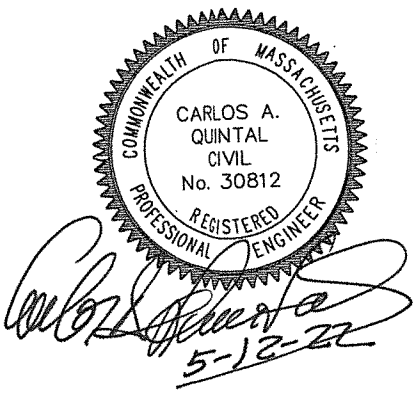
DRAINAGE ANALYSIS

FOR
Site Plan
175 East Central Street
and 9 Chestnut Street

LOCATED IN
FRANKLIN, MASSACHUSETTS

PREPARED FOR
Franklin Ford, LLC
175 East Central Street
Franklin, MA 02038



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DATE: April 14, 2022

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APPENDIX A

I. DESCRIPTION

This report is offered in support of the stormwater management system designed for the "Site Plan – for Franklin Ford located at 185 East Central Street" in Franklin, Massachusetts. The primary goals of this system are to collect the stormwater runoff generated from the existing parking area as well as the proposed parking lot expansion located easterly of the existing building. Additionally, the design provided for capturing a portion of the roof runoff and direct it to a swale. Both the pre-development and post-development conditions flowing offsite are summarized in Appendix B. This design will allow for the rate and volume of offsite storm-water to be decrease.

II. Purpose

The purpose of this report is to examine the hydrological and hydraulic aspects of the proposed 175 Central Street" Site Plan. This report was developed for review by the Town of Franklin Planning Board and Conservation Commission to obtain the necessary permits to allow the project to proceed.

This report considers the overall hydrological impact of proposed, additional development upon the local watersheds with specific emphasis directed toward the adjacent and immediate downstream areas. The hydrology and criteria are consistent with the Town of Franklin Planning Board Storm Water Management Policies.

III. Pre-Development Conditions

The site consists of two parcels of land containing 226,697 +/- square feet of land and is located off of East Central Street and Chestnut Street in Franklin. The 175 East Central Street parcel is currently developed with an existing structure, paved and gravel parking areas, landscaping, and a ledge outcrop. The 9 Chestnut Street site is currently developed with a single family house, driveway, lawn and landscaping. The upland soils for the site were taken from the soil survey of Norfolk and Suffolk counties. The soils are classified as Merrimack-Urban Land complex, Urban Land and Freetown Muck. The Merrimack soil type is classified as a hydrologic soil group A Soil testing was conducted on the site to determine soil types and permeability rates. See the soil logs and permeability test results located in Appendix F. Two permeability test were completed on site and the infiltration rate was calculated using the 50 percent of the slowest rate.
Utilizing a Hydrocad computer model the pre-development and post development conditions were calculated. This included an analysis of the watershed utilizing a Hydrologic soil group A. A comparison of the pre-development vs. post development rate and volume of runoff can be found in Appendix B.

IV. Post Development Conditions

The proposed development will consist of the construction of a 7,735 +/- sq. ft addition to the existing dealership building. The existing paved and gravel parking lot located to the east of the existing dealership will be expanded and curbing will be added along with a storm-water system. Additionally the 9Chestnut Street house will be razed and the parking area will be expanded. Curbing will be added and the storm-water runoff will be directed to the proposed drainage system.

The storm-water will be captured in deep sump hooded catch basing and will be directed to a hydrodynamic separator prior to discharge to the underground infiltration pond.
The proposed infiltration system will promote groundwater re-charge as the site is located witin a Town of Franklin Water Resource District. Municipal utility connections are also included in the project. The proposal is to service the building with town water and sewer. The project design includes the construction of the driveway entrance from Chestnut Street and the closing off of the existing Chestnut

Street curb cuts. The drainage system for the building and parking area consists of a closed drainage system. The stormwater runoff generated from the parking areas will be collected catch basins. The catch basins will direct the captures storm water to a water quality unit. The storm water will then be piped to manhole's and directed to underground infiltration pond. TSS removal will be provided prior to discharging to the down gradient wetland. Utilizing the same computer model as the existing conditions we have modeled the changes in surfaces and ground cover and have calculated the post development conditions.
All calculations for the above have been included in this report. Pre-development calculations are located in Appendix C. Post-development calculations are located in Appendix D.

V. Conclusion

Stormwater from the existing and proposed parking areas located easterly of the existing building will be captured by the catch basins and then piped to the water quality unit for additional TSS removal which will then be directed to the underground infiltration pond. The addition roof will be captured and directed to a swale. A Drainage analysis was completed during the permitting process for the Franklin Ford project located at 175 East Central Street and the 9 Chestnut Street property that is being converted into a parking area. The comparison in Appendix B summarizes the rate and volumes of runoff leaving the site in both the pre-development and post-development conditions. This comparison indicates that there is not an increase in the rate or volume of runoff during the 2-year 10-year or 100-year storm events.

VI. Stormwater Management Standards

Refer to Checklist for Stormwater Report in Appendix I

Town of Franklin Stormwater Management Bylaw – Chapter 153 – Bylaw Amendment 21-867

Total Impervious Coverage 175 and 9 Chestnut St Street site =

1" x 135,580 sq. ft. impervious = 11,298.3 cubic feet (Required)

Refer to Appendix G for Groundwater Recharge Calculations

This narrative is for the Franklin Ford Site located at 175 East Central Street and 9 Chestnut Street.

LID Measures
- No disturbance is proposed to any Wetland Resource Area.
- Existing Vegetation Removal is minimal.

Standard 1: No New Untreated Discharges
No new untreated discharges are proposed.
A potion of the front parking area, the parking area located easterly of the existing building and the proposed parking lot expansion will captured in deep sump hooded catch basins and will be directed to a Water Quality Unit for TSS removal. The storm-water runoff will then be directed to the Infiltration Pond. The storm-water systems will provide for the required TSS removal for a large portion of the existing parking area as well as the parking area expansion.

Standard 2: Peak Rate Attenuation
The drainage system has been designed to reduce the rate and volume of storm-water runoff from the site when comparing the pre-development conditions to the post development conditions. See Appendix B of this report for a summary of the design storms.

Standard 3: Recharge

- Soil testing has been completed. See Appendix F or this report for permeability test results and sheet 2 for soil testing information.
- Refer to Appendix G for the Simple Dynamic recharge volume calculations. Calculation have been provided to show compliance with Standard 3 as well as the Town of Franklin Stormwater Management Bylaw.

- Drawdown within 72 hours
  Storage Volume below outlet = 7,275 cf
  Time = (7,275) / (5.58"/hr x 1'/12" x 2,233 sf. = 7 hours < 72 hours

- Sheet 2 provides the soil logs with depths of test pits.

Standard 4: Water Quality

- The owner will be responsible for compliance with standard four requirements.
- Refer to the Operation and Maintenance Plan and the Storm-water Facilities Plan for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.
- See Appendix E for the Manufactures TSS removal rate. The developed portion of the site is located within a zone II. The Infiltration Pond has been designed with an infiltration rate of 5.58 inches per hour. This led to the Water Quality unit being modeled with a 1" WQV.
- The proposed project will include a Water Quality Unit's which will provide TSS removal. The summary of the Manufacturers Predicted Net Annual results as well as the TSS Removal Worksheet are included.

Standard 5: Land uses with higher potential pollutant loads

Not applicable. Automobile maintenance will be completed within the building.

Standard 6: Critical Areas

Zone II

Standard 7: Re-developments and Other Projects

A portion of the site is being re-developed. The storm-water standards have been net for the portion of the site which is directed to the infiltration pond.

Standard 8: Construction Period Pollution Prevention and Erosion Sedimentation Control

- Refer to sheet 6 for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.
- The project will not be covered by a NPDES Construction General Permit.

Standard 9: Operation and Maintenance Plan

- Refer to sheet 6 for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.
- The owner will be responsible for the storm-water management system, implementation of the operation and maintenance, the maintenance costs, and completion of the maintenance logs.

- Refer to sheet 6 for the Inspection and Maintenance Schedule and the Operation and Maintenance Schedule.

- Refer to the Operation and Maintenance Plan.

Standard 10: Prohibition of Illicit Discharges

- Owner to be responsible for compliance with avoiding illicit discharges.
- The site will be connected to the town sewer system.

APPENDIX B

Pre-Development vs. Post Development Rate and Volume of Runoff

This analysis was prepared to show the summary of the pre-development and post development rate and volume of runoff as required by the Town of Franklin Storm-water Requirements.

The pre-development watershed area EW is located to the northeast portion of the site with a discharge to the existing wetland area. Post-development Link 1L was provided to combine the pond outlet with the roof outlet which also discharge to the exiting wetland area. A comparison of the rate and volume for pre-development area EW and post-development Link 1L is provided below:

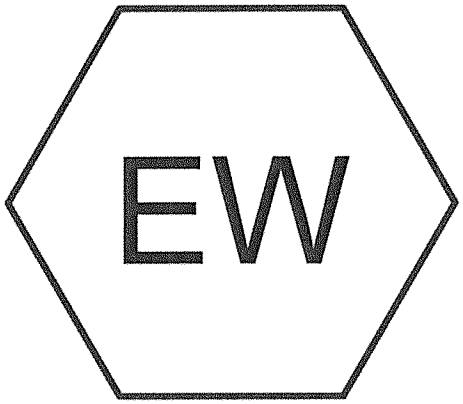
2-year storm event (CFS)			2 year storm event (A.F.)		
Pre		Post	Pre		Post
EW	vs	1L	EW	vs	1L
5.83		0.50	0.445		0.040

10 year storm event (CFS)			10 year storm event (A.F.)		
Pre		Post	Pre		Post
EW	vs	1L	EW	vs	1L
8.62		3.63	0.674		0.158

100 year storm event (CFS)			100 year storm event (A.F.)		
Pre		Post	Pre		Post
EW	vs	1L	EW	vs	1L
12.62		10.62	1.006		0.367

A reduction in both the rate of runoff and volume of runoff has been realized with the proposed storm-water systems.

APPENDIX C



Pre-Dev.

Subcat Reach Pond Link

Drainage Diagram for UC1007-PRE
Prepared by United Consultants, Inc.

2 YR PRE-DEVELOPMENT

Subcatchment EW: Pre-Dev.

Runoff = 5.83 cfs @ 12.08 hrs, Volume= 0.445 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
73,950	98	Paved parking & roofs
9,228	76	Gravel roads, HSG A
83,178	96	Weighted Average
9,228		Pervious Area
73,950		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	35	0.0310	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.25"
0.5	44	0.0455	1.49		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.7	133	0.0345	1.30		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, MIN. TC**
6.0	212	Total			

10 YR PRE-DEVELOPMENT

Subcatchment EW: Pre-Dev.

Runoff = 8.62 cfs @ 12.08 hrs, Volume= 0.674 af, Depth= 4.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
73,950	98	Paved parking & roofs
9,228	76	Gravel roads, HSG A
83,178	96	Weighted Average
9,228		Pervious Area
73,950		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	35	0.0310	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.25"
0.5	44	0.0455	1.49		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.7	133	0.0345	1.30		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, MIN. TC**
6.0	212	Total			

100 YR PRE-DEVELOPMENT

Subcatchment EW: Pre-Dev.

