STORMWATER REPORT

for

COLONY RETIREMENT HOMES – PHASE 1

485 Grove Street
Worcester, MA 01605

Prepared for:

Colony Retirement Homes
485 Grove Street
Worcester, MA 01605

Date:

February 26, 2024

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NARRATIVE

Project Description

Site Location:	Colony Retirement Homes 485 Grove Street, Worcester, MA 01605
Development Type:	Multi-Family Residential

Project Summary:

The proposed project consists of the redevelopment of the existing elder campus at 485 Grove Street. The property is currently developed with 13 buildings, accommodating 139 apartment units dedicated for the elderly, with multiple paved parking areas. Over the course of 4 phases, the existing buildings will be replaced with 4 new multistory buildings, accommodating approximately 200 new apartment units. The redevelopment will also provide parking and community spaces for its residents as well as visitors, and install stormwater management features for the property. Phase 1 of the project proposes to construct one 5-story building comprised of 45 apartment units, associated paved parking areas, an internal driveway, and internal walkways. As part of Phase 1, stormwater management features will be constructed to treat and attenuate runoff from the respective new construction. The proposed drainage and stormwater management system for Phase 1 is in full compliance with MassDEP Stormwater Management Standards. The project results in a net increase of impervious surface areas.

Existing Site Conditions

Location:	The project site is located at 485 Grove Street in Worcester, MA.
Ground Cover:	The ground cover in the drainage study area is a mix of impervious surfaces (roof and pavement), and lawn areas.
Slopes:	The project area generally slopes towards Grove Street. The existing drainage system within the property is connected to the existing municipal drainage system in Grove Street.
Soil Types:	Site soil types as mapped by the USDA-NRCS are primarily Paxton-Urban land complex (map unit symbol 622C) and Paxton fine sandy loam (map unit symbol 305B). These soils are classified as hydrologic soil group (HSG) “C”. Refer to Appendix D for more detailed USDA-NRCS soil information and to the site plans for the onsite soil testing data.

HYDROLOGY CALCULATIONS

Methodology

Peak rate of runoff flows were calculated using SCS TR-20 and TR-55 methodology as implemented by the HydroCAD Stormwater Modeling System computer program. The 2, 10, 25, and 100-year storm events were analyzed with the HydroCAD program using site-specific NRCC rainfall frequency data as follows:

Rainfall Amounts (inches) by Frequency (NRCC)			
2 Year	**10 Year**	**25 Year**	**100 Year**
3.25	4.89	6.18	8.82

Pre-Development

The total pre-development drainage area studied in this report consists of approximately 7.0 acres. The pre-development hydrology has been modeled as one subcatchment area that ultimately drains to one discharge point (design point).

> Design Point #1 – Grove Street Drainage System: This design point represents runoff from the site's existing closed drainage system which is connected to the existing municipal drainage system in Grove Street.

Refer to Appendix B for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Pre-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Grove Street Drainage System	13.54	24.11	32.50	49.59

Post-Development

The total post-development drainage area is the same as the pre-development area in size and is modeled as three subcatchment areas.

Refer to Appendix C for the HydroCAD output sheets for each storm event. A summary of the peak rate of runoff for the design point for each storm is as follows:

Post-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Grove Street Drainage System	12.98	23.24	31.41	47.68

The total net change in peak rate of runoff from pre-development to post-development at the design points for each storm is as follows:

Comparison of Pre- vs. Post-Development Peak Rate of Runoff (cfs) Net Change				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Grove Street Drainage System	-0.56	-0.87	-1.09	-1.91

STORMWATER MANAGEMENT

To demonstrate compliance with MassDEP Stormwater Management, we offer the following in response to each of the 10 Standards.

Drain Outfall Riprap Sizing Calculations (Stormwater Management Standard 1)

There are no proposed drain outfalls as part of this project.

Peak Rate Attenuation (Stormwater Management Standard 2)

Runoff is attenuated for the 2, 10, 25 and 100-year storm events.

