	5.09
155	0.78	39.2	1.1413	2.70526	0.42	4.9	5.64
160	0.83	41.3	1.2253	2.79253	0.44	5.1	6.21
165	0.87	43.5	1.3105	2.87979	0.46	5.2	6.81
170	0.91	45.6	1.3967	2.96706	0.47	5.3	7.42
175	0.96	47.8	1.4836	3.05433	0.49	5.4	8.05
180	1.00	50.0	1.5708	3.14159	0.50	5.5	8.69
185	1.04	52.2	1.6580	3.22886	0.51	5.6	9.33
190	1.09	54.4	1.7449	3.31613	0.53	5.7	9.99
195	1.13	56.5	1.8311	3.40339	0.54	5.8	10.64
200	1.17	58.7	1.9163	3.49066	0.55	5.9	11.28
205	1.22	60.8	2.0003	3.57792	0.56	6.0	11.92
210	1.26	62.9	2.0826	3.66519	0.57	6.0	12.54
215	1.30	65.0	2.1630	3.75246	0.58	6.1	13.15
220	1.34	67.1	2.2413	3.83972	0.58	6.1	13.74
225	1.38	69.1	2.3170	3.92699	0.59	6.2	14.31
230	1.42	71.1	2.3902	4.01426	0.60	6.2	14.85
235	1.46	73.1	2.4603	4.10152	0.60	6.2	15.36
240	1.50	75.0	2.5274	4.18879	0.60	6.3	15.84
245	1.54	76.9	2.5912	4.27606	0.61	6.3	16.29
250	1.57	78.7	2.6515	4.36332	0.61	6.3	16.70
255	1.61	80.4	2.7083	4.45059	0.61	6.3	17.08
260	1.64	82.1	2.7613	4.53786	0.61	6.3	17.41
265	1.68	83.8	2.8107	4.62512	0.61	6.3	17.70
270	1.71	85.4	2.8562	4.71239	0.61	6.3	17.96
275	1.74	86.9	2.8979	4.79966	0.60	6.3	18.18
280	1.77	88.3	2.9359	4.88692	0.60	6.3	18.35
285	1.79	89.7	2.9701	4.97419	0.60	6.2	18.49
290	1.82	91.0	3.0006	5.06145	0.59	6.2	18.59
295	1.84	92.2	3.0275	5.14872	0.59	6.2	18.66
300	1.87	93.3	3.0510	5.23599	0.58	6.1	18.69
305	1.89	94.4	3.0712	5.32325	0.58	6.1	18.69
310	1.91	95.3	3.0883	5.41052	0.57	6.0	18.66
315	1.92	96.2	3.1024	5.49779	0.56	6.0	18.60
320	1.94	97.0	3.1139	5.58505	0.56	5.9	18.52
325	1.95	97.7	3.1229	5.67232	0.55	5.9	18.42
330	1.97	98.3	3.1298	5.75959	0.54	5.8	18.30
335	1.98	98.8	3.1347	5.84685	0.54	5.8	18.16
340	1.98	99.2	3.1381	5.93412	0.53	5.7	18.02
345	1.99	99.6	3.1401	6.02139	0.52	5.7	17.86
350	2.00	99.8	3.1412	6.10865	0.51	5.6	17.70
355	2.00	100.0	3.1415	6.19592	0.51	5.6	17.54
360	2.00	100.0	3.1416	6.28319	0.50	5.5	17.38

PROJECT NAME: *CHATHAM ESTATES* DATE: *9-May-12*
PROJECT LOCATION: *WOODBRIDGE STREET*
SOUTH HADLEY, MA
CLIENT NAME: *STEPHEN DOYLE*
JOB No.: *131-1104*

STORM FLOW / CAPACITY -

Pipe Diameter, inches =	*18*
Slope (ft/ft) =	*0.005*
Pipe Material =	ADS N-12
Roughness Coefficient, n =	*0.012*