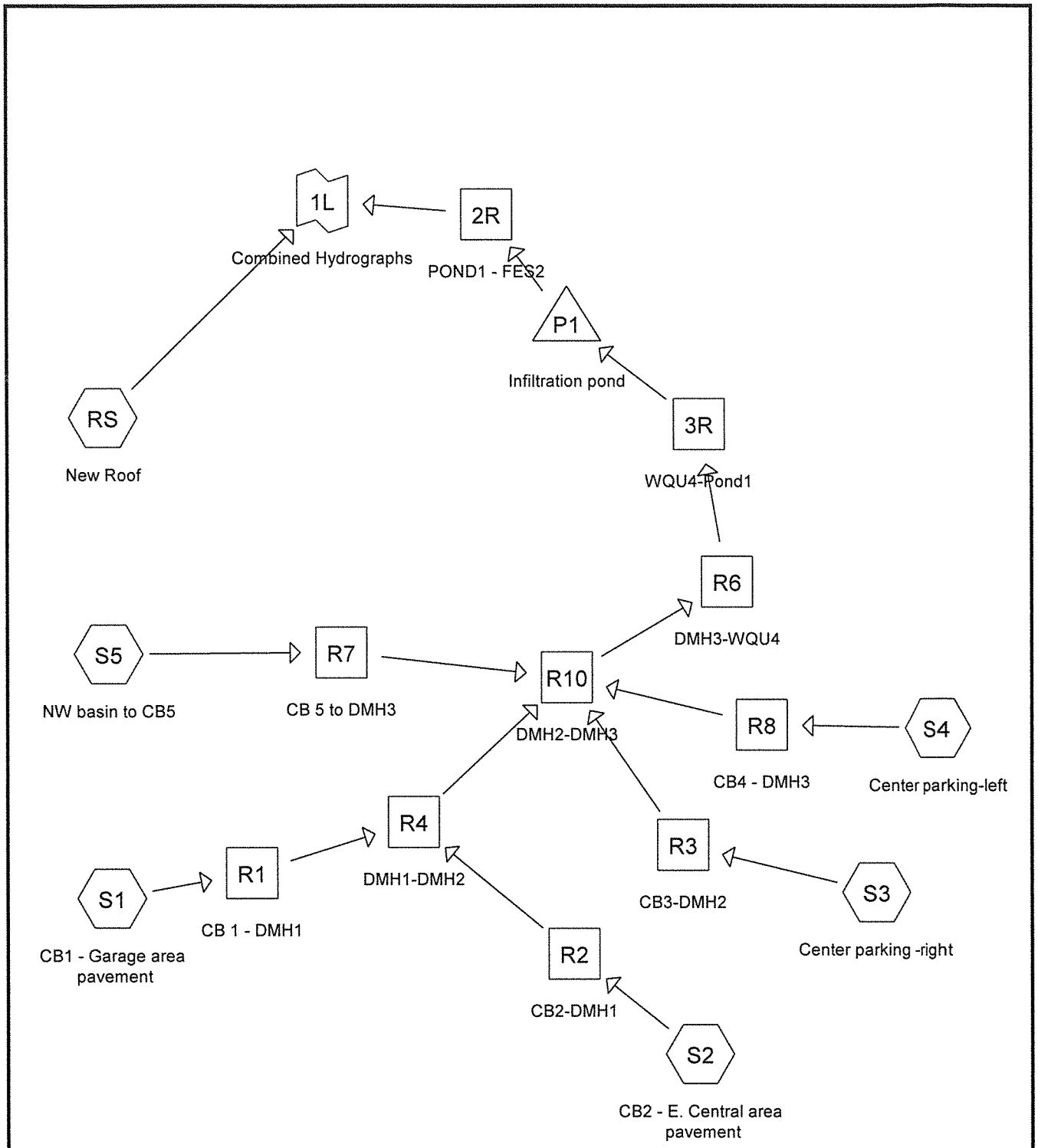
Runoff = 12.62 cfs @ 12.08 hrs, Volume= 1.006 af, Depth= 6.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
73,950	98	Paved parking & roofs
9,228	76	Gravel roads, HSG A
83,178	96	Weighted Average
9,228		Pervious Area
73,950		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.5	35	0.0310	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.25"
0.5	44	0.0455	1.49		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.7	133	0.0345	1.30		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.3					**Direct Entry, MIN. TC**
6.0	212	Total			

APPENDIX D



Drainage Diagram for UC1007-post
Prepared by United Consultants, Inc.

2 YR POST-DEVELOPMENT

Subcatchment RS: New Roof

Runoff = 0.50 cfs @ 12.09 hrs, Volume= 0.040 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
6,955	98	Paved parking & roofs
6,955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, roof**
0.3	66	0.0100	4.09	1.43	**Circular Channel (pipe),** Diam= 8.0" Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
6.3	66	Total			

Subcatchment S1: CB1 - Garage area pavement

Runoff = 1.41 cfs @ 12.08 hrs, Volume= 0.112 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
19,466	98	Paved parking & roofs
19,466		Impervious Area

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

Subcatchment S2: CB2 - E. Central area pavement

Runoff = 0.95 cfs @ 12.08 hrs, Volume= 0.075 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
13,064	98	Paved parking & roofs
13,064		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Parking by E. Central St**

Subcatchment S3: Center parking -right

Runoff = 0.66 cfs @ 12.08 hrs, Volume= 0.053 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
9,134	98	Paved parking & roofs
9,134		Impervious Area

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

Subcatchment S4: Center parking-left

Runoff = 1.70 cfs @ 12.08 hrs, Volume= 0.136 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
23,488	98	Paved parking & roofs
23,488		Impervious Area

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

Subcatchment S5: NW basin to CB5

Runoff = 0.75 cfs @ 12.08 hrs, Volume= 0.059 af, Depth= 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2YR Rainfall=3.25"

Area (sf)	CN	Description
10,305	98	Paved parking & roofs
10,305		Impervious Area

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

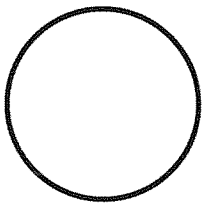
Reach 2R: POND1 - FES2

Inflow Area = 1.732 ac, Inflow Depth = 0.00" for 2YR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 13.87 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 148.0' Slope= 0.0149 '/'
Inlet Invert= 85.20', Outlet Invert= 83.00'



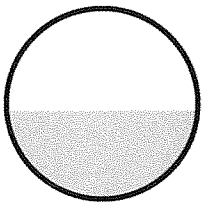
Reach 3R: WQU4-Pond1

Inflow Area = 1.732 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 5.44 cfs @ 12.09 hrs, Volume= 0.436 af
Outflow = 5.43 cfs @ 12.09 hrs, Volume= 0.436 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.79 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.26 fps, Avg. Travel Time= 0.3 min

Peak Storage= 28 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.69'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 12.41 cfs

18.0" Diameter Pipe, n= 0.011 PVC, smooth interior
Length= 35.0' Slope= 0.0100 '/'
Inlet Invert= 85.55', Outlet Invert= 85.20'



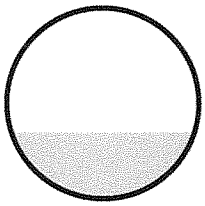
Reach R1: CB 1 - DMH1

Inflow Area = 0.447 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 1.41 cfs @ 12.08 hrs, Volume= 0.112 af
Outflow = 1.41 cfs @ 12.10 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.72 fps, Min. Travel Time= 0.5 min
Avg. Velocity = 1.88 fps, Avg. Travel Time= 1.4 min

Peak Storage= 39 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.32 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 157.0' Slope= 0.0190 '/'
Inlet Invert= 90.55', Outlet Invert= 87.57'



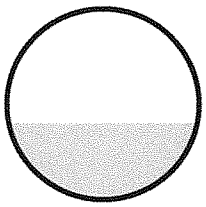
Reach R10: DMH2-DMH3

Inflow Area = 1.732 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 5.44 cfs @ 12.09 hrs, Volume= 0.436 af
Outflow = 5.44 cfs @ 12.09 hrs, Volume= 0.436 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.22 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.71 fps, Avg. Travel Time= 0.1 min

Peak Storage= 13 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 19.0' Slope= 0.0200 '/'
Inlet Invert= 86.05', Outlet Invert= 85.67'



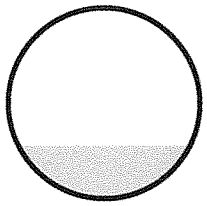
Reach R2: CB2-DMH1

Inflow Area = 0.300 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 0.95 cfs @ 12.08 hrs, Volume= 0.075 af
Outflow = 0.95 cfs @ 12.09 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.21 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.70 fps, Avg. Travel Time= 0.4 min

Peak Storage= 8 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 45.0' Slope= 0.0200 '/'
Inlet Invert= 88.47', Outlet Invert= 87.57'



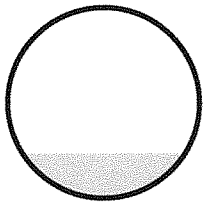
Reach R3: CB3-DMH2

Inflow Area = 0.210 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 0.66 cfs @ 12.08 hrs, Volume= 0.053 af
Outflow = 0.66 cfs @ 12.08 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.70 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.53 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.5' Slope= 0.0200 '/'
Inlet Invert= 86.58', Outlet Invert= 86.55'



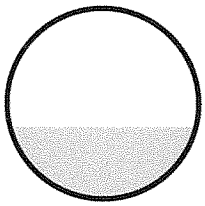
Reach R4: DMH1-DMH2

Inflow Area = 0.747 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 2.35 cfs @ 12.09 hrs, Volume= 0.188 af
Outflow = 2.35 cfs @ 12.09 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.62 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.84 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 7.72 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 23.0' Slope= 0.0400 '/'
Inlet Invert= 87.47', Outlet Invert= 86.55'



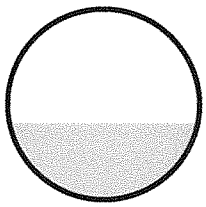
Reach R6: DMH3-WQU4

Inflow Area = 1.732 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 5.44 cfs @ 12.09 hrs, Volume= 0.436 af
Outflow = 5.44 cfs @ 12.09 hrs, Volume= 0.436 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.22 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.71 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.0' Slope= 0.0200 '/'
Inlet Invert= 85.57', Outlet Invert= 85.55'



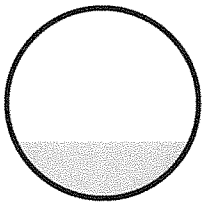
Reach R7: CB 5 to DMH3

Inflow Area = 0.237 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 0.75 cfs @ 12.08 hrs, Volume= 0.059 af
Outflow = 0.74 cfs @ 12.09 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.74 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.22 fps, Avg. Travel Time= 0.9 min

Peak Storage= 13 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 3.77 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 66.0' Slope= 0.0095 '/'
Inlet Invert= 86.80', Outlet Invert= 86.17'



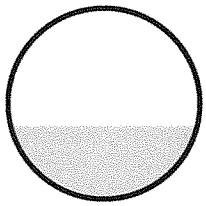
Reach R8: CB4 - DMH3

Inflow Area = 0.539 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 1.70 cfs @ 12.08 hrs, Volume= 0.136 af
Outflow = 1.70 cfs @ 12.08 hrs, Volume= 0.136 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.14 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.03 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.38'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.0' Slope= 0.0200 '/'
Inlet Invert= 86.19', Outlet Invert= 86.17'



Pond P1: Infiltration pond

Inflow Area = 1.732 ac, Inflow Depth = 3.02" for 2YR event
Inflow = 5.43 cfs @ 12.09 hrs, Volume= 0.436 af
Outflow = 0.63 cfs @ 12.70 hrs, Volume= 0.436 af, Atten= 88%, Lag= 36.4 min
Discarded = 0.63 cfs @ 12.70 hrs, Volume= 0.436 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.13' @ 12.70 hrs Surf.Area= 0.079 ac Storage= 0.161 af

Plug-Flow detention time= 94.2 min calculated for 0.435 af (100% of inflow)
Center-of-Mass det. time= 94.2 min (851.3 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1	82.80'	0.179 af	**37.22'W x 60.00'L x 3.50'H Prismatoid**
#2	83.30'	0.066 af	**36.0"D x 58.00'L Horizontal Cylinder** x 7
		0.245 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.580 in/hr Exfiltration over Wetted area**
#2	Primary	85.20'	**12.0" Vert. Orifice/Grate X 7.00** C= 0.600