Recharge to Groundwater (Stormwater Management Standard 3)

USDA-NRCS soil survey indicates site soils in the project area are Hydrologic Soil Group "C" soils. The recharge calculations are as follows:

Required Recharge Volume

Required Recharge Volume (R_v) = F x Impervious Area where, F = Target Depth Factor (in.)
F = 0.25" for 'C' Soils

Net increase in site impervious area (pre to post conditions) = 10,663 ft²

R_v = (0.25"/12") x 10,663 ft² = 222.2 ft³

Onsite soil testing revealed ledge and groundwater at the bottom of the proposed subsurface detention system, therefore infiltration into the subgrade is not accounted for in the design. Additionally, site constraints at this time do not allow groundwater recharge to be proposed at other locations within the Phase 1 work area. As a result, Phase 1 will not provide groundwater recharge. However, full groundwater recharge will be provided in the subsequent phases of the project where such site constraints are not anticipated and more suitable soils are present so that Standard 3 is satisfied.

Water Quality Calculations (Stormwater Management Standard 4)

The proposed treatment train entails runoff directed to deep sump and hooded catch basins connected to proprietary stormwater treatment (water quality) units and a subsurface detention system (with no treatment), which will then flow into the municipal drainage system in Grove Street. The proposed treatment train of catch basins and proprietary stormwater treatment units is anticipated to have a TSS removal rate of 85%. Refer to Appendix G for detailed TSS calculations that demonstrate the TSS removal rates for the site.

The sizing of the proprietary stormwater treatment units are based on the water quality flow rates associated with the respective water quality volume. The site does not discharge to any known or mapped Critical Area thus the required Water Quality Volume was calculated using 0.5 inches of runoff times the amount of increase of impervious area (see calculations and water quality unit information sheets following this Narrative).

A Long-Term Pollution Prevention Plan has also been developed for the site (refer to Appendix F).

Higher Potential Pollutant Loads (Stormwater Management Standard 5)

The site's existing and proposed use does not constitute a land use with a higher potential pollutant load (LUHPPL).

Protection of Critical Areas (Stormwater Management Standard 6)

The site does not discharge to a known or mapped Critical Area.

Redevelopment Projects (Stormwater Management Standard 7)

The project does not qualify as a redevelopment project.

Erosion/Sediment Control (Stormwater Management Standard 8)

Site development plans provide details for erosion and sediment control during construction.

Operation/Maintenance Plan (Stormwater Management Standard 9)

Refer to Appendix E for the site Long-Term Drainage System Operation & Maintenance Plan.

Illicit Discharge Compliance Statement (Stormwater Management Standard 10)

There are no existing illicit discharges to GEI's or the owner's knowledge and there are no proposed illicit discharges. There are no cross-connections between the stormwater system and the wastewater system and discharges to each will remain separate; these systems are shown on the project drawings.

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Metadata for Point	
Smoothing	Yes
State	
Location	
Latitude	42.288 degrees North
Longitude	71.811 degrees West
Elevation	160 feet
Date/Time	Mon Oct 23 2023 09:11:12 GMT-0400 (Eastern Daylight Time)

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day
1yr	0.27	0.42	0.52	0.68	0.85	1.08	**1yr**	0.73	1.06	1.25	1.60	2.05	2.65	2.88	**1yr**	2.35	2.77	3.18	3.88	4.49
2yr	0.35	0.54	0.67	0.88	1.10	1.39	**2yr**	0.95	1.27	1.62	2.04	2.57	3.25	3.49	**2yr**	2.88	3.35	3.85	4.56	5.21
5yr	0.41	0.63	0.80	1.07	1.36	1.74	**5yr**	1.18	1.58	2.03	2.57	3.24	4.10	4.43	**5yr**	3.63	4.26	4.88	5.71	6.44
10yr	0.46	0.72	0.91	1.23	1.60	2.06	**10yr**	1.38	1.86	2.41	3.07	3.88	4.89	5.32	**10yr**	4.33	5.11	5.84	6.78	7.56
25yr	0.53	0.85	1.08	1.49	1.97	2.57	**25yr**	1.70	2.31	3.02	3.86	4.90	6.18	6.77	**25yr**	5.47	6.51	7.40	8.50	9.35
50yr	0.59	0.96	1.23	1.72	2.32	3.06	**50yr**	2.00	2.73	3.61	4.63	5.86	7.38	8.13	**50yr**	6.53	7.82	8.87	10.08	10.99
100yr	0.68	1.10	1.42	2.01	2.73	3.63	**100yr**	2.36	3.22	4.29	5.51	7.00	8.82	9.78	**100yr**	7.81	9.40	10.62	11.97	12.92
200yr	0.77	1.25	1.62	2.33	3.22	4.30	**200yr**	2.78	3.79	5.11	6.58	8.37	10.54	11.76	**200yr**	9.33	11.31	12.72	14.21	15.19
500yr	0.91	1.50	1.96	2.85	4.00	5.39	**500yr**	3.45	4.72	6.43	8.32	10.60	13.36	15.03	**500yr**	11.82	14.46	16.17	17.85	18.82