Pipe Radius, feet = 0.75

Maximum Flow, cfs =	*8.68*
Maximum Velocity, f/s =	*5.20*

From DMH 1 to DMH 2

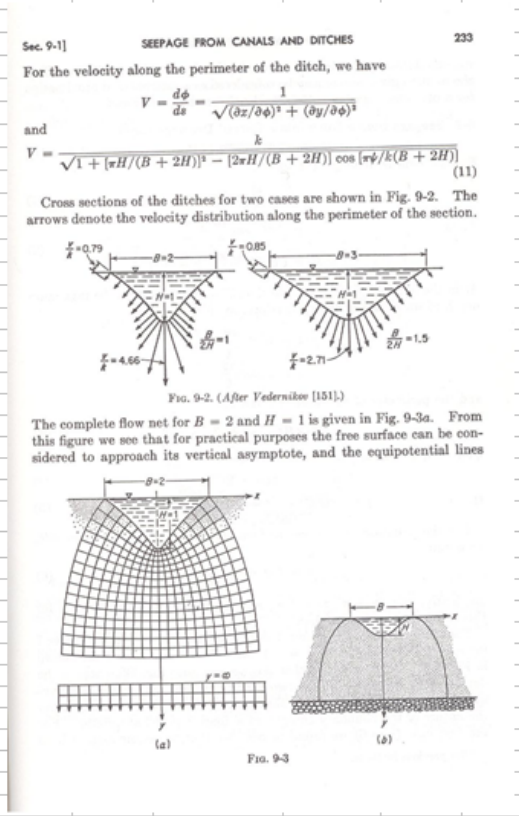
Angle Degrees	Pipe Flow Depth (ft)	Depth by %	Area (ft^2)	Perimiter (ft)	Hydraulic Radius	Velocity (f/s)	Capacity (c.f.s.)
0	0	0.0	0.0000	0.00000		0.0	0.00
5	0.00	0.0	0.0000	0.06545	0.00	0.1	0.00
10	0.00	0.2	0.0002	0.13090	0.00	0.1	0.00
15	0.01	0.4	0.0008	0.19635	0.00	0.2	0.00
20	0.01	0.8	0.0020	0.26180	0.01	0.3	0.00
25	0.02	1.2	0.0039	0.32725	0.01	0.5	0.00
30	0.03	1.7	0.0066	0.39270	0.02	0.6	0.00
35	0.03	2.3	0.0105	0.45815	0.02	0.7	0.01
40	0.05	3.0	0.0156	0.52360	0.03	0.8	0.01
45	0.06	3.8	0.0220	0.58905	0.04	1.0	0.02
50	0.07	4.7	0.0300	0.65450	0.05	1.1	0.03
55	0.08	5.6	0.0396	0.71995	0.05	1.3	0.05
60	0.10	6.7	0.0510	0.78540	0.06	1.4	0.07
65	0.12	7.8	0.0642	0.85085	0.08	1.6	0.10
70	0.14	9.0	0.0793	0.91630	0.09	1.7	0.14
75	0.15	10.3	0.0965	0.98175	0.10	1.9	0.18
80	0.18	11.7	0.1157	1.04720	0.11	2.0	0.23
85	0.20	13.1	0.1371	1.11265	0.12	2.2	0.30
90	0.22	14.6	0.1605	1.17810	0.14	2.3	0.37
95	0.24	16.2	0.1862	1.24355	0.15	2.5	0.46
100	0.27	17.9	0.2139	1.30900	0.16	2.6	0.56
105	0.29	19.6	0.2438	1.37445	0.18	2.8	0.68
110	0.32	21.3	0.2757	1.43990	0.19	2.9	0.80
115	0.35	23.1	0.3096	1.50535	0.21	3.1	0.95
120	0.38	25.0	0.3455	1.57080	0.22	3.2	1.11
125	0.40	26.9	0.3832	1.63625	0.23	3.3	1.28
130	0.43	28.9	0.4227	1.70170	0.25	3.5	1.47
135	0.46	30.9	0.4638	1.76715	0.26	3.6	1.67
140	0.49	32.9	0.5064	1.83260	0.28	3.7	1.89
145	0.52	35.0	0.5504	1.89805	0.29	3.8	2.12
150	0.56	37.1	0.5957	1.96350	0.30	4.0	2.36
155	0.59	39.2	0.6420	2.02895	0.32	4.1	2.62
160	0.62	41.3	0.6892	2.09440	0.33	4.2	2.88
165	0.65	43.5	0.7371	2.15984	0.34	4.3	3.16
170	0.68	45.6	0.7856	2.22529	0.35	4.4	3.45
175	0.72	47.8	0.8345	2.29074	0.36	4.5	3.74
180	0.75	50.0	0.8836	2.35619	0.38	4.6	4.03
185	0.78	52.2	0.9326	2.42164	0.39	4.6	4.33
190	0.82	54.4	0.9815	2.48709	0.39	4.7	4.64
195	0.85	56.5	1.0300	2.55254	0.40	4.8	4.94
200	0.88	58.7	1.0779	2.61799	0.41	4.9	5.24
205	0.91	60.8	1.1252	2.68344	0.42	4.9	5.53
210	0.94	62.9	1.1715	2.74889	0.43	5.0	5.82
215	0.98	65.0	1.2167	2.81434	0.43	5.0	6.11
220	1.01	67.1	1.2607	2.87979	0.44	5.1	6.38
225	1.04	69.1	1.3033	2.94524	0.44	5.1	6.65
230	1.07	71.1	1.3445	3.01069	0.45	5.1	6.90
235	1.10	73.1	1.3839	3.07614	0.45	5.2	7.13
240	1.13	75.0	1.4217	3.14159	0.45	5.2	7.36
245	1.15	76.9	1.4575	3.20704	0.45	5.2	7.56
250	1.18	78.7	1.4915	3.27249	0.46	5.2	7.76
255	1.21	80.4	1.5234	3.33794	0.46	5.2	7.93
260	1.23	82.1	1.5532	3.40339	0.46	5.2	8.08
265	1.26	83.8	1.5810	3.46884	0.46	5.2	8.22
270	1.28	85.4	1.6066	3.53429	0.45	5.2	8.34
275	1.30	86.9	1.6301	3.59974	0.45	5.2	8.44
280	1.32	88.3	1.6514	3.66519	0.45	5.2	8.52
285	1.35	89.7	1.6707	3.73064	0.45	5.1	8.59
290	1.36	91.0	1.6878	3.79609	0.44	5.1	8.63
295	1.38	92.2	1.7030	3.86154	0.44	5.1	8.66
300	1.40	93.3	1.7162	3.92699	0.44	5.1	8.68
305	1.42	94.4	1.7276	3.99244	0.43	5.0	8.68
310	1.43	95.3	1.7372	4.05789	0.43	5.0	8.66
315	1.44	96.2	1.7451	4.12334	0.42	4.9	8.64
320	1.45	97.0	1.7516	4.18879	0.42	4.9	8.60
325	1.47	97.7	1.7567	4.25424	0.41	4.9	8.55
330	1.47	98.3	1.7605	4.31969	0.41	4.8	8.50
335	1.48	98.8	1.7633	4.38514	0.40	4.8	8.43
340	1.49	99.2	1.7652	4.45059	0.40	4.7	8.37
345	1.49	99.6	1.7663	4.51604	0.39	4.7	8.29
350	1.50	99.8	1.7669	4.58149	0.39	4.7	8.22
355	1.50	100.0	1.7671	4.64694	0.38	4.6	8.14
360	1.50	100.0	1.7671	4.71239	0.38	4.6	8.07