Discarded OutFlow Max=0.63 cfs @ 12.70 hrs HW=85.13' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.63 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.80' (Free Discharge)
↑**2=Orifice/Grate** (Controls 0.00 cfs)

Link 1L: Combined Hydrographs

Inflow Area = 1.892 ac, Inflow Depth = 0.25" for 2YR event
Inflow = 0.50 cfs @ 12.09 hrs, Volume= 0.040 af
Primary = 0.50 cfs @ 12.09 hrs, Volume= 0.040 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

10 YR POST-DEVELOPMENT

Subcatchment RS: New Roof

Runoff = 0.73 cfs @ 12.09 hrs, Volume= 0.059 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
6,955	98	Paved parking & roofs
6,955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, roof**
0.3	66	0.0100	4.09	1.43	**Circular Channel (pipe),** Diam= 8.0" Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
6.3	66	Total			

Subcatchment S1: CB1 - Garage area pavement

Runoff = 2.05 cfs @ 12.08 hrs, Volume= 0.166 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
19,466	98	Paved parking & roofs
19,466		Impervious Area

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

Subcatchment S2: CB2 - E. Central area pavement

Runoff = 1.38 cfs @ 12.08 hrs, Volume= 0.112 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
13,064	98	Paved parking & roofs
13,064		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Parking by E. Central St**

Subcatchment S3: Center parking -right

Runoff = 0.96 cfs @ 12.08 hrs, Volume= 0.078 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
9,134	98	Paved parking & roofs
9,134		Impervious Area

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

Subcatchment S4: Center parking-left

Runoff = 2.48 cfs @ 12.08 hrs, Volume= 0.201 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
23,488	98	Paved parking & roofs
23,488		Impervious Area

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

Subcatchment S5: NW basin to CB5

Runoff = 1.09 cfs @ 12.08 hrs, Volume= 0.088 af, Depth= 4.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10YR Rainfall=4.70"

Area (sf)	CN	Description
10,305	98	Paved parking & roofs
10,305		Impervious Area

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

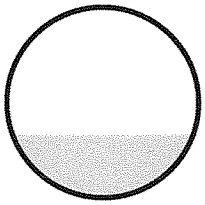
Reach 2R: POND1 - FES2

Inflow Area = 1.732 ac, Inflow Depth = 0.69" for 10YR event
Inflow = 3.29 cfs @ 12.23 hrs, Volume= 0.099 af
Outflow = 3.28 cfs @ 12.25 hrs, Volume= 0.099 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.43 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 3.16 fps, Avg. Travel Time= 0.8 min

Peak Storage= 76 cf @ 12.24 hrs, Average Depth at Peak Storage= 0.50'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 13.87 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 148.0' Slope= 0.0149 '/'
Inlet Invert= 85.20', Outlet Invert= 83.00'



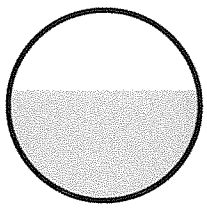
Reach 3R: WQU4-Pond1

Inflow Area = 1.732 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 7.92 cfs @ 12.09 hrs, Volume= 0.644 af
Outflow = 7.92 cfs @ 12.09 hrs, Volume= 0.644 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.45 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.54 fps, Avg. Travel Time= 0.2 min

Peak Storage= 37 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.87'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 12.41 cfs

18.0" Diameter Pipe, n= 0.011 PVC, smooth interior
Length= 35.0' Slope= 0.0100 '/'
Inlet Invert= 85.55', Outlet Invert= 85.20'



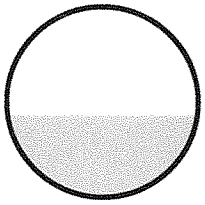
Reach R1: CB 1 - DMH1

Inflow Area = 0.447 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 2.05 cfs @ 12.08 hrs, Volume= 0.166 af
Outflow = 2.05 cfs @ 12.10 hrs, Volume= 0.166 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.33 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.11 fps, Avg. Travel Time= 1.2 min

Peak Storage= 51 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.32 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 157.0' Slope= 0.0190 '/'
Inlet Invert= 90.55', Outlet Invert= 87.57'



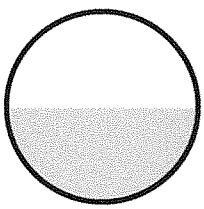
Reach R10: DMH2-DMH3

Inflow Area = 1.732 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 7.93 cfs @ 12.09 hrs, Volume= 0.644 af
Outflow = 7.92 cfs @ 12.09 hrs, Volume= 0.644 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.07 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.05 fps, Avg. Travel Time= 0.1 min

Peak Storage= 17 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 19.0' Slope= 0.0200 '/'
Inlet Invert= 86.05', Outlet Invert= 85.67'



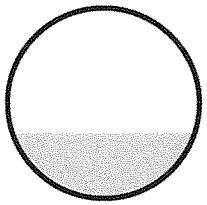
Reach R2: CB2-DMH1

Inflow Area = 0.300 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 1.38 cfs @ 12.08 hrs, Volume= 0.112 af
Outflow = 1.38 cfs @ 12.09 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.79 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.92 fps, Avg. Travel Time= 0.4 min

Peak Storage= 11 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 45.0' Slope= 0.0200 '/'
Inlet Invert= 88.47', Outlet Invert= 87.57'



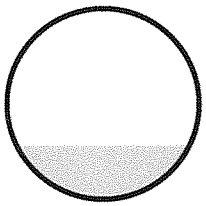
Reach R3: CB3-DMH2

Inflow Area = 0.210 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 0.96 cfs @ 12.08 hrs, Volume= 0.078 af
Outflow = 0.96 cfs @ 12.08 hrs, Volume= 0.078 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.24 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.72 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.5' Slope= 0.0200 '/'
Inlet Invert= 86.58', Outlet Invert= 86.55'



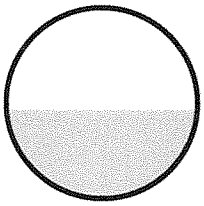
Reach R4: DMH1-DMH2

Inflow Area = 0.747 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 3.42 cfs @ 12.09 hrs, Volume= 0.278 af
Outflow = 3.42 cfs @ 12.09 hrs, Volume= 0.278 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.53 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.19 fps, Avg. Travel Time= 0.1 min

Peak Storage= 8 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 7.72 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 23.0' Slope= 0.0400 '/'
Inlet Invert= 87.47', Outlet Invert= 86.55'



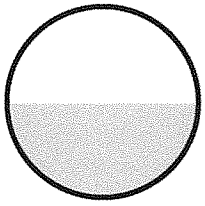
Reach R6: DMH3-WQU4

Inflow Area = 1.732 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 7.92 cfs @ 12.09 hrs, Volume= 0.644 af
Outflow = 7.92 cfs @ 12.09 hrs, Volume= 0.644 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.07 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.05 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.74'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.0' Slope= 0.0200 '/'
Inlet Invert= 85.57', Outlet Invert= 85.55'



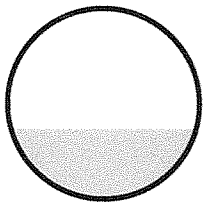
Reach R7: CB 5 to DMH3

Inflow Area = 0.237 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 1.09 cfs @ 12.08 hrs, Volume= 0.088 af
Outflow = 1.08 cfs @ 12.09 hrs, Volume= 0.088 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.15 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.38 fps, Avg. Travel Time= 0.8 min

Peak Storage= 17 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.37'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 3.77 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 66.0' Slope= 0.0095 '/'
Inlet Invert= 86.80', Outlet Invert= 86.17'



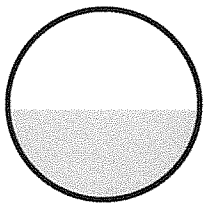
Reach R8: CB4 - DMH3

Inflow Area = 0.539 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 2.48 cfs @ 12.08 hrs, Volume= 0.201 af
Outflow = 2.48 cfs @ 12.08 hrs, Volume= 0.201 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.78 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.28 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.47'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.0' Slope= 0.0200 '/'
Inlet Invert= 86.19', Outlet Invert= 86.17'



Pond P1: Infiltration pond

Inflow Area = 1.732 ac, Inflow Depth = 4.46" for 10YR event
Inflow = 7.92 cfs @ 12.09 hrs, Volume= 0.644 af
Outflow = 3.97 cfs @ 12.23 hrs, Volume= 0.644 af, Atten= 50%, Lag= 8.5 min
Discarded = 0.69 cfs @ 12.23 hrs, Volume= 0.545 af
Primary = 3.29 cfs @ 12.23 hrs, Volume= 0.099 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.54' @ 12.23 hrs Surf.Area= 0.076 ac Storage= 0.193 af

Plug-Flow detention time= 88.3 min calculated for 0.644 af (100% of inflow)
Center-of-Mass det. time= 88.3 min (838.3 - 750.0)

Volume	Invert	Avail.Storage	Storage Description
#1	82.80'	0.179 af	**37.22'W x 60.00'L x 3.50'H Prismatoid**
#2	83.30'	0.066 af	**36.0"D x 58.00'L Horizontal Cylinder** x 7
		0.245 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.580 in/hr Exfiltration over Wetted area**
#2	Primary	85.20'	**12.0" Vert. Orifice/Grate X 7.00** C= 0.600

Discarded OutFlow Max=0.69 cfs @ 12.23 hrs HW=85.54' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.69 cfs)

Primary OutFlow Max=3.28 cfs @ 12.23 hrs HW=85.54' (Free Discharge)
↑—**2=Orifice/Grate** (Orifice Controls 3.28 cfs @ 1.99 fps)

Link 1L: Combined Hydrographs

Inflow Area = 1.892 ac, Inflow Depth = 1.00" for 10YR event
Inflow = 3.63 cfs @ 12.24 hrs, Volume= 0.158 af
Primary = 3.63 cfs @ 12.24 hrs, Volume= 0.158 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

100 YR POST-DEVELOPMENT

Subcatchment RS: New Roof

Runoff = 1.05 cfs @ 12.09 hrs, Volume= 0.087 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
6,955	98	Paved parking & roofs
6,955		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, roof**
0.3	66	0.0100	4.09	1.43	**Circular Channel (pipe),** Diam= 8.0" Area= 0.3 sf Perim= 2.1' r= 0.17' n= 0.011 PVC, smooth interior
6.3	66	Total			

Subcatchment S1: CB1 - Garage area pavement

Runoff = 2.98 cfs @ 12.08 hrs, Volume= 0.244 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
19,466	98	Paved parking & roofs
19,466		Impervious Area

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

Subcatchment S2: CB2 - E. Central area pavement

Runoff = 2.00 cfs @ 12.08 hrs, Volume= 0.164 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
13,064	98	Paved parking & roofs
13,064		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Parking by E. Central St**

Subcatchment S3: Center parking -right

Runoff = 1.40 cfs @ 12.08 hrs, Volume= 0.115 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
9,134	98	Paved parking & roofs
9,134		Impervious Area

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

Subcatchment S4: Center parking-left

Runoff = 3.60 cfs @ 12.08 hrs, Volume= 0.295 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
23,488	98	Paved parking & roofs
23,488		Impervious Area

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

Subcatchment S5: NW basin to CB5

Runoff = 1.58 cfs @ 12.08 hrs, Volume= 0.129 af, Depth= 6.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100YR Rainfall=6.80"

Area (sf)	CN	Description
10,305	98	Paved parking & roofs
10,305		Impervious Area

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

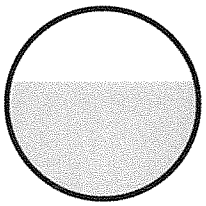
Reach 2R: POND1 - FES2

Inflow Area = 1.732 ac, Inflow Depth = 1.94" for 100YR event
Inflow = 9.75 cfs @ 12.13 hrs, Volume= 0.279 af
Outflow = 9.72 cfs @ 12.14 hrs, Volume= 0.279 af, Atten= 0%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 8.50 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 3.54 fps, Avg. Travel Time= 0.7 min