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day
1yr	0.20	0.30	0.37	0.50	0.61	0.94	**1yr**	0.53	0.92	1.08	1.45	1.88	2.42	2.50	**1yr**	2.15	2.40	2.98	3.58	4.16
2yr	0.34	0.52	0.64	0.87	1.08	1.26	**2yr**	0.93	1.23	1.43	1.88	2.41	3.14	3.37	**2yr**	2.78	3.24	3.72	4.42	5.05
5yr	0.38	0.59	0.73	1.00	1.27	1.50	**5yr**	1.10	1.46	1.71	2.23	2.86	3.75	4.07	**5yr**	3.32	3.92	4.48	5.30	5.96
10yr	0.42	0.65	0.80	1.12	1.45	1.70	**10yr**	1.25	1.67	1.92	2.53	3.24	4.26	4.67	**10yr**	3.77	4.49	5.15	6.07	6.74
25yr	0.49	0.74	0.92	1.31	1.73	2.02	**25yr**	1.49	1.98	2.27	3.01	3.85	5.03	5.60	**25yr**	4.45	5.38	6.13	7.25	7.94
50yr	0.54	0.82	1.02	1.46	1.97	2.30	**50yr**	1.70	2.25	2.58	3.42	4.37	5.69	6.40	**50yr**	5.03	6.15	6.97	8.30	8.99
100yr	0.60	0.91	1.13	1.64	2.25	2.62	**100yr**	1.94	2.57	2.93	3.77	4.99	6.38	7.28	**100yr**	5.64	7.00	7.88	9.47	10.16
200yr	0.67	1.00	1.27	1.84	2.57	3.00	**200yr**	2.21	2.93	3.32	4.28	5.70	7.16	8.27	**200yr**	6.34	7.95	8.92	10.79	11.48
500yr	0.77	1.15	1.48	2.16	3.07	3.58	**500yr**	2.65	3.50	3.94	5.07	6.83	8.29	9.72	**500yr**	7.33	9.35	10.42	12.86	13.49

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day
1yr	0.31	0.47	0.58	0.78	0.96	1.19	**1yr**	0.83	1.16	1.37	1.74	2.28	2.86	3.09	**1yr**	2.54	2.97	3.52	4.14	4.80
2yr	0.36	0.56	0.69	0.93	1.15	1.35	**2yr**	0.99	1.32	1.54	2.01	2.57	3.39	3.63	**2yr**	3.00	3.49	4.02	4.73	5.40
5yr	0.43	0.67	0.83	1.14	1.45	1.76	**5yr**	1.25	1.72	2.01	2.56	3.23	4.46	4.84	**5yr**	3.94	4.65	5.30	6.18	7.02
10yr	0.51	0.78	0.96	1.35	1.74	2.15	**10yr**	1.50	2.10	2.47	3.08	3.86	5.52	6.05	**10yr**	4.89	5.82	6.62	7.60	8.56
25yr	0.63	0.95	1.18	1.69	2.22	2.81	**25yr**	1.92	2.75	3.22	3.93	4.88	7.34	8.17	**25yr**	6.50	7.86	8.88	9.93	11.14
50yr	0.73	1.11	1.39	1.99	2.68	3.44	**50yr**	2.32	3.36	3.96	4.73	5.83	9.15	10.28	**50yr**	8.10	9.89	11.13	12.21	13.61
100yr	0.86	1.30	1.63	2.36	3.24	4.21	**100yr**	2.79	4.12	4.86	5.90	6.97	11.41	12.98	**100yr**	10.10	12.48	13.96	15.03	16.63
200yr	1.01	1.53	1.93	2.80	3.91	5.17	**200yr**	3.37	5.05	5.97	7.13	8.33	14.25	16.41	**200yr**	12.62	15.78	17.51	18.51	20.33
500yr	1.26	1.88	2.42	3.52	5.00	6.77	**500yr**	4.32	6.61	7.83	9.19	10.52	19.11	22.48	**500yr**	16.91	21.61	23.68	24.41	26.59