*= unity gradient

Quick Subsurface Exfiltration Model

Use	Q = CIA	>>>>>>>	C	0	ND							
			I	0	in/hr	Q =	0	cfs				
			A	0	acres							
	Leaching= SA	3600	sqft	Leaching Pipe diameter			0	ft		0	cf/LF	
				LF of pipe			0	ft		**0**	cf	
				Void volume in stone			x	y	z			
							0	0	0	**0**	cf	35% porosity

Time (mins)	Runoff Q in (cf)	Rate of Soil Infiltration (cfs) *	Total Infiltration Q out (cf)	Water Storage Req'd cf	
1	0	0.59	35	-35	OK
5	0	0.59	177	-177	OK
10	0	0.59	354	-354	OK
15	0	0.59	531	-531	OK
20	0	0.59	709	-709	OK
30	0	0.59	1063	-1063	OK
				0	**cf**



Sec. 9-1] SEEPAGE FROM CANALS AND DITCHES 233

For the velocity along the perimeter of the ditch, we have

$$V = \frac{d\phi}{ds} = \frac{1}{\sqrt{(\partial x/\partial\phi)^2 + (\partial y/\partial\phi)^2}}$$

and

$$V = \frac{k}{\sqrt{1 + [\pi H/(B+2H)]^2 - [2\pi H/(B+2H)]\cos[\pi\psi/k(B+2H)]}} \quad (11)$$

Cross sections of the ditches for two cases are shown in Fig. 9-2. The arrows denote the velocity distribution along the perimeter of the section.

FIG. 9-2. (*After Vedernikov* [151].)

The complete flow net for $B = 2$ and $H = 1$ is given in Fig. 9-3a. From this figure we see that for practical purposes the free surface can be considered to approach its vertical asymptote, and the equipotential lines

FIG. 9-3

Assigned Permeability

k =	0.005	cm/sec		
=	14.173	ft/day	= 0.000164042	ft/sec

k = 0.005 cm/sec
Conservative

Seepage Analysis – Infiltration. Note flared streamlines increases effective area.

Project Summary

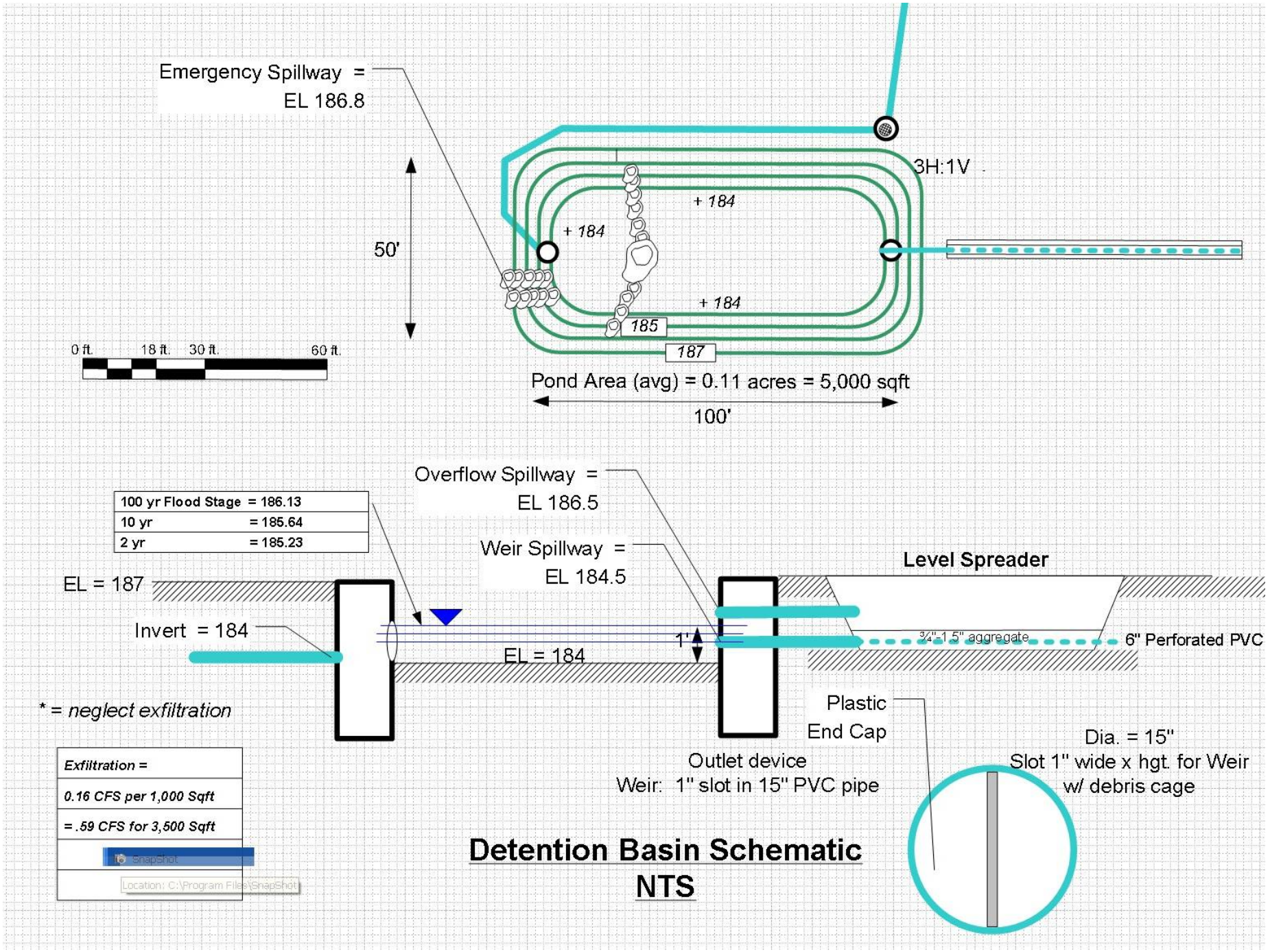
Pre Construction Peak Flow **100 year storm = 5.53 CFS**