Peak Storage= 170 cf @ 12.13 hrs, Average Depth at Peak Storage= 0.93'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 13.87 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 148.0' Slope= 0.0149 '/'
Inlet Invert= 85.20', Outlet Invert= 83.00'



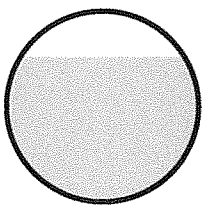
Reach 3R: WQU4-Pond1

Inflow Area = 1.732 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 11.51 cfs @ 12.09 hrs, Volume= 0.947 af
Outflow = 11.50 cfs @ 12.09 hrs, Volume= 0.947 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.98 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.85 fps, Avg. Travel Time= 0.2 min

Peak Storage= 50 cf @ 12.09 hrs, Average Depth at Peak Storage= 1.14'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 12.41 cfs

18.0" Diameter Pipe, n= 0.011 PVC, smooth interior
Length= 35.0' Slope= 0.0100 '/'
Inlet Invert= 85.55', Outlet Invert= 85.20'



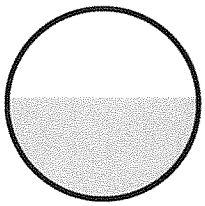
Reach R1: CB 1 - DMH1

Inflow Area = 0.447 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 2.98 cfs @ 12.08 hrs, Volume= 0.244 af
Outflow = 2.97 cfs @ 12.09 hrs, Volume= 0.244 af, Atten= 0%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.96 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 2.37 fps, Avg. Travel Time= 1.1 min

Peak Storage= 67 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.53'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.32 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 157.0' Slope= 0.0190 '/'
Inlet Invert= 90.55', Outlet Invert= 87.57'



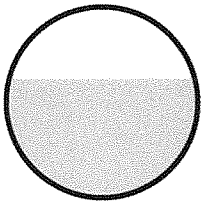
Reach R10: DMH2-DMH3

Inflow Area = 1.732 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 11.51 cfs @ 12.09 hrs, Volume= 0.947 af
Outflow = 11.51 cfs @ 12.09 hrs, Volume= 0.947 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.90 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.43 fps, Avg. Travel Time= 0.1 min

Peak Storage= 22 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 19.0' Slope= 0.0200 '/'
Inlet Invert= 86.05', Outlet Invert= 85.67'



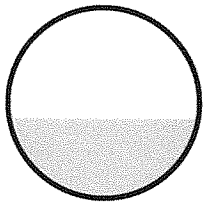
Reach R2: CB2-DMH1

Inflow Area = 0.300 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 2.00 cfs @ 12.08 hrs, Volume= 0.164 af
Outflow = 2.00 cfs @ 12.09 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.41 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 2.15 fps, Avg. Travel Time= 0.3 min

Peak Storage= 14 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.42'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 45.0' Slope= 0.0200 '/'
Inlet Invert= 88.47', Outlet Invert= 87.57'



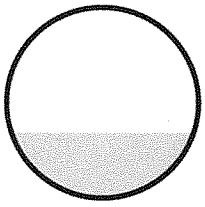
Reach R3: CB3-DMH2

Inflow Area = 0.210 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 1.40 cfs @ 12.08 hrs, Volume= 0.115 af
Outflow = 1.40 cfs @ 12.08 hrs, Volume= 0.115 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.82 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 1.94 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.5' Slope= 0.0200 '/'
Inlet Invert= 86.58', Outlet Invert= 86.55'



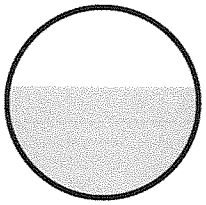
Reach R4: DMH1-DMH2

Inflow Area = 0.747 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 4.96 cfs @ 12.09 hrs, Volume= 0.408 af
Outflow = 4.96 cfs @ 12.09 hrs, Volume= 0.408 af, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 10.44 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.59 fps, Avg. Travel Time= 0.1 min

Peak Storage= 11 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.58'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 7.72 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 23.0' Slope= 0.0400 '/'
Inlet Invert= 87.47', Outlet Invert= 86.55'



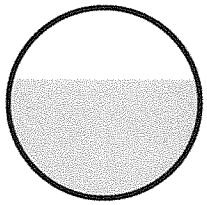
Reach R6: DMH3-WQU4

Inflow Area = 1.732 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 11.51 cfs @ 12.09 hrs, Volume= 0.947 af
Outflow = 11.51 cfs @ 12.09 hrs, Volume= 0.947 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 9.90 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 3.43 fps, Avg. Travel Time= 0.0 min

Peak Storage= 1 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.94'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 16.09 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.0' Slope= 0.0200 '/'
Inlet Invert= 85.57', Outlet Invert= 85.55'



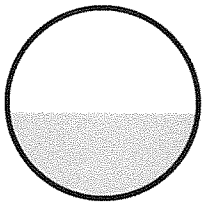
Reach R7: CB 5 to DMH3

Inflow Area = 0.237 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 1.58 cfs @ 12.08 hrs, Volume= 0.129 af
Outflow = 1.57 cfs @ 12.09 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.59 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 1.54 fps, Avg. Travel Time= 0.7 min

Peak Storage= 23 cf @ 12.09 hrs, Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 3.77 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 66.0' Slope= 0.0095 '/'
Inlet Invert= 86.80', Outlet Invert= 86.17'



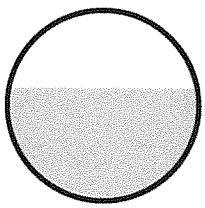
Reach R8: CB4 - DMH3

Inflow Area = 0.539 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 3.60 cfs @ 12.08 hrs, Volume= 0.295 af
Outflow = 3.60 cfs @ 12.08 hrs, Volume= 0.295 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 7.42 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.56 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 12.08 hrs, Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.00', Capacity at Bank-Full= 5.46 cfs

12.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 1.0' Slope= 0.0200 '/'
Inlet Invert= 86.19', Outlet Invert= 86.17'



Pond P1: Infiltration pond

Inflow Area = 1.732 ac, Inflow Depth = 6.56" for 100YR event
Inflow = 11.50 cfs @ 12.09 hrs, Volume= 0.947 af
Outflow = 10.48 cfs @ 12.13 hrs, Volume= 0.947 af, Atten= 9%, Lag= 2.2 min
Discarded = 0.73 cfs @ 12.13 hrs, Volume= 0.668 af
Primary = 9.75 cfs @ 12.13 hrs, Volume= 0.279 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.83' @ 12.13 hrs Surf.Area= 0.072 ac Storage= 0.214 af

Plug-Flow detention time= 79.5 min calculated for 0.947 af (100% of inflow)
Center-of-Mass det. time= 79.4 min (823.6 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1	82.80'	0.179 af	**37.22'W x 60.00'L x 3.50'H Prismatoid**
#2	83.30'	0.066 af	**36.0"D x 58.00'L Horizontal Cylinder** x 7
		0.245 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**5.580 in/hr Exfiltration over Wetted area**
#2	Primary	85.20'	**12.0" Vert. Orifice/Grate X 7.00** C= 0.600

Discarded OutFlow Max=0.73 cfs @ 12.13 hrs HW=85.83' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.73 cfs)

Primary OutFlow Max=9.73 cfs @ 12.13 hrs HW=85.83' (Free Discharge)
↑**2=Orifice/Grate** (Orifice Controls 9.73 cfs @ 2.69 fps)

Link 1L: Combined Hydrographs

Inflow Area = 1.892 ac, Inflow Depth = 2.33" for 100YR event
Inflow = 10.62 cfs @ 12.13 hrs, Volume= 0.367 af
Primary = 10.62 cfs @ 12.13 hrs, Volume= 0.367 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

APPENDIX E

Project:	Franklin Ford
Location:	Franklin, MA
Prepared For:	United Consultants

CONTECH® ENGINEERED SOLUTIONS

Purpose: To calculate the water quality flow rate (WQF) over a given site area. In this situation the WQF is derived from the first 1" of runoff from the contributing impervious surface.

Reference: Massachusetts Dept. of Environmental Protection Wetlands Program / United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Procedure: Determine unit peak discharge using Figure 1 or 2. Figure 2 is in tabular form so is preferred. Using the tc, read the unit peak discharge (qu) from Figure 1 or Table in Figure 2. qu is expressed in the following units: cfs/mi^2/watershed inches (csm/in).

Compute Q Rate using the following equation:

$$Q = (qu)\ (A)\ (WQV)$$

where:

Q = flow rate associated with first 1" of runoff
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1" in this case)

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQU 4	1.71	0.0026781	6.0	0.100	1.00	774.00	2.07

CONTECH® ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

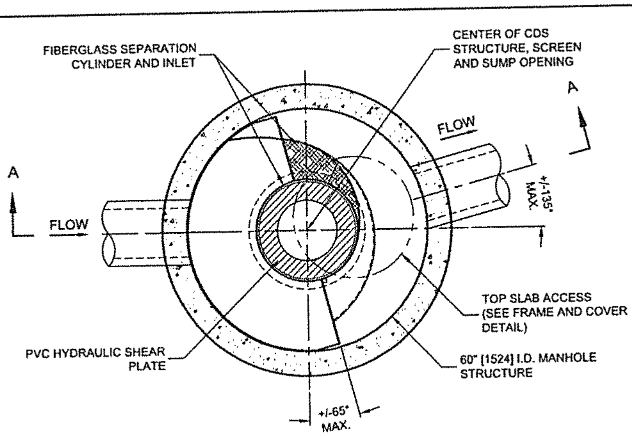
CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

FRANKLIN FORD
FRANKLIN, MA

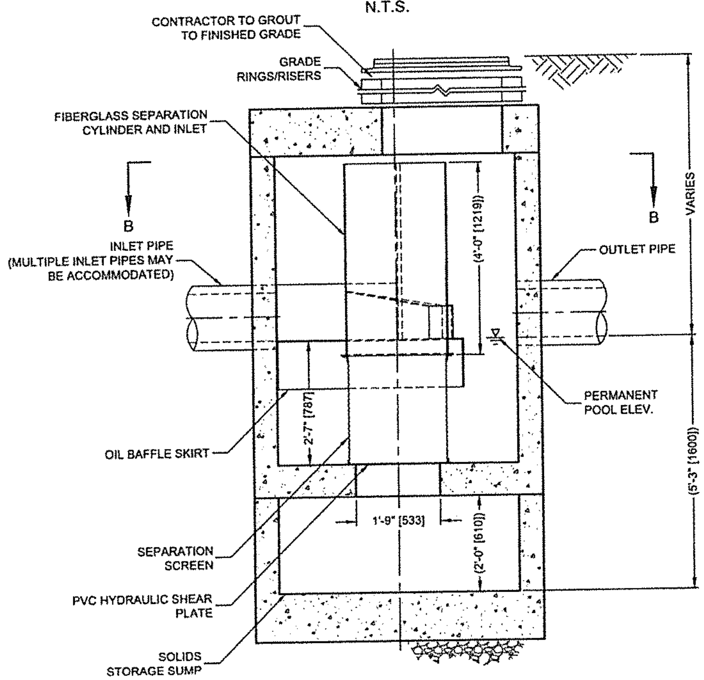
Area	1.71 ac	Unit Site Designation	WQU 4
Weighted C	0.9	Rainfall Station #	68
t_c	6 min		
CDS Model	2020-5	CDS Treatment Capacity	**2.2 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.3%	9.3%	0.03	0.03	9.3
0.04	9.5%	18.8%	0.06	0.06	9.5
0.06	8.7%	27.5%	0.09	0.09	8.7
0.08	10.1%	37.6%	0.12	0.12	10.0
0.10	7.2%	44.8%	0.15	0.15	7.0
0.12	6.0%	50.8%	0.19	0.19	5.9
0.14	6.3%	57.1%	0.22	0.22	6.1
0.16	5.6%	62.7%	0.25	0.25	5.4
0.18	4.7%	67.4%	0.28	0.28	4.5
0.20	3.6%	71.0%	0.31	0.31	3.4
0.25	8.2%	79.1%	0.39	0.39	7.6
0.50	14.9%	94.0%	0.77	0.77	12.6
0.75	3.2%	97.3%	1.16	1.16	2.5
1.00	1.2%	98.5%	1.54	1.54	0.8
1.50	0.7%	99.2%	2.31	2.20	0.4
2.00	0.8%	100.0%	3.09	2.20	0.3
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
0.00	0.0%	100.0%	0.00	0.00	0.0
					93.9
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**87.4%**

1 - Based on 10 years of rainfall data from NCDC station 736, Blue Hill, Norfolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.



