DRAIANGE ANALYSIS

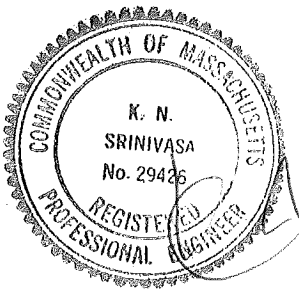
REPORT

FOR

COLLIN FARMS

FRAMINGHAM, MA

DECEMBER 18, 2013



SUBMITTED BY:

KALKUNTE ENGINEERING CORPORATION

1749 CENTRAL STREET

STOUGHTON, MA 02072

Tel: 781-344-8565

PROJECT DESCRIPTION
AND
OPERATION AND MAINTENANCE PLAN
FOR STORMWATER MANAGEMENT
COLLIN FARMS, FRAMINGHAM

December 18, 2013

A. PROJECT NARRATIVE:

Collin Farms Subdivision: Owner & Developer:

STARR CONSTRUCTION, INC.
550 Edgel Road
Framingham, MA 01701

Subdivision Engineer/Surveyor:

Applewood Survey LLC
21 Green Street
Holliston, MA 01746

Drainage Design Engineer:

Kalkunte Engineering Corporation
1749 Central Street
Stoughton, MA 02072

Collin Farms subdivision consists of two cul-de-sacs;

Feildstone Way with 3 buildable lots
Meadowview Lane with 4 buildable lots

Drainage design is done in accordance with the Framingham Subdivision Rules and Regulations which incorporates the DEP's Stormwater Management Standards of 2008, only for the two cul-de sacs. When individual lost are developed, at that time each lot should have an on-site drainage design be done in accordance with the Framingham Rules and Regulations.

Major Design Criteria:

1. The proposed subdivision will not increase the flow rates.
2. 100 year storm frequency rates are used in TR55 Calculations, and 100-year storm from post-construction flows are discharged in its entirety into ground through infiltration galleys, and drawdown is about four (4) hours.
3. TSS removal of not less than 44% prior to discharging into infiltration galleys
4. Storage is calculated by the Static Method
5. DEP's Checklist for Stormwater Report

Each cul-de-sac is considered separately for stormwater analysis.

B. HYDROLOGIC AND HYDRAULIC DESIGN:

B. 1: Description of the design storm frequency: In accordance the DPW regulations the following storm event frequencies are considered, and their maximum intensity of rainfall.

Runoff: Roof runoff from the street is directed is towards catch basins, and flows to water quality inlet tank, and then to the infiltration galleys. Estimated storm event intensity for 100-year storm event is 8.00 inches per hour

Test pits were made, and observed by Terry Ryan (SE) of Applewood Surveyor. Soil encountered was an excessively draining material, and a 1 MPI is assumed in the galley design and discharge to groundwater, Type A soil.

TR55 method is used to calculate the flows based of the storm event frequency. A summary sheet follows this page showing the storm event, pre and post construction flows, and storage required.

Following presents the Best management Practices adopted for the project to provide treatment to storm-water:

- Street sweeping: the Developer of the project will be responsible to keep the entire street clean, sweep all impervious surfaces periodically such that runoff carries minimal pollutants to the drainage system.
- Catch Basins: All catch basins shall have a minimum of 4' (four foot) sump to capture all solids brought by the runoff. Catch basins to be cleaned periodically to accommodate the incoming solids and to prevent it from overflow.
- Water Quality Inlet tank
- Infiltration galleys, discharge into ground.

Separate plan is added, to provide the needed details.
Soil evaluation sheet is enclosed.
Summary of pre and post development flows is in the report.
TSS removal sheet is enclosed.
Estimated operation and maintenance cost is about $500 to $1000 per year.
Long term pollution plan, shall be to keep the paved areas clean, and inspect the galleys to remove materials accumulated.
DEP Stormwater checklist is enclosed.

Construction Inspections by the Town; coordinate w/Town for advance time needed.

1. The initial site inspection of the erosion controls prior to any land disturbance;
2. Inspection of the bottom of the excavation of any stormwater facilities for soil conditions and groundwater before any stone or components are installed,
3. Inspection of the completed stormwater facilities with the components exposed prior to backfill; and
4. Final inspection of the as-built conditions of the completed stormwater facilities, and the stabilized site.

OPERATION AND MAINTENANCE PLAN
FOR STORMWATER MANAGEMENT
COLLIN FARMS, FRAMINGHAM

December 18, 2013

A. During Site Preparation and Construction: The site preparation work includes grading by bringing material from outside. No wetland on site. This area will be protected by siltation fence as directed in the field to the contractor. Any excavated material should be protected by covering with plastic sheets where wash out may reach the street area. Keep the construction site clean by removing excess material off-site.

B. Post-Construction – the owner of the facility will be made directly responsible to maintain all facilities properly and to the satisfaction of the DPW and Planning Board. The Developer shall have the power to seek additional help through consultants, when needed, for proper maintenance

1. Street Maintenance – Source Control: Street and site sweeping should be done periodically, at least ONCE 6 MONTHS, to keep the street clean and prevent erosion of dust and solids accumulation being transported to catch basins and leaching system. This will protect leaching system from plugging. Based on the usage of the roadway develop a sweeping program, that is, at the minimum how many times in a year or how often sweeping is needed to keep the source pollutants to be removed from the paved areas, and disposed properly. Regarding sweeping, the following suggested items be considered:

    - To insure good sweeping, entire paved areas shall be swept by power-full high efficiency vacuum sweeper. In addition, sweeping shall be undertaken soon after significant dirt collection on the paved areas. Sweeping is very essential in the storm water quality management.

    - When sand is used in winter, this should be removed promptly to insure the infiltration galleys do not get plugged.

    - Sweeping on regular basis is a powerful source control, and the record documents shall include the necessary procedures to implement sweeping regularly.

2. Routinely pick-up and remove litter from the paved areas, islands, and from the landscaped areas in addition to pavement sweeping.

3. The catch basins should be inspected and cleaned annually (at least) as they are equipped with hooded outlets to trap debris, sediments and floating contaminants. Each catch basin also includes an oil absorbent pillow and this should be removed and disposed properly, and be replaced.

4. The proposed catch basins are with four foot deep sump. The sump will trap settleable solids washed from the site and prevent it from further transportation. To retain a high efficient sump, pump out the sump periodically depending on a schedule that should be established based on the type of site usage.