Post Construction Peak Flow **= 5.84 CFS**
- 0.59 CFS (Soil infiltration)

= 5.25 CFS

Conclusion:

Standard 2 is met



Detention Basin Schematic
NTS

APPENDIX B

Recharge Analysis	-	Standard 3
Water Quality Analysis	-	Standard 4

Stormwater Spreadsheet

Standard 3 - Recharge

Example: Assume a one (1) acre undeveloped site. Assume 75% impervious area is proposed (0.75-acre). The soils are classified as Hydrologic Soil Group "A."
An infiltration basin is proposed to meet Stormwater Standard 3. Determine the storage volume of the infiltration basin, using the Static method.

Solution: The *Required Recharge Volume* is based on 0.60-inches (see Table 2) of runoff. Using *Equation (1):*

Site=
HSG A

$Rv = F \times \text{impervious area}$
$Rv = (F_{HSG\ "A"}) \times (\text{impervious area})$
$Rv = [(0.6 \text{ inches}/12 \text{ inches/foot})][(0.75\text{-acre})(43{,}560 \text{ square feet/acre})]$
$Rv = 1{,}633.5 \text{ cubic feet or } 60.5 \text{ cubic yards}$

NRCS HYDROLOGIC SOIL TYPE	APPROX. SOIL TEXTURE	TARGET DEPTH FACTOR (F)
A	sand	**0.6-inch**
B	loam	**0.35-inch**
C	silty loam	**0.25-inch**
D	clay	**0.1-inch**

Table 2.3.2: Recharge Target Depth by Hydrologic Soil Group

Static Method

Step 3

Solve for required volume

Volume = F * Impervious Area * (1 ft/12 in)

F =	0.6	inches	from Table 2.3.2
Impervious Area =	28500	sf	Computed for site
Volume =	**1425**	**cf**	required volume

Dimension check	in	ft ft	1 ft / 12 in	OK

Provided:				
Detention Basin	30' x 80'	@ 0.6" depth"	**2400**	**sf**

Comment: Can reduce Volume by using weighed average of NRCS on-site soil types. See Table 2.3.2

Solution: The Rawls infiltration rate is 2.41 inches/hour for loamy sand (See Table 3).
Assuming the infiltration rate is constant, the time to drawdown the 1620 cubic feet Required Recharge Volume would be:

$Time_{drawdown}$ = (*Required Recharge Volume in cubic feet as determined by the Static Method*)(1/Design Infiltration Rate in inches per hour)(conversion for inches to feet)(1/bottom area in feet)

$Time_{drawdown}$ = (1620 cubic feet)(1/2.4 inches/hour)(1 ft/12 inches)(1/200 square feet)

$Time_{drawdown}$ = 40.5 hours

Dimension check	ft ft ft	hr / in	check: 12 in / 1 ft	ft ft	OK

Drawdown Time

Step 5

Solve for drawdown time, T

T = Volume * (1/I) * (1/A) * (12 in/1 ft)

Volume =	1425	cf	from above
I =	2.41	inches/hr	Loamy Sand — Rawl's approach, assumes hydraulic gradient of 1
A =	2400	sf	(bottom area only)
T =	**3.0 hours**	**OK**	must be < 72 hours

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Table 2.3.3: Rawls, Brakensiek and Saxton, 1982[12]

Stormwater Spreadsheet

Standard 4 - Water Quality

Note: ***44% TSS Pretreatment Removal required - see Standard 5***

INSTRUCTIONS:
1. Complete Blue Blocks
2. In BMP Column, Click on Blue Cell to Activate Drop Down Menu
3. Select BMP from the Drop Down Menu