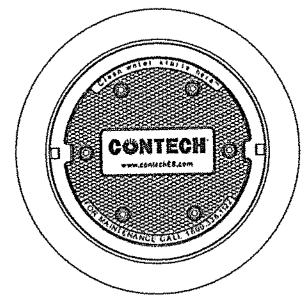
PLAN VIEW B-B
N.T.S.



ELEVATION A-A
N.T.S.

CDS

CDS2020-5-C DESIGN NOTES
CDS2020-5-C RATED TREATMENT CAPACITY IS 2.2 CFS, OR PER LOCAL REGULATIONS. THE STANDARD CDS2020-5-C CONFIGURATION IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.
CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES



FRAME AND COVER
(DIAMETER VARIES)
N.T.S.

SITE SPECIFIC DATA REQUIREMENTS			
STRUCTURE ID			
WATER QUALITY FLOW RATE (CFS OR L/s)			*
PEAK FLOW RATE (CFS OR L/s)			*
RETURN PERIOD OF PEAK FLOW (YRS)			*
SCREEN APERTURE (2400 OR 4700)			*
PIPE DATA:	I.E.	MATERIAL	DIAMETER
INLET PIPE 1	*	*	*
INLET PIPE 2	*	*	*
OUTLET PIPE	*	*	*
RIM ELEVATION			*
ANTI-FLOTATION BALLAST		WIDTH	HEIGHT
		*	*
NOTES/SPECIAL REQUIREMENTS:			
* PER ENGINEER OF RECORD			

GENERAL NOTES
1. CONTECH TO PROVIDE ALL MATERIALS UNLESS NOTED OTHERWISE.
2. FOR SITE SPECIFIC DRAWINGS WITH DETAILED STRUCTURE DIMENSIONS AND WEIGHT, PLEASE CONTACT YOUR CONTECH ENGINEERED SOLUTIONS LLC REPRESENTATIVE. www.ContechES.com
3. CDS WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF PROJECT.
4. STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2', AND GROUNDWATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER OF RECORD TO CONFIRM ACTUAL GROUNDWATER ELEVATION. CASTINGS SHALL MEET AASHTO M306 AND BE CAST WITH THE CONTECH LOGO..
5. IF REQUIRED, PVC HYDRAULIC SHEAR PLATE IS PLACED ON SHELF AT BOTTOM OF SCREEN CYLINDER. REMOVE AND REPLACE AS NECESSARY DURING MAINTENANCE CLEANING.
6. CDS STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C-478 AND AASHTO LOAD FACTOR DESIGN METHOD.

INSTALLATION NOTES
A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE CDS MANHOLE STRUCTURE.
C. CONTRACTOR TO INSTALL JOINT SEALANT BETWEEN ALL STRUCTURE SECTIONS AND ASSEMBLE STRUCTURE.
D. CONTRACTOR TO PROVIDE, INSTALL, AND GROUT INLET AND OUTLET PIPE(S). MATCH PIPE INVERTS WITH ELEVATIONS SHOWN. ALL PIPE CENTERLINES TO MATCH PIPE OPENING CENTERLINES.
E. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO ASSURE UNIT IS WATER TIGHT, HOLDING WATER TO FLOWLINE INVERT MINIMUM. IT IS SUGGESTED THAT ALL JOINTS BELOW PIPE INVERTS ARE GROUTED.

CONTECH®
ENGINEERED SOLUTIONS LLC
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9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

CDS2020-5-C
ONLINE CDS
STANDARD DETAIL

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: 175 East Central St. + 9 Chestnut Street

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Hooded CB	25%	1.00	25%	75%
CDS Unit (WQU)	87.4%	75%	65.5	9.5%
Infiltration Basin	80%	9.5	7.6	1.9%

Total TSS Removal = 98.1%

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

Project: Franklin Ford

Prepared By: [illegible]

Date: 9/14/2022

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

APPENDIX F

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 5
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 12.6000

Res Type	35.2	
H	5	
a	3	
H/a	1.67	
α^*	0.36	
G0.01	0.91	
G0.04	0.84	
G0.12	0.6	
G0.36	0.8	
C	0.9	
R	######	
Q	7.34	
pi	3.14	

α^* = 0.36 (cm^{-1})

C = 0.80315

Q = 7.3375

K_{fs} = 2.21E-02 cm/sec
####### cm/min
2.21E-04 m/sec
5.21E-01 inch/min
8.69E-03 inch/sec

Φ_m = 6.13E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1
Enter water Head Height ("H" in cm): 10
Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 17.6500

Res Type	35.22	
H	10	
a	3	
H/a	3.3333	
α^*	0.36	
G0.01	1.2184	
G0.04	1.2592	
G0.12	1.2875	
G0.36	1.2675	
C	1.2675	
R	17.650	
Q	10.361	
pi	3.1415	

α^* = 0.36 (cm^{-1})

C = 1.28754

Q = 10.3606

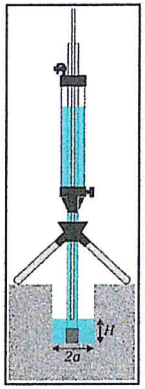
K_{fs} = 1.59E-02 cm/sec
9.54E-01 cm/min
1.59E-04 m/ses
3.75E-01 inch/min
6.26E-03 inch/sec

Φ_m = 4.42E-02 (cm^2/min)

Average

K_{fs} = 1.90E-02 cm/sec
1.14E+00 cm/min
1.90E-04 m/s
4.48E-01 inch/min
7.47E-03 inch/sec

Φ_m = 5.27E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir): 1

Enter the first water Head Height ("H1" in cm): 5
Enter the second water Head Height ("H2" in cm): 10

Enter the Borehole Radius ("a" in cm): 3

Enter the soil texture-structure category (enter one of the below numbers): 4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

α^* = 0.36 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 12.6000

Steady State Rate of Water Level Change ("R2" in cm/min): 17.6500

Res Type	2.10	
H1/a	1.66667	
H2/a	3.33333	
G1-0.01	0.60049	
G2-0.01	1.21647	
G1-0.04	0.84228	
G2-0.04	1.26023	
G1-0.12	0.93015	
G2-0.12	1.28754	
G1-0.36	0.93015	
G2-0.36	1.28754	

1.95

Q_1 = 0.45

Q_2 = 0.6354

C_1 = 0.80315

C_2 = 1.28754

G_1 = 0.00496

G_2 = 0.00397

G_3 = 0.05569

G_4 = 0.02415

K_{fs} = 2.94E-04 cm/sec
1.76E-02 cm/min
2.94E-06 m/sec
6.94E-03 inch/min
1.16E-04 inch/sec

Φ_m = 9.72E-03 (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two head method, C_1 and C_2 are calculated (Zhang et al., 1998).

Soil Texture-Structure Category	α^*(cm^{-1})	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.653}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.653}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.754}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.754}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	$G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$

Guelph Permeameter Data Sheet

Investigator: CACO & RPG Date: 3/25/22

Location: FRANKLIN FOOD Test Id: TP #1

Depth of hole: 76" Radius: 3 cm (standard calcs assume 3 cm radius)

Reservoirs used during test (check one): Combined: ✓ Inner only: _____

Reservoir constant used: 35.22

Water level in well = 5 cm

Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		17		
0:12	0.2	20	3	15.0
0:34	0.37	25	5	13.64
0:57	0.38	30	5	13.04
1:21	0.40	35	5	12.50
1:45	0.40	40	5	12.50
2:11	0.43	45	5	11.53
2:34	0.38	50	5	13.04
3:00	0.43	55	5	11.54
3:24	0.40	60	5	12.50
3:48	0.40	65	5	12.50
4:14	0.43	70	5	11.53
4:39	0.42	75	5	12.0

Steady rate for 3 consecutive readings (R_1): 12.50

Water level in well = 10 cm

Time t (min)	Dt (min)	Water level in reservoir h (cm)	Dh (cm)	Rate of change Dh/ Dt
0		18		
0:19	0.32	25	7	22.10
0:35	0.27	30	5	18.75
0:51	0.27	35	5	18.75
1:08	0.27	40	5	18.75
1:24	0.28	45	5	17.65
1:41	0.28	50	5	17.65
2:00	0.32	55	5	15.79
2:17	0.28	60	5	17.65
2:35	0.30	65	5	16.62
2:52	0.28	70	5	17.65
3:10	0.30	75	5	16.69

Steady rate for 3 consecutive readings (R_2): 17.65

Comments:

$K_G = 0.448$ in/min = 26.88 in/hr

GP FIELD DATA SHEET

SECTION 1: SITE INFORMATION

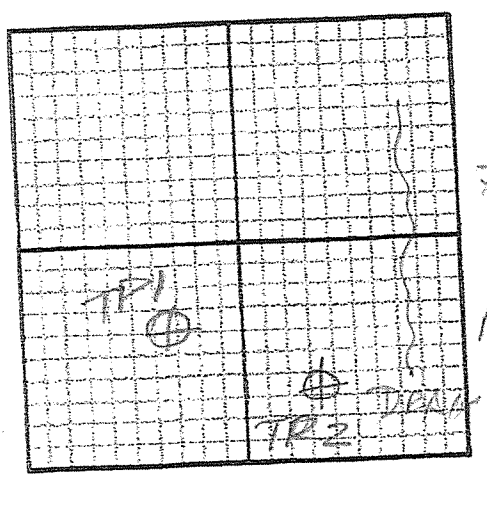
Date 3/25/22 Investigator CARLOS QUINTAL & RICK GOUDREAU

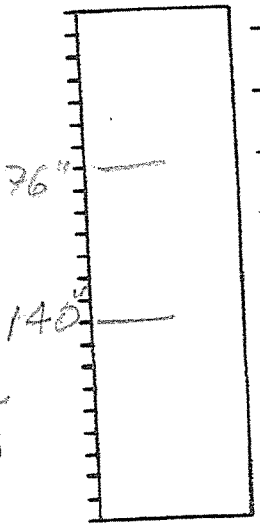
Site Location FRANKLIN FORD

Dominant Soil Type(s) MEDIUM - URBAN COMPLEX

Site Map: TP #1

Soil Profile Description (horizon depth, texture, structure, color, etc.):





Depth	Description
	FILL
76"	STRATIFIED SAND & GRAVEL
140"	

Presence of special soil conditions (mottling, water table depth, hardpan, induration, compacted layers, etc.):

NO WATER

NO MOISTURE

Comments and Notes (topography, slope, vegetation, etc.):

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025, Santa Barbara, CA 93130 USA
Phone: 805-964-3525 - Fax: (805) 683-2189 - Email: sales@soilmoisture.com
Website: http://www.soilmoisture.com

SOILMOISTURE®

Guelph Permeameter Calculations

Input

Result

Support: ali@soilmoisture.com

Head #1

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	5
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 4.2800