5. **Catch Basins (CB)**: Catch basins are the first line of defense to capture storm water pollution. All catch basins are equipped with four-foot sump. The following minimum maintenance should be performed regularly:
   - Develop a detailed log sheet for best management.
   - Number all catch basins
   - Observe how the sump is filled-up with sand/debris
   - Measure the sump depth available below the CB outlet.
   - If the sump is half full start making arrangement to clean the sump.
   - Note all CBs may not be equally full at the same time. This depends on the location of a CB.
   - Establish a cleaning schedule.
   - Have a contract with a cleaning company.
   - CB cleaning must be done in early spring and as often as needed.

6. **Water Quality Inlet Tank**: This tank should be inspected every three months, clean the tank of any debris collected.

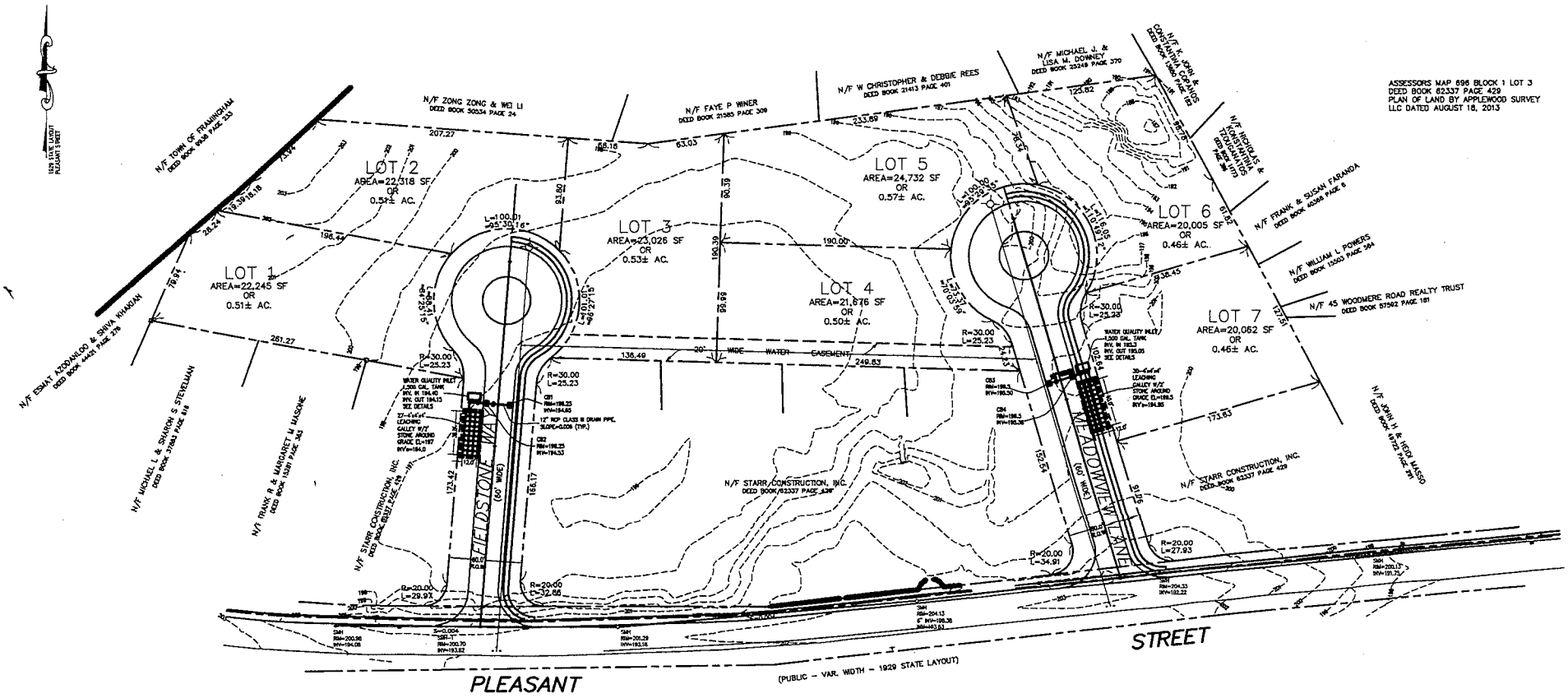
7. **Infiltration Galleys: Infitration galleys** are prone to failure due to clogging of porous soils. Therefore, it is very essential to maintain pretreatment facilities in high efficient status at all times. To achieve this, after a heavy storm event, the catch basins should inspected. Once the system is on-line, for first few storms it is very essential to check after each storm event to insure proper stabilization of the site and to make sure that the proposed system will function properly. If the water stands for more than three (3) days, the system may be plugged. Many factors responsible for clogging are upland sediment erosion, excessive compaction of soils and low spots. Take corrective action immediately.

8. Inspect for oil sheen on the surface of the catch basin sump and on the liquid surface of the Water Quality Inlet tank. Call an appropriate company to pump out the oil.

9. Spill Prevention: For any oil spill on the site, develop an emergency notification to the Board of Health and DEP.

10. Inspect for structural integrity of the storm water system. Notice for any crack in the catch basin gratings, access covers, crack in the tank. And any other noticeable deficiencies. For defect found, initiate remedial measures including contacting professional help.

Develop a logbook and keep a book of maintenance work done, prepare an annual report summarizing work done and actions taken.



DEFINITIVE SUBDIVISION PLAN
GRADING AND UTILITY PLAN
COLLIN FARMS
FRAMINGHAM, MASS.

PREPARED FOR:
STARR CONSTRUCTION, INC.
550 EDGELL ROAD
FRAMINGHAM, MASS. 01701

PROPERTY OF:
STARR CONSTRUCTION, INC.
550 EDGELL ROAD
FRAMINGHAM, MASS. 01701

ENGINEERS & SURVEYORS:
APPLEWOOD SURVEY LLC
21 GREEN STREET
HOLLISTON, MASS. 01746
TERRENCE M. RYAN R.L.S. 37057

DATE: NOVEMBER 10, 2013

SCALE: 1" = 40'

0 40 80 FEET 120 160 200
0 10 20 METERS 40 50 60

FRAMINGHAM PLANNING BOARD
APPROVAL UNDER THE SUBDIVISION CONTROL LAW REQUIRED

DATE:

I CERTIFY THAT THIS SURVEY AND PLAN WERE PREPARED IN ACCORDANCE WITH THE PROCEDURAL AND TECHNICAL STANDARDS FOR THE PRACTICE OF LAND SURVEYING IN THE COMMONWEALTH OF MASSACHUSETTS.