Location: Chatham Estates

TSS Removal Calculation Worksheet

	B BMP[1]	C TSS Removal Rate[2]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
		0.00	1.00	0.00	1.00
	Deep Sump and Hooded Catch Basin	0.25	1.00	0.25	0.75
	Sediment Trap (Forebay)	0.25	0.75	0.19	0.56
		0.00	0.56	0.00	0.56
		0.00	0.56	0.00	0.56
	Total TSS Removal =				44%

Project:
Prepared By: EC/WAS
Date:

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

1. BMP From Table on Page 1-7 of MassDEP Stormwater Mgt. Policy Handbook Volume 1
2. TSS Removal Rate from Table on page 1-7 of the MassDEP Stormwater Mgt. Policy: Volume 1

Note:

TSS Removal

Oil Grit separator = 25% used sediment forebay in spreadsheet

Determine whether 1"2" or 1" water depth required for analysis.

Example for 1-inch D_{WQ}: Assume a two (2) acre site. One (1) acre is to be developed for a retail store and parking lot.

Solution: The *Required Water Quality Volume* is determined for the impervious surface

The parking lot is proposed to have 50 parking spaces, and generate less than 1,000 vehicle trips/day. The discharge is proposed to be directed to a wetland resource area that is a cold- water fishery. A cold -water fishery is defined as a critical area by the Wetland Regulations. The Required Water Quality Volume is to be directed to a filtering Bioretention Area that is not designed to infiltrate. Determine the Required Water Quality Volume.

Volume Sizing

V_{WQ} = (D_{WQ}/12 inches/foot) * (A_{IMP} * 43,560 square feet/acre)

V_{WQ} = (1-inch/12 inches/foot) * (1 acre * 43,560 square feet/acre)

V_{WQ} = 3630 cubic feet

Water Quality Depth: one-inch for discharges within a Zone II or Interim Wellhead Protection Area, to or near another critical area, runoff from a LUHPPL, or exfiltration to soils with infiltration rate greater than 2.4 inches/hour or greater; ½-inch for discharges near or to other areas.

$V_{wq} = D_{wq} * (1ft/12in) * A_{imp}$

D_{wq} =	0.5	in	
A_{imp} =	28500	sqft	from measurements
V_{wq} =	**1188**	**cf**	compare result with Standard 3

Dimension check	in	1 ft	ft ft	
		12 in		OK

Provided:		
Detention Basin	Volume before weir flow	
	0.5' x 40' x 90' = 1,800 CF, OK	

Conclusion:

Standard 3 is met

Standard 4 is met

Appendix C

Subsurface information

Supplemental Soils Investigations

AEI
W. Shaheen
E. Chapdelaine

15 May 2012

Use hand auger and driven soil probe
Location: Within proposed detention basin

B-1

24-72” C-M Sand, 5YR5/4
Dry @ 72”

B-2

24-48” C-M Sand, 5YR5/4
48-72” Med. Sand 5YR5/4
Strata interface interruption mottles at 48”
Dry at 72”

COLD SPRING ENVIRONMENTAL CONSULTANTS, INC.

ALAN E. WEISS, M.S., R.S., L.S.P.
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Registered Sanitarian
Hydrogeologist
President

•Wetland Consults
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•21E Site Investigations
•Percolation Tests and
•Septic Designs
•Title 5 Inspections

350 Old Enfield Rd.
Belchertown, MA 01007
(413) 323-5957 & 323-4916 (FAX)
aeweiss@charter.net

Date: 11-17-2011

Commonwealth of Massachusetts
S. Hadley , Massachusetts

Soil Suitability Assessment for On-site Sewage Disposal

Performed By: A Weiss, LS Date: 11-17-2011
Witnessed By: S. Hart, BOH

Location Address or Lot #	Owner's Name, Address, and Telephone #
Multiple Lots off Woodbridge St.	c/o Ken Leblanc. Woodbridge St. & Pearl LN. S. Hadley, MA.
New Construction ☑ Repair ☐	

Office Review

Published Soil Survey Available: No ☐ Yes ☑

Year Published Publication Scale Soil Map Unit

Drainage Class Soil Limitations

Surficial Geologic Report Available: No ☑ Yes ☐

Year Published Publication Scale

Geologic Material (Map Unit)

Landform

Flood Insurance Rate Map:

Above 500 year flood boundary No ☐ Yes ☑

Within 500 year flood boundary No ☑ Yes ☐

Within 100 year flood boundary No ☑ Yes ☐

Wetland Area:

National Wetland Inventory Map (map unit)

Wetlands Conservancy Program Map (map unit)

Current Water Resource Conditions (USGS): Month

Range :Above Normal ☑ Normal ☐ Below Normal ☐

Other References Reviewed: _____

* 4 Lots per Location By Chapdelaine, RLS *

Location Address or Lot No. Lot A: 1A + 2A

On-site Review

Deep Hole Number 1A + 2A Date: 11/17/11 Time: 9:00 AM Weather Clouds 40°

Location (identify on site plan) _____

Land Use meadow Slope (%) 1 Surface Stones Not

Vegetation grasses

Landform Terrace (Kame delta)

Position on landscape (sketch on the back) . . .