Res Type 35.2
H 5
a 3
H/a 1.67
α* 0.36
C0.01 0.81
C0.04 0.84
C0.12 0.8
C0.36 0.8
C 0.8
R 4.280
Q 2.51
pi 3.14

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 0.80315

$Q =$ 2.51236

$K_{fs} =$ 7.56E-03 cm/sec
4.53E-01 cm/min
7.56E-05 m/sec
1.78E-01 inch/min
2.97E-03 inch/sec

$\Phi_m =$ 2.10E-02 (cm^2/min)

Head #2

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter water Head Height ("H" in cm):	10
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

Steady State Rate of Water Level Change ("R" in cm/min): 9.0900

Res Type 35.22
H 10
a 3
H/a 3.3333
α* 0.36
C0.01 1.2184
C0.04 1.2802
C0.12 1.2975
C0.36 1.2975
C 1.2975
R 9.090
Q 5.3358
pi 3.1415

$\alpha^* =$ 0.36 (cm^{-1})

$C =$ 1.28754

$Q =$ 5.33583

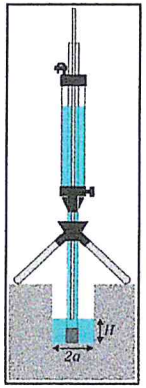
$K_{fs} =$ 8.19E-03 cm/sec
4.91E-01 cm/min
8.19E-05 m/sec
1.93E-01 inch/min
3.22E-03 inch/sec

$\Phi_m =$ 2.27E-02 (cm^2/min)

Average

$K_{fs} =$ 7.87E-03 cm/sec
4.72E-01 cm/min
7.87E-05 m/s
1.86E-01 inch/min
3.10E-03 inch/sec

$\Phi_m =$ 2.19E-02 (cm^2/min)



Two Head Method

Reservoir Type (enter "1" for Combined and "2" for Inner reservoir):	1
Enter the first water Head Height ("H1" in cm):	5
Enter the second water Head Height ("H2" in cm):	10
Enter the Borehole Radius ("a" in cm):	3
Enter the soil texture-structure category (enter one of the below numbers):	4

1. Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.
2. Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.
3. Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.
4. Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macropors, etc

$\alpha^* =$ 0.36 (cm^{-1})

Steady State Rate of Water Level Change ("R1" in cm/min): 4.2800

Steady State Rate of Water Level Change ("R2" in cm/min): 9.0900

1.95

$Q_1 =$ 0.15408

$Q_2 =$ 0.32724

$C_1 =$ 0.80315

$C_2 =$ 1.28754

Res Type 2.19
H1/a 1.666667
H2/a 3.333333
C1-0.01 0.800349
C2-0.01 1.218041
C1-0.04 0.802265
C2-0.04 1.220053
C1-0.12 0.803319
C2-0.12 1.287754
C1-0.36 0.803319
C2-0.36 1.287754

$G_1 =$ 0.00496

$G_2 =$ 0.00397

$G_3 =$ 0.05569

$G_4 =$ 0.02415

$K_{fs} =$ 5.36E-04 cm/sec
3.22E-02 cm/min
5.36E-06 m/sec
1.27E-02 inch/min
2.11E-04 inch/sec

$\Phi_m =$ 6.79E-04 (cm^2/min)

Calculation formulas related to shape factor (C). Where H_1 is the first water head height (cm), H_2 is the second water head height (cm), a is borehole radius (cm) and α^* is macroscopic capillary length factor which is decided according to the soil texture-structure category. For one-head method, only C_1 needs to be calculated while for two-head method, C_1 and C_2 are calculated (Zang et al., 1998).

Soil Texture-Structure Category	$\alpha^*(cm^{-1})$	Shape Factor
Compacted, Structure-less, clayey or silty materials such as landfill caps and liners, lacustrine or marine sediments, etc.	0.01	$C_1 = \left(\frac{H_1/a}{2.102 + 0.118(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{2.102 + 0.118(H_2/a)}\right)^{0.655}$
Soils which are both fine textured (clayey or silty) and unstructured; may also include some fine sands.	0.04	$C_1 = \left(\frac{H_1/a}{1.992 + 0.091(H_1/a)}\right)^{0.655}$ $C_2 = \left(\frac{H_2/a}{1.992 + 0.091(H_2/a)}\right)^{0.655}$
Most structured soils from clays through loams; also includes unstructured medium and fine sands. The category most frequently applicable for agricultural soils.	0.12	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.774}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.774}$
Coarse and gravely sands; may also include some highly structured soils with large and/or numerous cracks, macro pores, etc.	0.36	$C_1 = \left(\frac{H_1/a}{2.074 + 0.093(H_1/a)}\right)^{0.774}$ $C_2 = \left(\frac{H_2/a}{2.074 + 0.093(H_2/a)}\right)^{0.774}$

Calculation formulas related to one-head and two-head methods. Where R is steady-state rate of fall of water in reservoir (cm/s), K_{fs} is Soil saturated hydraulic conductivity (cm/s), Φ_m is Soil matric flux potential (cm^2/s), α^* is Macroscopic capillary length parameter (from Table 2), a is Borehole radius (cm), H_1 is the first head of water established in borehole (cm), H_2 is the second head of water established in borehole (cm) and C is Shape factor (from Table 2).

One Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$	$K_{fs} = \frac{C_1 \times Q_1}{2\pi H_1^2 + \pi a^2 C_1 + 2\pi\left(\frac{H_1}{\alpha^*}\right)}$ $\Phi_m = \frac{C_1 \times Q_1}{(2\pi H_1^2 + \pi a^2 C_1)\alpha^* + 2\pi H_1}$
One Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$	
Two Head, Combined Reservoir	$Q_1 = \bar{R}_1 \times 35.22$ $Q_2 = \bar{R}_2 \times 35.22$	$G_1 = \frac{H_2 C_1}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_2 = \frac{H_1 C_2}{\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $K_{fs} = G_2Q_2 - G_1Q_1$ $G_3 = \frac{(2H_2^2 + a^2C_2)C_1}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $G_4 = \frac{(2H_1^2 + a^2C_1)C_2}{2\pi(2H_1H_2(H_2 - H_1) + a^2(H_1C_2 - H_2C_1))}$ $\Phi_m = G_3Q_1 - G_4Q_2$
Two Head, Inner Reservoir	$Q_1 = \bar{R}_1 \times 2.16$ $Q_2 = \bar{R}_2 \times 2.16$	

Guelph Permeameter Data Sheet

Investigator: CAG & RAG Date: 3-25-22

Location: FRANKLIN FORD Test Id: TP # 2

Depth of hole: 50" Radius: 3 cm (standard calcs assume 3 cm radius)

Reservoirs used during test (check one): Combined: ✓ Inner only: _____

Reservoir constant used: 35.22

Water level in well = 5 cm

Time *t* (min)	D*t* (min)	Water level in reservoir *h* (cm)	D*h* (cm)	Rate of change D*h*/ D*t*
0		16		
1:36	1.60	20	4	6.67
2:55	1.32	25	5	3.80
4:10	1.25	30	5	4.00
5:21	1.18	35	5	4.22
6:36	1.25	40	5	4.00
7:50	1.23	45	5	4.05
9:00	1.17	50	5	4.28
10:12	1.20	55	5	4.17
11:24	1.20	60	5	4.17
12:34	1.17	65	5	4.28
13:44	1.17	70	5	4.28
14:50	1.10	75	5	4.54

Steady rate for 3 consecutive readings (R_1): 4.28

Water level in well = 10 cm

Time *t* (min)	D*t* (min)	Water level in reservoir *h* (cm)	D*h* (cm)	Rate of change D*h*/ D*t*
0		18		
0:59	0.65	25	7	10.77
1:09	0.50	30	5	10.00
1:40	0.52	35	5	9.68
2:10	0.50	40	5	10.00
2:44	0.57	45	5	8.82
3:15	0.52	50	5	9.68
3:48	0.55	55	5	9.09
4:21	0.55	60	5	9.09
4:56	0.58	65	5	8.57
5:29	0.55	70	5	9.09
6:03	0.57	75	5	8.82

Steady rate for 3 consecutive readings (R_2): 9.09

Comments:

$K_f = 0.186$ in/min = 11.16 in/hr

GP FIELD DATA SHEET

SECTION 1: SITE INFORMATION

Date 3/25/22 Investigator CARLOS QUINTAL & RICK GAUDREAU

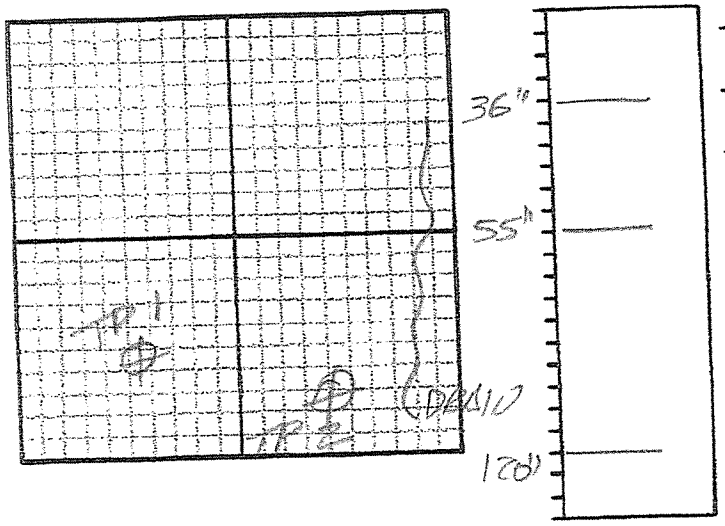
Site Location FRANKLIN FORD

Dominant Soil Type(s) MERRIMAC - UDORTHENTS COMPLEX

Site Map:

TP #2

Soil Profile Description (horizon depth, texture, structure, color, etc.):



Depth | Description

FILL

B - SUBSOIL 10YR 4/6

C - MED. SAND 2.5Y 6/4

Presence of special soil conditions (mottling, water table depth, hardpan, induration, compacted layers, etc.):