I CERTIFY THAT THIS PLAN CONFORMS TO THE RULES AND REGULATIONS OF THE REGISTRY OF DEEDS.

TERRENCE M. RYAN R.L.S. 37057

C:\dwg\framingham\dwg\subdivision.dwg, 12/18/2013 12:19:01 PM

SOIL TESTING COLIN FARMS FRAMINGHAM
Performed on May 7, 2013 by TMR

DTH-1
Location: approx. sta 1+00 Meadowview Lane

0-10" Ap 10YR3/3 Sandy Loam Granular
10"-50" Bw 2.5Y6/6 Sandy Loam Structureless
50"-115" C 5Y4/3 Coarse Sand & Gravel Structureless Many Cobbles
No water, No mottles, No refusal
Perc rate: LT 2 mpi

DTH-2
Location: approx. sta 2+25 Meadowview Lane

0-6" A 10YR3/3 Sandy Loam Structureless
6"-48" C1 Unconsolidated fill, many cobbles and stones
48"-78" C2 2.5Y5/3 Coarse Sand & Gravel Structureless Many cobbles
78"- 108" C3 2.5Y5/3 Coarse Sand & Gravel Structureless
No water, No mottles, No refusal
Perc rate: LT 2 mpi

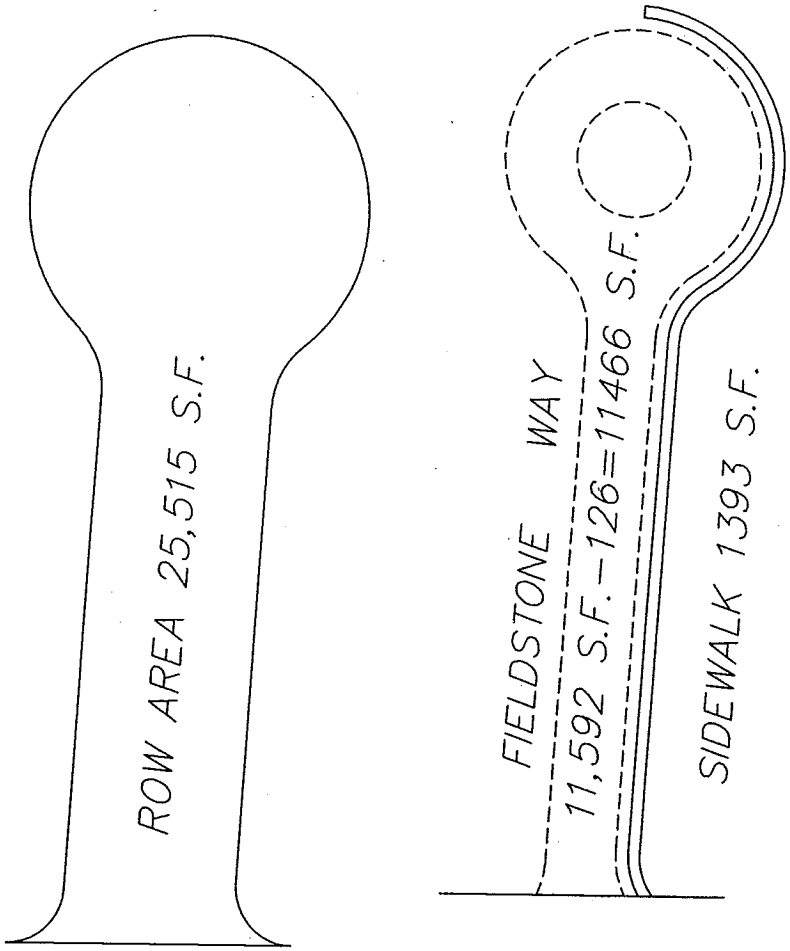
DTH-3
Location: approx. sta 3+00 Fieldstone Way

0-15" Ap 10YR3/3 Sandy Loam Granular
15"-55" Bw 10YR5/6 Sandy Loam Structureless
55"-108" C Coarse Sand & Gravel Structureless Few cobbles
No water, No, mottles, No refusal
Perc rate: LT 2 mpi

DTH-4
Location: approx sta 0+75 Fieldstone Way

0-13" Ap 10YR3/3 Sandy Loam Granular
13"-24" Bw 10YR5/6 Sandy Loam Structureless
24"-36" C1 5YR5/3 Coarse Sand & Gravel Strutureless
36"-108" C2 10YR4/4 Coarse Sand & Gravel Strutureless Some small cobbles
No water, No mottles, No refusal
Perc rate: LT 2 mpi

COLLIN FARMS
FRAMINGHAM, MASS.



Total Drainage Area: 25,515 SF

= 0.58574 Acres

Kalkunte Engineering Corporation
Consulting Engineers
1749 Central Street, Stoughton, MA 02072
Tel: 781-344-8565; Fax: 781-341-6017

December 17, 2013

RE: Collin Farms -Fieldstone Way, Framingham, MA
ON-SITE DRAINAGE ANALYSIS – STORMWATER STORAGE
Drainage C

Proposed Stormwater Storage is shown on the site plan.
Observed percolation rate: Less than 0.5 MPI
Based on the Percolation rate of 1 MPI, storage volume is calculated.

Drainage system is designed for a 100 year storm event, by using TR55 method for small areas. Volume needed is 1740.37 **cubic feet** of storage based on net increase in the roof impervious area.

Leaching system: 27 pre-cast concrete leaching galleys (4'x4'x4 deep, Benson's) are proposed, with 2' stone around, plus 3.25' of water depth is taken for calculations and 12 inches of stone in the bottom.