Distances from:

Open Water Body 200'+ feet Drainage way 50'+ feet

Possible Wet Area 200'+ feet Property Line 20'+ feet

Drinking Water Well 100'+ feet Other _____

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
1A					
0-8"	FSL	Ap	10YR 3/2		- Friable.
8"-24"	FS	Bw	10YR 5/6		- F Sand.
24"-120"	CS	C	10YR 4/6	110" 7.5YR 5/8	- C. Sand. Loose, granular.
2A					
0-10"	FSL	Ap	10YR 3/2		- Friable.
10"-25"	FS	Bw	10YR 5/6		- F. Sand.
25"-120"	CS	C	10YR 4/6	7.5YR 5/8 110"	- C. Sand, Loose, granular.

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash (Kame delta) Depth to Bedrock: 110 - 120"

Depth to Groundwater: Standing Water in the Hole: Not Weeping from Pit Face: Not

Estimated Seasonal High Ground Water: 110"

2 Deeps: * Trench Design Required. * Reserve Between.

Location Address or Lot No. Lot 4A - Woodbuffe

COMMONWEALTH OF MASSACHUSETTS

S. Hadley, Massachusetts

Percolation Test*

Date: . . . Time:

Observation Hole #	(1A) 1-4A		(2A) 1-4A
Depth of Perc	46"		50"
Start Pre-soak	9:00	COULD	9:30
End Pre-soak	9:15	NOT	9:45
Time at 12"	9:15	HOLD	9:45
Time at 9"	9:16	H_2O	9:46
Time at 6"	9:17	↓	9:47
Time (9"-6")	~~8:42~~		<2
Rate Min./Inch	<2		<2

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☑ Site Failed ☐

Performed By: Alan Weiss, RS

Witnessed By: Shawn Hart

Comments: 5' offset to ESHGW.

* Trench Design Reserve Determination *

Location Address or Lot No. off Woodbridge sts. s. Hadley, Lots "A"

Determination for Seasonal High Water Table

Method Used:

- ☐ Depth observed standing in observation hole ..... inches
- ☐ Depth weeping from side of observation hole ..... inches
- ☑ Depth to soil mottles 110" inches
- ☐ Ground water adjustment ..... feet

Index Well Number ..... Reading Date ..... Index well level

Adjustment factor ..... Adjusted ground water level .....

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? yes

If not, what is the depth of naturally occurring pervious material? _____

Certification

I certify that on June, 95 (date) I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date 11/17/11

COMMONWEALTH OF MASSACHUSETTS
ALAN C. WEISS
REG. #933
REGISTERED SANITARIAN

Location Address or Lot No. Lot "4B" off Woodvale St

Determination for Seasonal High Water Table

Method Used:

- ☐ Depth observed standing in observation hole ..... inches
- ☐ Depth weeping from side of observation hole ..... inches
- ☐ Depth to soil mottles ..... inches
- ☐ Ground water adjustment ..... feet

Index Well Number ..... Reading Date ..... Index well level

Adjustment factor ..... Adjusted ground water level .....

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? _____

If not, what is the depth of naturally occurring pervious material? _____

Certification

I certify that on _____ (date) I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature _____ Date _____

COMMONWEALTH OF MASSACHUSETTS
ALAN C. WEISS
REG. #933
REGISTERED SANITARIAN

Location Address or Lot No. "Lot B" off Woodbridge St. 4/B -

On-site Review

Deep Hole Number 3+4 Date: 10/17/11 Time: 10:30 Weather Cloudy 40°F

Location (identify on site plan) _____

Land Use Meadow Slope (%) 1 Surface Stones Not obs

Vegetation grassy

Landform Kame Terrace (Delta).

Position on landscape (sketch on the back) . . .

Distances from:

Open Water Body 200'+ feet Drainage way 50'+ feet

Possible Wet Area 200'+ feet Property Line 20'+ feet

Drinking Water Well 100'+ feet Other _____

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
#3					
0-10"	Ap	FSL	10yr 3/2		-Friable
10"-28"	Bw	FS	10yr 5/6		-f. Sand. Loose
28"-126"	C1	CS	10yr 6/6	120" 7.5yr 5/8	-C. Sand. 10% gravel Loose.
#4					
0-9"	Ap	FSL	10yr 3/2		-Friable
9"-27"	Bw	FS	10yr 5/6		-F Sand, Loose.
27"-126"	C1	CS	10yr 6/6	120"	-C. Sand, 10% gravel Loose.

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash. Depth to Bedrock: 126"+

Depth to Groundwater: Standing Water in the Hole: Not + Weeping from Pit Face: NOT

Estimated Seasonal High Ground Water: 120"

* 2 Deep: Trench Design, Reserve Between *

FORM 12 - PERCOLATION TEST

Location Address or Lot No. 43 off Woodbridge ST.

COMMONWEALTH OF MASSACHUSETTS

S. Hadley , Massachusetts

Percolation Test*		
Date: 11/17/4	Time: 10:00	
Observation Hole #	3	4
Depth of Perc	46	48"
Start Pre-soak	10:00	10:10
End Pre-soak	10:15	10:45
Time at 12"	10:15	10:46
Time at 9"	10:16	10:46
Time at 6"	10:17	10:47
Time (9"-6")	<2	<2
Rate Min./Inch	<2	<2

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☑ Site Failed ☐

Performed By: Alan Weiss, RS

Witnessed By: Sharon Hall, Bd. H.