NO water

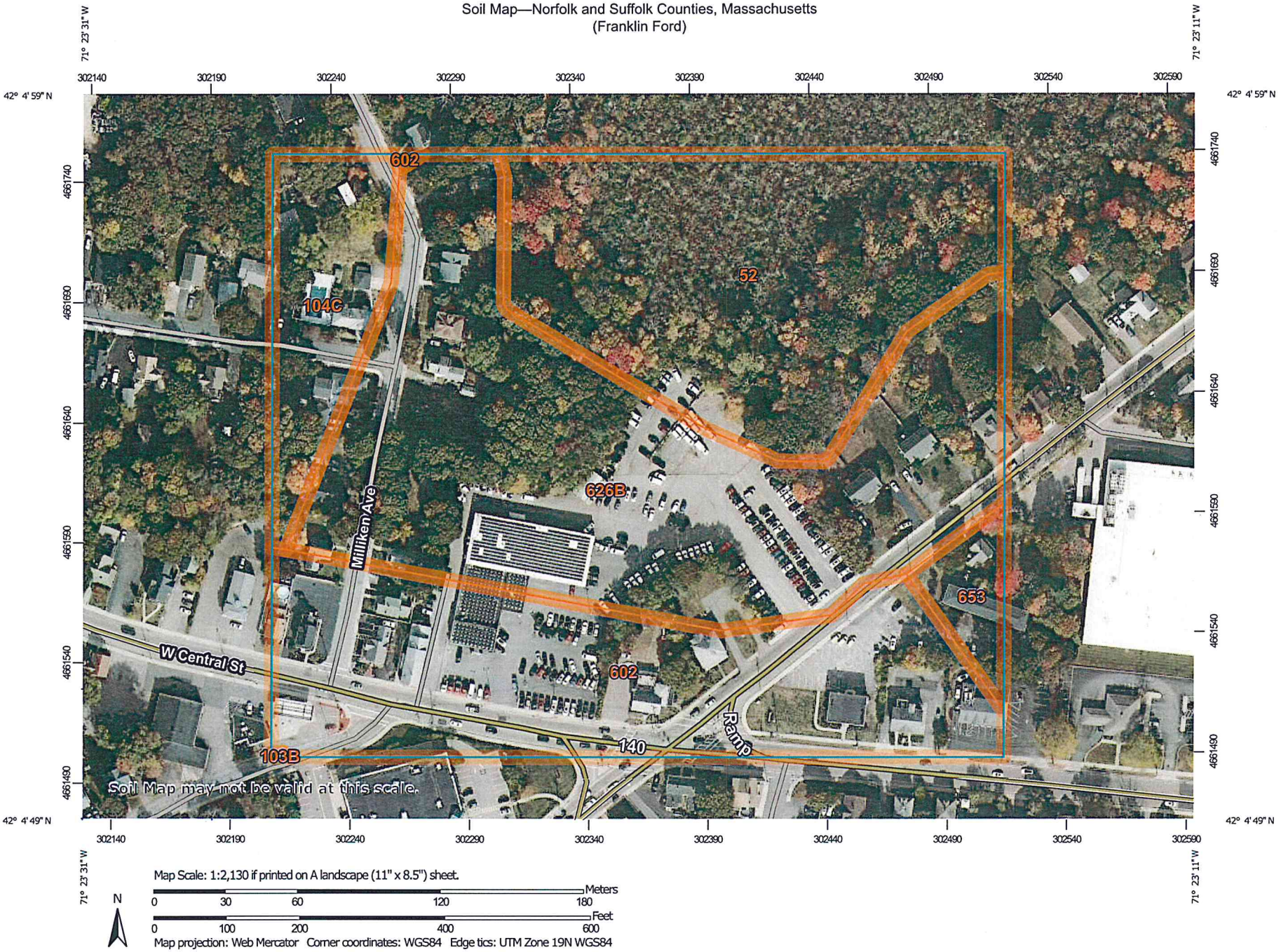
NO MOTTLING

Comments and Notes (topography, slope, vegetation, etc.):

SOILMOISTURE EQUIPMENT CORP.
P.O. Box 30025, Santa Barbara, CA 93130 USA
Phone: 805-964-3525 - Fax: (805) 683-2189 - Email: sales@soilmoisture.com
Website: http://www.soilmoisture.com

SOILMOISTURE®

Soil Map—Norfolk and Suffolk Counties, Massachusetts
(Franklin Ford)



Map Scale: 1:2,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

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

Date(s) aerial images were photographed: Aug 31, 2020—Oct 22, 2020

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52	Freetown muck, 0 to 1 percent slopes	4.9	25.5%
103B	Charlton-Hollis-Rock outcrop complex, 3 to 8 percent slopes	0.0	0.0%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	1.5	7.6%
602	Urban land, 0 to 15 percent slopes	4.9	25.9%
626B	Merrimac-Urban land complex, 0 to 8 percent slopes	7.4	38.7%
653	Udorthents, sandy	0.4	2.3%
Totals for Area of Interest		**19.1**	**100.0%**

Norfolk and Suffolk Counties, Massachusetts

626B—Merrimac-Urban land complex, 0 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyr9
Elevation: 0 to 820 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Merrimac and similar soils: 45 percent
Urban land: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, outwash terraces, moraines, eskers, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)

Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Description of Urban Land

Typical profile

M - 0 to 10 inches: cemented material

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: 0 inches to manufactured layer
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: Unranked

Minor Components

Hinckley

Percent of map unit: 5 percent
Landform: Deltas, kames, eskers, outwash plains
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Head slope, nose slope, side slope, crest, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, dunes, outwash plains, deltas
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Deltas, terraces, outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave

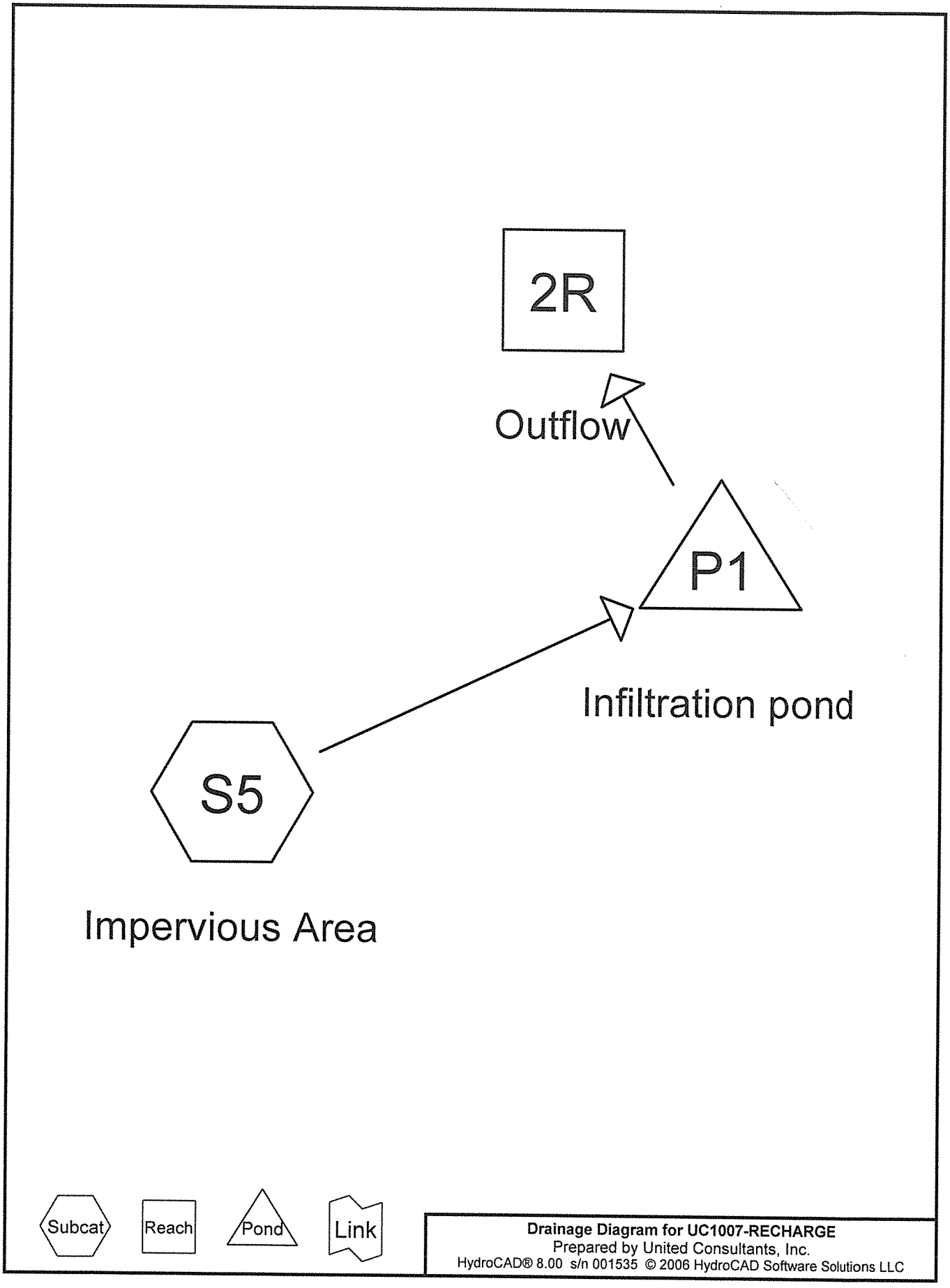
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 17, Sep 3, 2021

APPENDIX G

Standar 3



Drainage Diagram for UC1007-RECHARGE
Prepared by United Consultants, Inc.

Subcatchment S5: Impervious Area

Runoff = 4.96 cfs @ 12.08 hrs, Volume= 0.208 af, Depth> 0.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Type III 24-hr RECHARGE Rainfall=1.69"

Area (sf)	CN	Description
135,580	98	Paved parking & roofs
135,580		Impervious Area

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

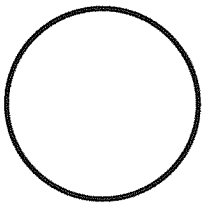
Reach 2R: Outflow

Inflow Area = 3.112 ac, Inflow Depth = 0.00" for RECHARGE event
Inflow = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 11.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.38 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 110.0' Slope= 0.0100 '/'
Inlet Invert= 83.10', Outlet Invert= 82.00'



Pond P1: Infiltration pond

Inflow Area = 3.112 ac, Inflow Depth > 0.80" for RECHARGE event
Inflow = 4.96 cfs @ 12.08 hrs, Volume= 0.208 af
Outflow = 0.83 cfs @ 12.55 hrs, Volume= 0.099 af, Atten= 83%, Lag= 27.8 min
Discarded = 0.83 cfs @ 12.55 hrs, Volume= 0.099 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 84.60' @ 12.55 hrs Surf.Area= 0.079 ac Storage= 0.119 af

Plug-Flow detention time= 24.5 min calculated for 0.098 af (47% of inflow)

Center-of-Mass det. time= 6.9 min (731.4 - 724.5)

Volume	Invert	Avail.Storage	Storage Description
#1	82.80'	0.179 af	**37.22'W x 60.00'L x 3.50'H Prismatoid**
#2	83.30'	0.066 af	**36.0"D x 58.00'L Horizontal Cylinder** x 7
		0.245 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Primary	85.20'	**12.0" Vert. Orifice/Grate X 7.00** C= 0.600

Discarded OutFlow Max=0.83 cfs @ 12.55 hrs HW=84.60' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.83 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=82.80' (Free Discharge)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Stormwater By-law

Subcatchment S5: Impervious Area

Runoff = 6.18 cfs @ 12.08 hrs, Volume= 0.260 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Type III 24-hr RECHARGE Rainfall=2.08"

Area (sf)	CN	Description
135,580	98	Paved parking & roofs
135,580		Impervious Area

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

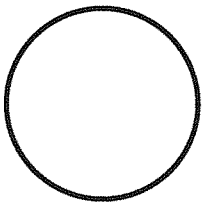
Reach 2R: Outflow

Inflow Area = 3.112 ac, Inflow Depth = 0.00" for RECHARGE event
Inflow = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 11.00 hrs, Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 1.50', Capacity at Bank-Full= 11.38 cfs

18.0" Diameter Pipe, n= 0.012 Concrete pipe, finished
Length= 110.0' Slope= 0.0100 '/'
Inlet Invert= 83.10', Outlet Invert= 82.00'



Pond P1: Infiltration pond

Inflow Area = 3.112 ac, Inflow Depth > 1.00" for RECHARGE event
Inflow = 6.18 cfs @ 12.08 hrs, Volume= 0.260 af
Outflow = 0.93 cfs @ 12.57 hrs, Volume= 0.109 af, Atten= 85%, Lag= 29.2 min
Discarded = 0.93 cfs @ 12.57 hrs, Volume= 0.109 af
Primary = 0.00 cfs @ 11.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 11.00-13.00 hrs, dt= 0.01 hrs
Peak Elev= 85.11' @ 12.57 hrs Surf.Area= 0.079 ac Storage= 0.160 af

Plug-Flow detention time= 27.3 min calculated for 0.109 af (42% of inflow)

Center-of-Mass det. time= 7.4 min (731.8 - 724.4)

Volume	Invert	Avail.Storage	Storage Description
#1	82.80'	0.179 af	**37.22'W x 60.00'L x 3.50'H Prismatoid**
#2	83.30'	0.066 af	**36.0"D x 58.00'L Horizontal Cylinder** x 7
		0.245 af	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	0.00'	**8.270 in/hr Exfiltration over Wetted area**
#2	Primary	85.20'	**12.0" Vert. Orifice/Grate X 7.00** C= 0.600

Discarded OutFlow Max=0.93 cfs @ 12.57 hrs HW=85.11' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.93 cfs)

Primary OutFlow Max=0.00 cfs @ 11.00 hrs HW=82.80' (Free Discharge)
└**2=Orifice/Grate** (Controls 0.00 cfs)

APPENDIX H

CHECKLIST FOR DESIGNERS

Site Planning

Checklist for Designers

GOALS and NEEDS addressed:

1. Create a visually appealing community
2. Stabilize and increase property values
3. Encourage low impact development
4. Preserve the Town's historic and cultural heritage
5. Protect Franklin's natural environment, including habitat, water resources, and ecosystem services

FRANKLIN POLICY:
Subdivision plans and site plans for all forms of development shall adhere to the principles of environmental and aesthetic compatibility and energy-efficient design.