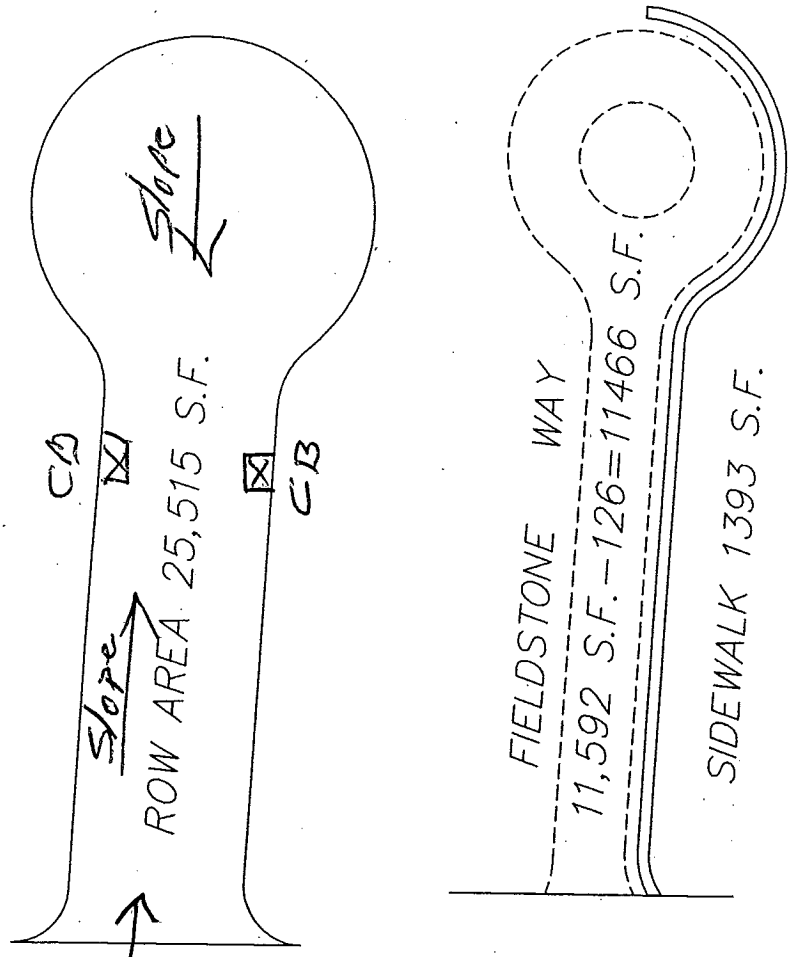
Concrete galleys: 3.25' depth x 4'x4'x 27 Units = 1404 Cu.Ft.
Bottom Stone:
16'x40'x12" inches depth = 640 Cu. Ft.
Vertical Stone:
((16'x40') – (12'x36')) x3.25' = 676 Cu. Ft

Total Stone Volume: 1316 Cu.Ft

Volume available for water: 1316 Cu Ft x 30% voids = 394.8 Cu.Ft

Total volume proposed for the leaching system: 1798.8 Cu. Ft.
Volume provided: 1799 Cu. Ft.
Volume provided is satisfactory.

COLLIN FARMS
FRAMINGHAM, MASS.



Total Drainage Area: 25,515 SFt
= 0.58574 Acres

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12/16/2013

Project: Collin Farms - Fieldstone Way, Framingham, MA
TR55 STORMWATER ANALYSIS BY: K.N. SRINIVASA,P.E.
AND BY RATIONAL METHOD
POST CONSTRUCTION FLOWS

Sheet Flow Time of Travel		
Segment ID		#VALUE!
Surface Description		Roof/Paved
Manning's roughness coefficient for overland flow, n		0.011
Flow Length, L (total L < 300 ft)	ft	100
100 year 24 hour rainfall, I	in/hr	8
Land slope S	ft/ft	0.0175
TC = (.933 ((nL)/S^0.5)^0.6) / (I^0.4*60)	hr	0.024122293
Volume of Runoff for 100 year Design Storm		
Segment ID		Roof/Paved
100 year design storm frequency, P; at 5 minutes	in	8
drainage area, A; includes Bldg. & paved areas	acres	0.58574
Conversion factor, Kc		3630
Volume of runoff, Vr=Kc I A	cf	17009.89
Runoff coefficient for rational method C		0.6062
Average rainfall intensity, I for 100 year frequency	in/hr	8
drainage area, A	acres	0.58574
Q = C I A	cfs	2.841
Volume of Storage required		
Vr, Volume of runoff	cf	17009.89
Qo, Peak flow of infiltration (a)	cfs	0.8888
Qi, Peak flow from runoff	cfs	2.841
Tp, Time to peak inflow of design storm	hr	0.1
Ti, Time base of inflow of design storm	hr	24
Vs/Vr = (1.291 * (1-Qo/Qi)^0.753) / ((Ti/Tp)^0.411)		0.102315085
Vs, Volume of storage required (multiply Vs/Vr ratio by the Vr from above	cf	1740.368292
(a) Perc Test:1 MPI;		ok
over an area of 16'x40' = 640 sft		
Note: Excessive draining soil, type A; <0.5 MPI		
Assumed 1 MPI		

Kalkunte Engineering Corporation
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12/16/2013

Project: Collin Farms - Fieldstone Way, Framingham, MA
TR55 STORMWATER ANALYSIS BY: K.N. SRINIVASA,P.E.
AND BY RATIONAL METHOD
PRE- CONSTRUCTION FLOWS

Sheet Flow Time of Travel		
Segment ID		#VALUE!
Surface Description		Roof/Paved
Manning's roughness coefficient for overland flow, n		0.011
Flow Length, L (total L < 300 ft)	ft	100
100 year 24 hour rainfall, I	in/hr	8
Land slope S	ft/ft	0.0175
TC = (.933 ((nL)/S^0.5)^0.6) / (I^0.4*60)	hr	0.024122293
Volume of Runoff for 100 year Design Storm		
Segment ID		Roof/Paved
100 year design storm frequency, P; at 5 minutes	in	8
drainage area, A; includes Bldg. & paved areas	acres	0.58574
Conversion factor, Kc		3630
Volume of runoff, Vr=Kc I A	cf	17009.89
Runoff coefficient for rational method C		0.25
Average rainfall intensity, I for 100 year frequency	in/hr	8
drainage area, A	acres	0.58574
Q = C I A	cfs	1.171
Volume of Storage required NOT APPLICABLE		
Vr, Volume of runoff	cf	17009.89
Qo, Peak flow of infiltration (a)	cfs	0.8888
Qi, Peak flow from runoff	cfs	1.171
Tp, Time to peak inflow of design storm	hr	0.1
Ti, Time base of inflow of design storm	hr	24
Vs/Vr = (1.291 * (1-Qo/Qi)^0.753) / ((Ti/Tp)^0.411)		0.046529379
Vs, Volume of storage required (multiply Vs/Vr ratio by the Vr from above	cf	791.4595987
(a) Perc Test:1 MPI;		ok
over an area of 16'x40' = 640 sft		
Note: Excessive draining soil, type A; <0.5 MPI		
Assumed 1 MPI		
(a) Perc Test:1 MPI;		ok
over an area of 16'x40' = 640 sft		
Note: Excessive draining soil, type A; <0.5 MPI		
Assumed 1 MPI		

KALKUNTE ENGINEERING CORPORATION
Consulting Engineers
1749 Central Street
STOUGHTON, MASSACHUSETTS 02072
(781) 344-8565