Comments: * Mound Design, 5' offset to ESHGW *

DEP APPROVED FORM - 12/07/95

Location Address or Lot No. 5+6 LOT C, Woodbridge RD

On-site Review

Deep Hole Number 1+2 Date: 11/17/11 Time: 10:00 Weather Cloudy 40°
Location (identify on site plan) _____
Land Use Field Slope (%) 1 Surface Stones Not obs.
Vegetation grass
Landform leveled (Kame Delta)
Position on landscape (sketch on the back) _____
Distances from:

Open Water Body	100'+ feet	Drainage way	50'+ feet
Possible Wet Area	100'+ feet	Property Line	20'+ feet
Drinking Water Well	100'+ feet	Other	_____

4 Deeps

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
5 = +SA: 0-8"	Ap	fsc	10yr 3/2		-friable
8"-18"	Bw	fs	10yr 5/8	80"	-f. Sand,
18"-120"	C1	cs	10yr 4/6	75yr 5/8	-C. Sand + gravel, granular
				72"	Loose, 5% cobbles
0-9" / 9-20" / 20-120"	Ap / Bw / C1	fsc / fs / cs	↓		Same as #5
6 = + CA: 0-10"	Ap	fsc	10yr 3/2		-Friable
10"-21"	Bw	fs	10yr 5/8		-f. Sand.
21"-120"	C1	cs	10yr 4/6	72"	-C. Sand, loose granular.
				75yr 5/8	5% cobbles
0-10"	Ap	fsc	↓	70"	Same as #6, see note
10-22"	Bw	fs			
22"-116"	C1	cs			

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) _____ Depth to Bedrock: 120"+
Depth to Groundwater: Standing Water in the Hole: yes 108" Weeping from Pit Face: yes 102"
Estimated Seasonal High Ground Water: 70-72"

4 Deeps Use Field Design? –

DEP APPROVED FORM - 12/07/95

FORM 12 - PERCOLATION TEST

Location Address or Lot No. LOT C. (5+6) Woodbridge St

COMMONWEALTH OF MASSACHUSETTS

S. Hadley , Massachusetts

Percolation Test*			
Date: 11/17/11		Time: 10:30	
Observation Hole #	P_5		P_6
Depth of Perc	42"		44"
Start Pre-soak	10:35	COULD	10:50
End Pre-soak	10:50	NOT HOLD	11:05
Time at 12"	10:50	H_2O	11:05
Time at 9"	10:52		11:06
Time at 6"	10:54		11:07
Time (9"-6")	<2		<2
Rate Min./Inch	<2		<2

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☑ Site Failed ☐

Performed By: Alan Weiss, RS

Witnessed By: Sharon Hartz, BOH.

Comments:

DEP APPROVED FORM - 12/07/95

Location Address or Lot No. Lots 5+6, off Woodbridge St

Determination for Seasonal High Water Table

Method Used:

- ☐ Depth observed standing in observation hole ..... inches
- ☐ Depth weeping from side of observation hole ..... inches
- ☑ Depth to soil mottles 70" inches
- ☐ Ground water adjustment ..... feet

Index Well Number ..... Reading Date ..... Index well level

Adjustment factor ..... Adjusted ground water level .....

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? yes

If not, what is the depth of naturally occurring pervious material? —

Certification

I certify that on June 95 (date) I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017.

Signature Alan Date 11/17/11

COMMONWEALTH OF MASSACHUSETTS
ALAN C. WEISS
REG. #933
REGISTERED SANITARIAN

Location Address or Lot No. 778 "Lot D" Woodbridge ST.

On-site Review

Deep Hole Number 7+8 Date: 11/17/11 Time: 11:00 Weather Clear 40°f
Location (identify on site plan) _____
Land Use Meadow Slope (%) 1 Surface Stones Not obs.
Vegetation grasses
Landform Kame Delta.
Position on landscape (sketch on the back) . . .
Distances from:

Open Water Body	100'+ feet	Drainage way	50'+ feet
Possible Wet Area	100'+ feet	Property Line	20'+ feet
Drinking Water Well	100'+ feet	Other	

DEEP OBSERVATION HOLE LOG*

Depth from Surface (Inches)	Soil Horizon	Soil Texture (USDA)	Soil Color (Munsell)	Soil Mottling	Other (Structure, Stones, Boulders, Consistency, % Gravel)
#7					
0-10"	A	FSL	10yR 3/2		-Friable.
10"-18"	Bw	FS	10yR 5/8		-F Sand.
18"-120"	C.	S	10yR 4/6	116" 7.5yR 5/8	-coarse Sand + gravel Interlayered, granular. Loose.
#8					
0-10"	A	FSL	10yR 3/2		↓ Same as above
10-20"	Bw	FS	10yR 5/6		
20"-122"	C.	S.	10yR 4/6	116" 7.5yR 5/8	

* MINIMUM OF 2 HOLES REQUIRED AT EVERY PROPOSED DISPOSAL AREA

Parent Material (geologic) Outwash. Depth to Bedrock: 122"+
Depth to Groundwater: Standing Water in the Hole: Not. Weeping from Pit Face: Not
Estimated Seasonal High Ground Water: 116"

Location Address or Lot No. Woodbridge ST

COMMONWEALTH OF MASSACHUSETTS

S. Hadley , Massachusetts

Percolation Test*

Date: 11/7/11 Time: 11:15

Observation Hole #	7	8
Depth of Perc	46"	45"
Start Pre-soak	11:15	11:18
End Pre-soak	11:30	11:33
Time at 12"	11:30	11:33
Time at 9"	11:32	11:35
Time at 6"	11:34	11:37
Time (9"-6")	<2	<2
Rate Min./Inch	<2	<2

* Minimum of 1 percolation test must be performed in both the primary area AND reserve area.