BEST DEVELOPMENT PRACTICES The site plan should be designed to address the following to the maximum extent practicable	Incorporated into Project?
Unique natural features have been preserved *(the development program should either avoid altering or showcase significant natural features)*	☑
Native vegetation planted in disturbed areas as needed to enhance or restore habitat	☑
Historic and cultural resources have been preserved *(the development program should either avoid altering or showcase significant historic and cultural features)*	☑
Clearing, grading, and building placement consider viewsheds	☑
Cut and fill have been minimized	☑
Buildings blend into the natural topography	☐
Buildings are oriented to the sun and wind for maximum energy efficiency *Vegetated protection from northwest (winter) winds is provided* *Deciduous species planted or retained close to the East, South and West building edges*	☐
Conforms to §185-31 of the Town of Franklin Zoning Code and/ or Chapter 300 of the Town of Franklin Subdivision Regulations	☑ w/waivers

GOALS and NEEDS addressed:

1. Protect local and regional wetlands and water bodies
2. Maximize groundwater recharge to retain a viable local groundwater supply
3. Minimize pollutants in stormwater runoff

FRANKLIN POLICIES:

(A) All new development and redevelopment projects in Franklin shall meet the following stormwater management performance standards.

i. Post-development peak discharge rates and volumes from the site shall not exceed pre-development peak discharge rates and volumes from the site.

ii. The stormwater management system shall remove at least 80% of the average annual load of total suspended solids (TSS), at least 80% of the phosphorus loading, and at least 60% of nitrogen loading from the post-development stormwater created on site.

iii. All drainage facilities proposed shall utilize best management practices as outlined in the Massachusetts Stormwater Management Standards.

iv. All sites will have an Operation and Maintenance plan to insure future compliance.

(B) Non-structural stormwater management systems should be used wherever site conditions allow.

BEST DEVELOPMENT PRACTICES The site plan should be designed to address the following to the maximum extent practicable	Incorporated into Project?
Vegetated swales *(recommended to convey runoff from roadways & parking lots)*	☑
Vegetated filter strips *(recommended to filter and infiltrate runoff from roadways, parking lots, and driveways; use along roadsides and parking lots)*	☐
Constructed wetlands *(preferred method for stormwater retention & pollutant removal)*	☐
Bioretention cells *(rain gardens) (recommended on residential lots and parking lot islands)*	☐
Pervious paving surfaces *(recommended in overflow parking and low-traffic areas)*	☐
Sediment Forebays *(use in combination with other BDP)*	☐
Roof gardens *(encouraged on flat or gently sloped commercial and industrial rooftops)*	☐
Retention/Detention basins *(may be used in series with other practices to provide pre-treatment)*	☑
Recharge Systems *(suitable for all areas of development)*	☑
Drain pipe/catch basin systems *(as required to collect runoff when other systems are not practical)*	☑
If utilizing drain pipe and/or catch basin systems, have you documented that other systems are infeasible?	☑

Erosion and Sedimentation Control

Checklist for Designers

GOALS and NEEDS addressed:

1. Minimize clearing and regrading;
2. Prevent erosion and sedimentation.

FRANKLIN POLICIES:

(A) Any proposed project on a previously undeveloped site shall accommodate the development program in a way that minimizes clearing and re-grading, especially in areas of steep slopes, erosion-prone soils, or sensitive vegetation. For redevelopment projects, the site plan shall concentrate development in previously-disturbed areas to the extent possible.

(B) As a condition of approval, every proposed project shall submit and adhere to an erosion control plan that addresses soil stabilization, sediment retention, perimeter protection, construction scheduling, traffic area stabilization and dust control.

(C) If the proposed project is in an area under conservation jurisdiction, the project will require permitting deemed appropriate by the Conservation Commission.

BEST DEVELOPMENT PRACTICES The site plan should be designed to address the following to the maximum extent practicable.	Incorporated into Project?
Clearing and re-grading have been minimized	☑
Plan identifies sensitive areas to be protected and areas that are suitable for development	☑
Conservation Permits have been obtained *(when applicable)*	☑ Filed Prior
The erosion and sedimentation control plan addresses:	
• **Soil stabilization** *(cover or stabilize erodible surfaces not in immediate use)*	☑
• **Sediment retention** *(runoff interceptors and sediment traps/ponds)*	☑
• **Perimeter protection** *(vegetated buffers, compost socks or straw wattles at limit of work)*	☑
• **Construction scheduling** *(minimize disturbed area at any given time)*	☑
• **Traffic area stabilization** *(crushed rock or similar at construction vehicle entrance and parking areas)*	☐
• **Dust control** *(plan for stabilizing dry, dust-prone surfaces when necessary)*	☑
• **Vegetation** *(preserve existing vegetation and/or identify areas to be revegetated including proposed planting species, quantity and planting specifications)*	☑

Landscape Design

Checklist for Designers

GOALS and NEEDS addressed:

1. Stabilize water use at a sustainable level
2. Create landscapes that minimize habitat destruction and maximize habitat value
3. Encourage the development of landscapes that provide environmental quality and visual relief through the planting of native or naturalized species

FRANKLIN POLICIES:

(A) Site plans and landscape plans for all proposed projects shall take appropriate steps, as outlined in the Guidebook, to minimize water use for irrigation and to allow for natural recharge of groundwater. Landscape plans shall follow the guidelines in the Guidebook for selecting species that are most appropriate to the site conditions.

(B) Native and habitat-creating species shall be used in all landscape plans to the maximum extent possible while still meeting the site's landscaping needs. Invasive species may not be planted in Franklin under any condition. Refer to the Massachusetts Prohibited Plant list for more information.

(C) Actively promote the Town of Franklin's Water Conservation Measures.

BEST DEVELOPMENT PRACTICES The site plan must address all of the following principles.	Incorporated into Project?
Retain and Recharge water on site *(install bio-retention cells, vegetated filter strips and minimize lawn areas where feasible)*	☑
Preserve natural vegetation to the maximum extent practicable	☑
Irrigation system is water efficient *(if an in-ground irrigation system is proposed, it is a water efficient system with timers and automatic sensors to prevent overwatering)*	☐
Preserve soil permeability *(minimize disturbing existing landscapes. Prepare new planting beds in accordance to the Planting Bed Guidelines on p. 13, and install 1-2" of shredded pine bark mulch on new planting areas)*	☑
Minimize the use of turf grass *(when applicable, reduce the size of the lawn area; instead, plant a bio-retention cell, use alternative, drought tolerant groundcover)*	☑
Specify variety of native and naturalized species *(species from the plant list have been incorporated into the landscape design, and no invasive species are used. Refer to the Plant Species Section and the Massachusetts Prohibited Plant List)*	☑
Species are appropriate to the soil, site, and microclimate conditions *(select appropriate species from the plant list in this guidebook)*	☑

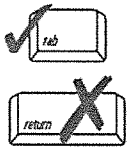
APPENDIX I

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.

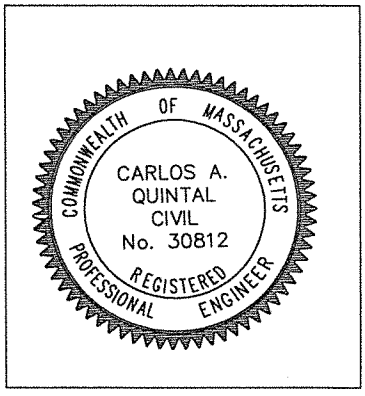
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the 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 5/12/22

Checklist

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

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX J

Operation and Maintenance Plan

FOR
Site Plan Modification
175 East Central Street
and 9 Chestnut Street

LOCATED IN
FRANKLIN, MASSACHUSETTS

PREPARED FOR
Franklin Ford, LLC
175 East Central Street
Franklin, MA 02038

PREPARED BY
UNITED CONSULTANTS, INC.
850 FRANKLIN STREET, SUITE 11D
WRENTHAM, MA. 02093

DATE: April 14, 2022

Operation and Maintenance Plan

Good House Keeping Measures

1. The parking area and driveway will receive the minimum amount of sand and salt. Snow will be stored at the locations shown on the site plan.
2. The site landscaping will consist of mulch with trees, shrubs, turf lawn and existing wooded areas. These areas will be assessed by the owner's landscape professional to determine the minimum amounts of fertilizers, herbicides and pesticides necessary and shall only apply the minimums necessary.
3. The site will be stabilized with landscaped areas with mulch and turf lawn. This will improve the existing site coverage.

Long Term Pollution Prevention Plan

The owner shall employ good housekeeping measures, which include removing trash and debris from the site, keeping trash in receptacles and complying with the long-term operation and maintenance plan.
The owner does not plan to store materials or waste products on the site.
The owner will not allow vehicles to be washed on site.
The owner will have routine inspections and maintenance completed for the Storm-water BMP's. See the Operation and Maintenance Plan Stormwater Facilities Plan for details and schedule.
The site will be continue to be used as a automobile dealership and maintenance facility. All hazardous materials for the businesses will continue to stored within the building. The owner will hire a licensed company to deal with any spills that may occur on the site.
The owner will employ a landscape professional to determine and apply the minimum amounts of fertilizers, herbicides and pesticides. No storage of landscape materials on site is proposed.
The site is serviced by Town water and sewer.
A dumpster is proposed to provide refuse storage and will be emptied and disposed of offsite.
The owner will de4signate an the emergency contact person prior to commencing with construction.
Snow will be placed in the snow storage areas provided on the site plan. If necessary, excess parking spaces could be used to store snow.
Floor drains are proposed and will be connected to an MDC style manhole and then will discharge to the town sewer system.
The owner will apply the minimum amount of sand and salt necessary. The parking area will be swept four per year with one sweeping being immediately following the last winter sanding.
Sand piles will not be stored on site.

Operation and Maintenance Plan

An operation and maintenance schedule for the construction period and the post-development period has been provided on the Operation and Maintenance Plan Stormwater Facilities Plan.
During the construction period and after completion the Owner, Franklin Ford, LLC shall be responsible for the operation and maintenance of the site and the drainage system.
Upon completion of the construction work the property owner shall be responsible for the maintenance of the drainage facilities.
The yearly estimated operation and maintenance budget is $2,500.

Yearly Inspection and Maintenance Log

Page 1

175 East Central Street
and 9 Chestnut Street
Franklin, Massachusetts

Parking Lot Sweeping and Curb Inspection – Four Times Per Year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Notes:

Water Quality Unit - 4 Times per year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed – 4 Times per year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Notes:

Catch Basins - 4 Times per year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed – When Sediment Depth reaches 18"

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Notes:

Underground Infiltration Pond – 4 times per year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Cleaning Performed:

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Date: _____ Performed By: _____

Notes:

Landscape Area Inspection – 4 times per year

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

Work Performed Repairs completed:

Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____
Date: _____ Performed By: _____

APPENDIX K

In Compliance with DEP Storm-water Management Standard 10

Franklin Ford Site

No Illicit discharges to the storm-water management system, including wastewater discharges and discharges of storm-water contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease are proposed and shall not be allowed.

The site map located in Appendix J shall be part of this Illicit Discharge Compliance Statement.

Franklin Ford, LLC is the responsible party.

_____

Name Title

APPENDIX L