JOB Collins Farm, Framingham
SHEET NO. _____ OF _____
CALCULATED BY KNS DATE 12/17/2015
CHECKED BY _____ DATE _____
SCALE Drainage

Collins Farm — Fieldstone Way

Weighted Average Runoff Coefficient C

Total area of R.O.W = 25,515 SFT

Paved Roadway = 11,592 SFT

Grass circle @ end = 126 SFT

Sidewalk = 1393 SFT

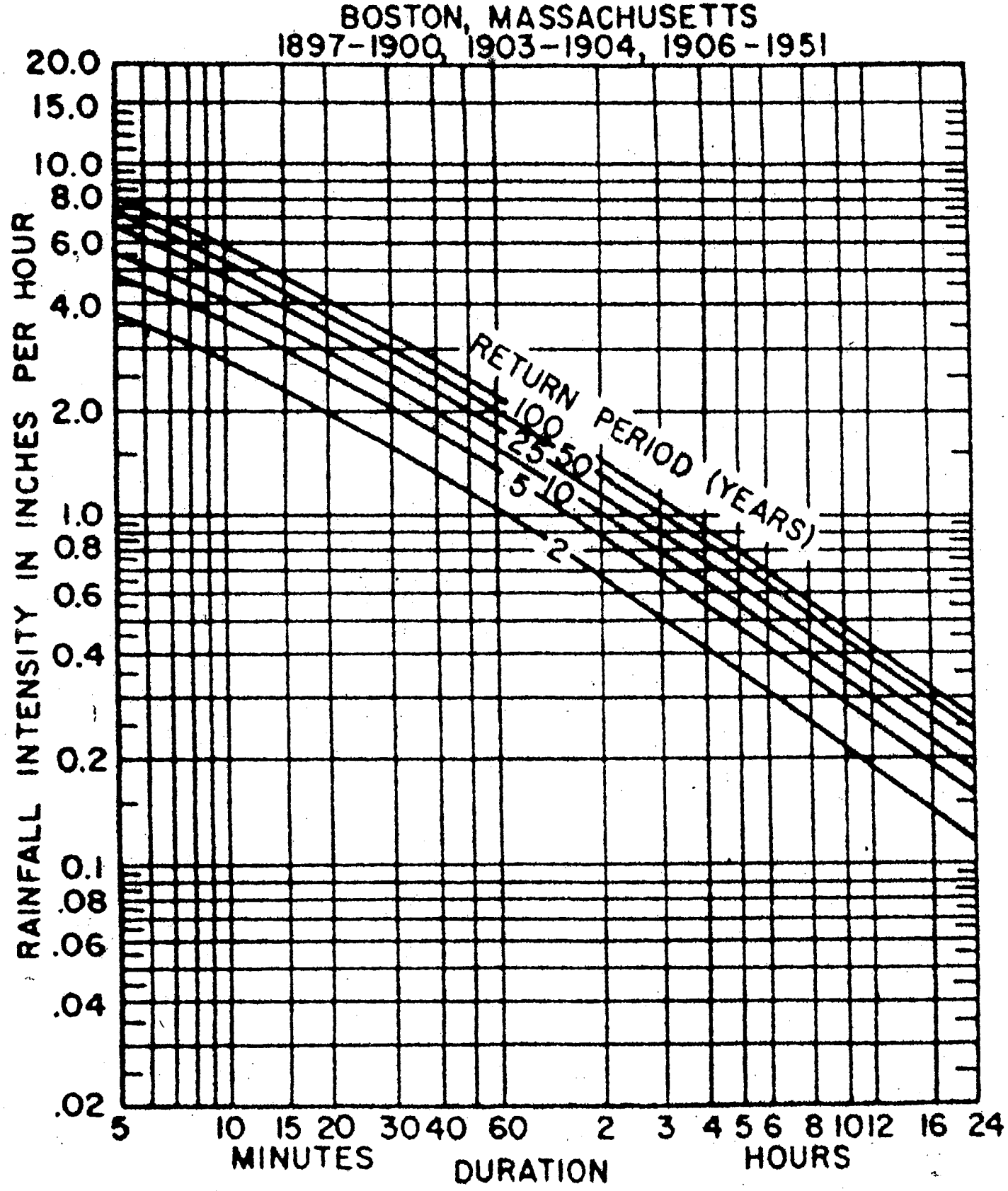
Grass area (within ROW) = 12404 SFT

$$C_{avg} = \frac{11,592 \times 0.95 + 126 \times 0.25 + 1393 \times 0.95 + 12404 \times 0.25}{25,515}$$

$$= \frac{11,012 + 31.5 + 1323.35 + 3101}{25,515}$$

$$= \frac{15467.85}{25,515}$$

$$C_{avg} = 0.6062$$


BOSTON, MASSACHUSETTS
1897-1900, 1903-1904, 1906-1951
RAINFALL INTENSITY IN INCHES PER HOUR
20.0
15.0
10.0
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
.08
.06
.04
.02
RETURN PERIOD (YEARS)
100
25
50
5
10
2
5
10
15
20
30
40
60
2
3
4
5
6
8
10
12
16
24
MINUTES
DURATION
HOURS

Project: Collin Farms, Framingham, MA

Flow Computation by Manning's formula
Q=AV; Q= Flow in cubic feet per second, V= Velocity in ft/second
A= Area in square feet
Mannig's formula for Pipe: 1.486/n x R^0.667 x S^0.5
R=Hyd. Radius; n=Mannig's Rohgness Coeffcient, S=Hydraulic slope

		SDR 35	
Inches	Avg. OD	Thickness	ID
4	4.215	0.12	3.975
6	6.275	0.18	5.915
8	8.4	0.24	7.92
10	10.5	0.3	9.9
12	12.5	0.36	11.78
15	15.3	0.437	14.426

Used 12" RCP Class III; Minimum Slope 0.006
Velocity > 3 ft/s

	Pipe			
	Pipe	12	RCP	
Slope		0.006		
A=		0.785	Sq.ft.	
Wetted Peri.	P=	3.14		
R=Hyd. Rad.	A/P	0.25		
n	0.01			
V=		4.565837	Ft/s	
Q=AV		3.584182	Cfs	
		2.31686	mgd	
		1608.92	gpm	

12" ϕ RCP

KALKUNTE ENGINEERING CORPORATION
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STOUGHTON, MASSACHUSETTS 02072
(781) 344-8565

JOB Collins Farms, Framingham
SHEET NO. _____ OF _____
CALCULATED BY PAS DATE 12/18/2013
CHECKED BY _____ DATE _____
SCALE Drainage Design