Site Passed ☑ Site Failed ☐

Performed By: Alan Weiss, RS

Witnessed By: Sharon Nash, Bot

Comments:

Location Address or Lot No. (718) Lot D off Woodhouse

Determination for Seasonal High Water Table

Method Used:

- ☐ Depth observed standing in observation hole ..... inches
- ☐ Depth weeping from side of observation hole ..... inches
- ☑ Depth to soil mottles 116" inches
- ☐ Ground water adjustment ..... feet

Index Well Number ..... Reading Date ..... Index well level

Adjustment factor ..... Adjusted ground water level .....

Depth of Naturally Occurring Pervious Material

Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system? yes

If not, what is the depth of naturally occurring pervious material? _____

Certification

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Signature _____ Date 11/17/11

COMMONWEALTH OF MASSACHUSETTS
ALAN C. WEISS
REG. #933
REGISTERED SANITARIAN

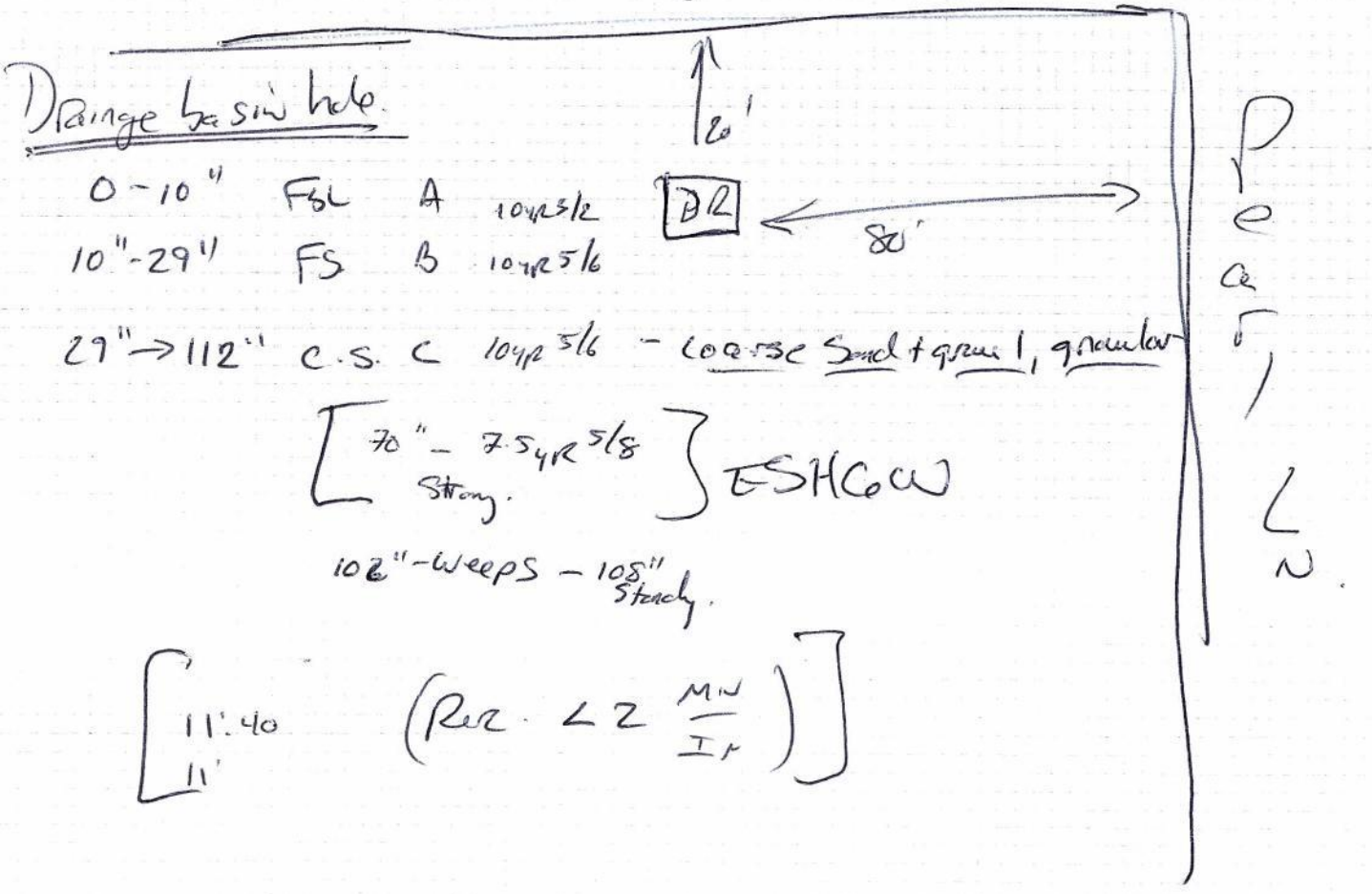
11/17/11 (AW)

2 ←

| #189 |

(NTS)

Woodbridge ST



Informal Storm Water Drainage Eval.

Fax: 413-323-4916

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