Drawdown Within 72 hours

Fieldstone Way

$$\text{Time}_{\text{drawdown}} = \frac{Rv}{(K)(\text{Bottom Area})}$$

Rv = Storage Volume
K = Standard hydraulic conductivity = 8.27 "/hour
(Copy of Table attached).

$$T_{\text{drawdown}} = \frac{1740.37 \text{ cft}}{(8.27 \text{"/hr}) \times (15\text{'}/12\text{"}) \times 640}$$

$$= 3.94 \text{ hours} < 72 \text{ hours}$$

OK

Type III 24-hr Rainfall=1.29"

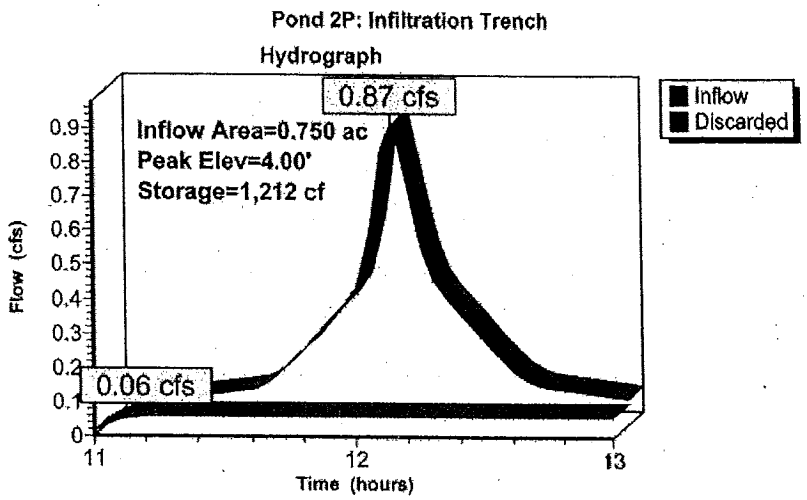
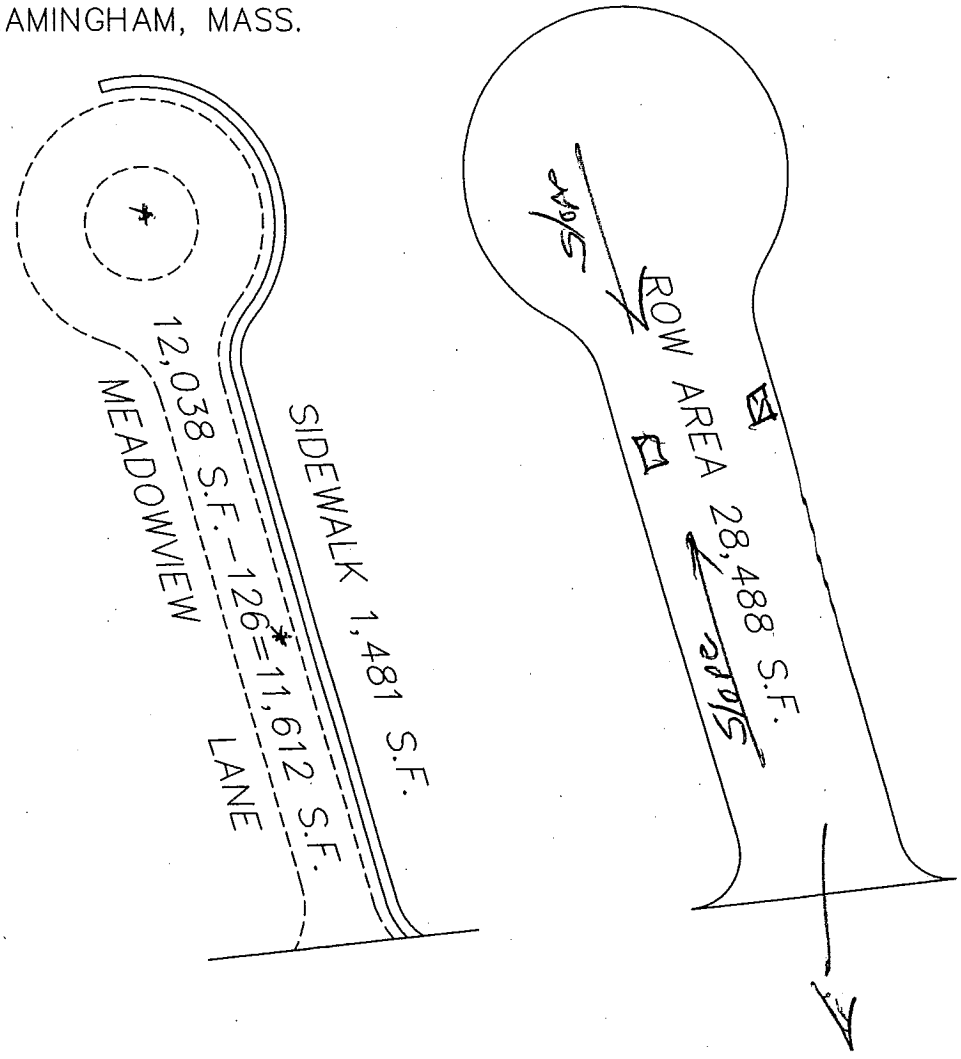


Table 2.3.3. 1982 Rawls Rates[18]

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

[18] Rawls, Brakensiek and Saxton, 1982

COLLIN FARMS
FRAMINGHAM, MASS.



Total Area, Row: 28,488 ~~SF~~
= 0.65399 Acres

Kalkunte Engineering Corporation
Consulting Engineers
1749 Central Street, Stoughton, MA 02072
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December 17, 2013

RE: Collin Farms -Meadowview Lane, Framingham, MA
ON-SITE DRAINAGE ANALYSIS – STORMWATER STORAGE
Drainage C

Proposed Stormwater Storage is shown on the site plan.
Observed percolation rate: Less than 0.5 MPI
Based on the Percolation rate of 1 MPI, storage volume is calculated.

Drainage system is designed for a 100 year storm event, by using TR55 method for small areas. Volume needed is 1926 **cubic feet** of storage based on net increase in the roof impervious area.

Leaching system: 30 pre-cast concrete leaching galleys (4'x4'x4 deep, Benson's) are proposed, with 2' stone around, plus 3.25' of water depth is taken for calculations and 12 inches of stone in the bottom.

Concrete galleys: 3.25' depth x 4'x4'x 30 Units = 1560 Cu.Ft.

Bottom Stone:
16'x44'x12" inches depth = 704 Cu. Ft.

Vertical Stone:
((16'x44') – (12'x40')) x3.25' = 728 Cu. Ft

Total Stone Volume: 1432 Cu.Ft

Volume available for water: 1432 Cu Ft x 30% voids = 429.6 Cu.Ft

Total volume proposed for the leaching system: 1989.6 Cu. Ft.
Volume provided: 1989 Cu. Ft.
Volume provided is satisfactory.

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12/16/2013

Project: Collin Farms - Meadowview lane, Framingham, MA
TR55 STORMWATER ANALYSIS BY: K.N. SRINIVASA,P.E.
AND BY RATIONAL METHOD
POST CONSTRUCTION FLOWS

Sheet Flow Time of Travel		
Segment ID		#VALUE!
Surface Description		Roof/Paved
Manning's roughness coefficient for overland flow, n		0.011
Flow Length, L (total L < 300 ft)	ft	100
100 year 24 hour rainfall, I	in/hr	8
Land slope S	ft/ft	0.0175
TC = (.933 ((nL)/S^0.5)^0.6) / (I^0.4*60)	hr	0.024122293
Volume of Runoff for 100 year Design Storm		
Segment ID		Roof/Paved
100 year design storm frequency, P; at 5 minutes	in	8
drainage area, A; includes Bldg. & paved areas	acres	0.65399
Conversion factor, Kc		3630
Volume of runoff, Vr=Kc I A	cf	18991.87
Runoff coefficient for rational method C		0.5822
Average rainfall intensity, I for 100 year frequency	in/hr	8
drainage area, A	acres	0.65399
Q = C I A	cfs	3.046
Volume of Storage required		
Vr, Volume of runoff	cf	18991.87
Qo, Peak flow of infiltration (a)	cfs	0.9777
Qi, Peak flow from runoff	cfs	3.046
Tp, Time to peak inflow of design storm	hr	0.1
Ti, Time base of inflow of design storm	hr	24
Vs/Vr = (1.291 * (1-Qo/Qi)^0.753) / ((Ti/Tp)^0.411)		0.10140725
Vs, Volume of storage required (multiply Vs/Vr ratio by the Vr from above	cf	1925.913273
(a) Perc Test:1 MPI;		ok
over an area of 16'x40' = 640 sft		
Note: Excessive draining soil, type A; <0.5 MPI		
Assumed 1 MPI		

Kalkunte Engineering Corporation
1749 Central Street, Stoughton, MA 02072
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12/16/2013

Project: Collin Farms -Meadowview Lane, Framingham, MA
TR55 STORMWATER ANALYSIS BY: K.N. SRINIVASA,P.E.
AND BY RATIONAL METHOD
PRE- CONSTRUCTION FLOWS

Sheet Flow Time of Travel		
Segment ID		#VALUE!
Surface Description		Roof/Paved
Manning's roughness coefficient for overland flow, n		0.011
Flow Length, L (total L < 300 ft)	ft	100
100 year 24 hour rainfall, I	in/hr	8
Land slope S	ft/ft	0.0175
TC = (.933 ((nL)/S^0.5)^0.6) / (I^0.4*60)	hr	0.024122293
Volume of Runoff for 100 year Design Storm		
Segment ID		Roof/Paved
100 year design storm frequency, P; at 5 minutes	in	8
drainage area, A; includes Bldg. & paved areas	acres	0.65399
Conversion factor, Kc		3630
Volume of runoff, Vr=Kc I A	cf	18991.87
Runoff coefficient for rational method C		0.5822
Average rainfall intensity, I for 100 year frequency	in/hr	8
drainage area, A	acres	0.65399
Q = C I A	cfs	3.046
Volume of Storage required NOT APPLICABLE		
Vr, Volume of runoff	cf	18991.87
Qo, Peak flow of infiltration (a)	cfs	0.9777
Qi, Peak flow from runoff	cfs	3.046
Tp, Time to peak inflow of design storm	hr	0.1
Ti, Time base of inflow of design storm	hr	24
Vs/Vr = (1.291 * (1-Qo/Qi)^0.753) / ((Ti/Tp)^0.411)		0.10140725
Vs, Volume of storage required (multiply Vs/Vr ratio by the Vr from above	cf	1925.913273
(a) Perc Test:1 MPI;		ok
over an area of 16'x40' = 640 sft		
Note: Excessive draining soil, type A; <0.5 MPI		
Assumed 1 MPI		

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JOB Collins Farm, Framingham
SHEET NO. ____ OF ____
CALCULATED BY PMS DATE 12/17/2013
CHECKED BY ____ DATE ____
SCALE Drainage

Collins Farm - Meadowview Lane

Weighted Average Runoff Coefficient Cav.

Total area of ROW = 28,488 SFT

Paved Roadway = 12,038 SFT

Grass circle @ end = 126 SFT

Sidewalk = 1481 SFT

Grass area (with ROW) = 14843 SFT.

$$C_{avg} = \frac{12038 \times 0.95 + 126 \times 0.25 + 1481 \times 0.95 + 14843 \times 0.25}{28,488}$$

$$= \frac{11,436 + 31.5 + 1407 + 3710.75}{28,488}$$

$$= 0.5822$$

Project: Collin Farms, Framingham, MA

Flow Computation by Manning's formula
Q=AV; Q= Flow in cubic feet per second, V= Velocity in ft/second
A= Area in square feet
Mannig's formula for Pipe: 1.486/n x R^0.667 x S^0.5
R=Hyd. Radius; n=Mannig's Rohgness Coeffcient, S=Hydraulic slope

		SDR 35	
Inches	Avg. OD	Thickness	ID
4	4.215	0.12	3.975
6	6.275	0.18	5.915
8	8.4	0.24	7.92
10	10.5	0.3	9.9
12	12.5	0.36	11.78
15	15.3	0.437	14.426

Used 12" RCP Class III; Minimum Slope 0.006
Velocity > 3 ft/s

	Pipe			
	Pipe	12	RCP	
Slope		0.006		
A=		0.785	Sq.ft.	
Wetted Peri.	P=	3.14		
R=Hyd. Rad.	A/P	0.25		
n	0.01			
V=		4.565837	Ft/s	
Q=AV		3.584182	Cfs	
		2.31686	mgd	
		1608.92	gpm	

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JOB Collin Farms, Framingham
SHEET NO. _____ OF _____
CALCULATED BY PNS DATE 12/18/2013
CHECKED BY _____ DATE _____
SCALE Drainage

Drawdown Within 72 hours

Meadowview Lane

$$\text{Time}_{\text{drawdown}} = \frac{R_v}{(K)(\text{Bottom Area})}$$

R_v = Storage Volume

K = Standard hydraulic Conductivity = 8.27"/hr
(Copy of Table Attached)

$$T_{drawdown} = \frac{1926}{8.27 \times \frac{1}{12} \times 704}$$

$$= 3.97 \text{ hrs} < 72 \text{ hrs}$$

OK

Type III 24-hr Rainfall=1.29"

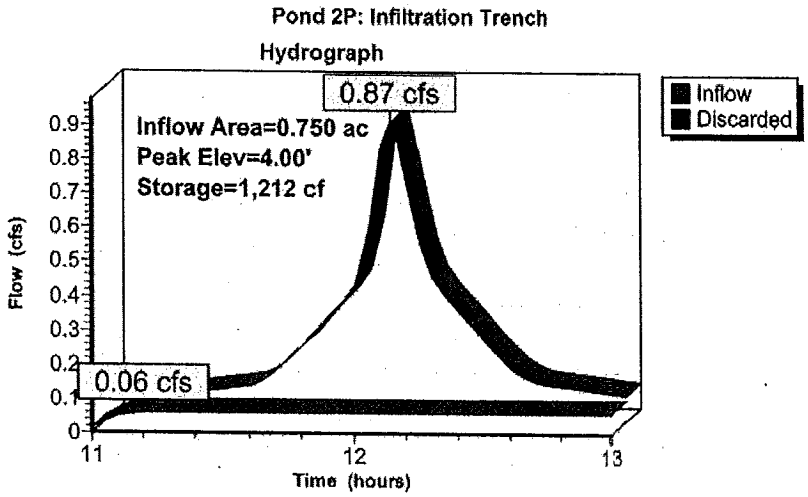


Table 2.3.3. 1982 Rawls Rates[18]

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

[18] Rawls, Brakensiek and Saxton, 1982

Location: Meadowview Lane / Fieldstone Way } Collin Farms, Framingham

TSS Removal Calculation Worksheet

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (BxC)	E Remaining Load (C-D)
Street Sweeping	10%	1.00*	0.10	0.90
Catch Basin Hooded W Sump	25%	0.90	0.225	0.675
WQ Inlet 1500 gal. Tank	25%	0.675	0.169	0.506
		Total TSS Removal =	49.4%	> 44% Reqd. Prior Discharging to Infiltration Galleys

Project: Collin Farms
Prepared By: KN SRINIVASA, P.E.
Date: 12/17/2013

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

TSS Removal Rates (adapted from Schueler, 1996 & EPA, 1993)

BMP List	Design Rate	Range of Average TSS Removal Rates	Brief Design Requirements
Extended Detention Pond	70%	60-80%	Sediment forebay
Wet Pond (a)	70%	60-80%	Sediment forebay.
Constructed Wetland (b)	80%	65-80%	Designed to infiltrate or retain.
Water Quality Swale	70%	60-80%	Designed to infiltrate or retain.
Infiltration Trench	80%	75-80%	Pretreatment critical.
Infiltration Basin	80%	75-80% (predicted)	Pretreatment critical.
Dry Well	80%	80% (predicted)	Rooftop runoff (uncontaminated only)
Sand Filter (c)	80%	80%	Pretreatment.
Organic Filter (d)	80%	80%+	Pretreatment.
Water Quality Inlet	25%	15-35% w/ cleanout	Off-line only; 0.1" minimum Water Quality Volume (WQV) storage
Sediment Trap (Forebay)	25%	25% w/ cleanout	Storm flows for 2 year event must not cause erosion; 0.1" minimum WQV storage
Drainage Channel	25%	25%	Check dams; non-erosive for 2 yr.
Deep Sump and Hooded Catch Basin	25%	25% w/ cleanout	Deep sump general rule = 4 x pipe diameter or 4.0' for pipes 18" or less.
Street Sweeping	10%	10%	Discretionary non-structural credit, must be part of approved plan.

Notes:

(a) Includes wet extended detention ponds, wet ponds, multiple pond designs.
(b) Includes shallow marsh, extended detention wetlands, pocket wetland, and pond/wetland designs.
(c) Includes surface, underground, pocket, and perimeter designs.
(d) Includes compost, peat/sand, and bio/filtration designs.

Land Uses with Higher Potential Pollutant Loads (Standard 5)

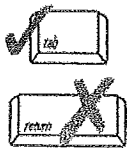
Residential, office, and institutional development and roads normally will not yield high potential pollutant loads. However, certain land uses generate higher concentrations of pollutants than found in typical runoff, based

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

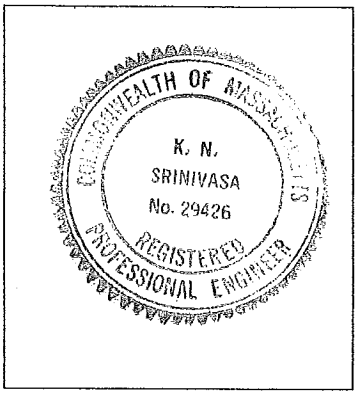
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature



Signature and Date 12/18/2013

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☑ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- [x] No disturbance to any Wetland Resource Areas
- [x] Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- [ ] Reduced Impervious Area (Redevelopment Only)
- [ ] Minimizing disturbance to existing trees and shrubs
- [ ] LID Site Design Credit Requested:
  - [ ] Credit 1
  - [ ] Credit 2
  - [ ] Credit 3
- [ ] Use of "country drainage" versus curb and gutter conveyance and pipe
- [ ] Bioretention Cells (includes Rain Gardens)
- [ ] Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- [ ] Treebox Filter
- [ ] Water Quality Swale
- [ ] Grass Channel
- [ ] Green Roof
- [ ] Other (describe): _____

Standard 1: No New Untreated Discharges

- [ ] No new untreated discharges
- [ ] Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- [ ] Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☐ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☑ Soil Analysis provided.

☑ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☑ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☑ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☑ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☑ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☑ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☐ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☑ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☑ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☑ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☑ The BMP is sized (and calculations provided) based on:

- ☐ The ½" or 1" Water Quality Volume or
- ☑ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

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

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☑ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☐ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☑ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☑ Name of the stormwater management system owners;
- ☑ Party responsible for operation and maintenance;
- ☑ Schedule for implementation of routine and non-routine maintenance tasks;
- ☑ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☑ Description and delineation of public safety features;
- ☑ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

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

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.