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Pond 1P: UG System - Chamber Wizard Field A

Chamber Model = ADS_StormTech SC-740 +Cap (ADS StormTech® SC-740 with cap length)
Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf
Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap

51.0" Wide + 6.0" Spacing = 57.0" C-C Row Spacing

7 Chambers/Row x 7.12' Long +0.81' Cap Length x 2 = 51.46' Row Length +12.0" End Stone x 2 = 53.46' Base Length
7 Rows x 51.0" Wide + 6.0" Spacing x 6 + 12.0" Side Stone x 2 = 34.75' Base Width
6.0" Stone Base + 30.0" Chamber Height + 6.0" Stone Cover = 3.50' Field Height

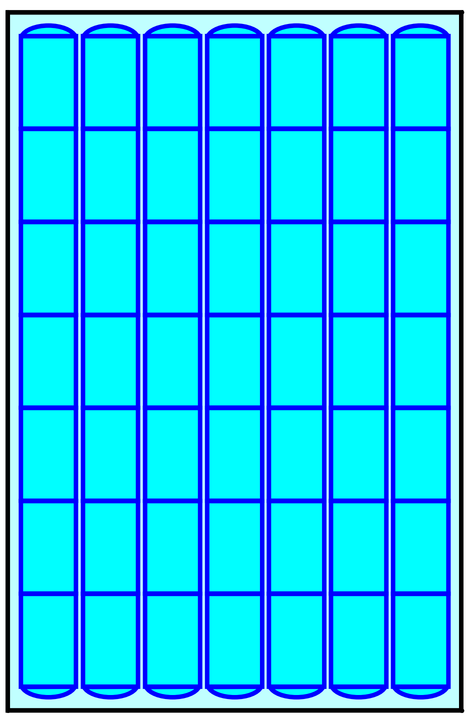
49 Chambers x 45.9 cf = 2,251.1 cf Chamber Storage

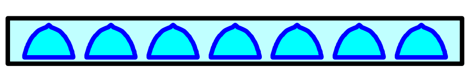
6,501.7 cf Field - 2,251.1 cf Chambers = 4,250.6 cf Stone x 40.0% Voids = 1,700.2 cf Stone Storage

Chamber Storage + Stone Storage = 3,951.3 cf = 0.091 af
Overall Storage Efficiency = 60.8%
Overall System Size = 53.46' x 34.75' x 3.50'

49 Chambers
240.8 cy Field
157.4 cy Stone

53.5' x 34.75' = 1,859.1 square feet





Summary for Subcatchment #1: WQU-1

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.56 cfs @ 12.12 hrs, Volume= 1,915 cf, Depth> 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D WQU-1 Rainfall=1.57"

Area (sf)	CN	Description
21,738	98	Paved parking, HSG C
24,591	74	>75% Grass cover, Good, HSG C
46,329	85	Weighted Average
24,591		53.08% Pervious Area
21,738		46.92% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	200		0.67		**Direct Entry, A-B**

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Detailed Stormceptor Sizing Report – Colony Homes - Phase 1 - WQU-1

Project Information & Location			
Project Name	Colony Homes - Phase 1 - WQU-1	**Project Number**	50198
City	Worcester	**State/ Province**	Massachusetts
Country	United States of America	**Date**	1/22/2024
Designer Information		**EOR Information (optional)**	
Name	Ronald Mendez	**Name**	
Company	Graves Engineering, Inc.	**Company**	
Phone #	508-856-0321	**Phone #**	
Email	rmendez@gravesengineering.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Colony Homes - Phase 1 - WQU-1
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	99
PSD	Fine Distribution
Rainfall Station	WORCESTER WSO AP

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	99
STC 900	100
STC 1200	100
STC 1800	100
STC 2400	100
STC 3600	100
STC 4800	100
STC 6000	100
STC 7200	100
STC 11000	100
STC 13000	100
STC 16000	100

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The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	7089
Rainfall Station Name	WORCESTER WSO AP	**Total Rainfall (in)**	2201.4
Station ID #	9923	**Average Annual Rainfall (in)**	38.0
Coordinates	42°16'2"N, 71°52'34"W	**Total Evaporation (in)**	2.4
Elevation (ft)	986	**Total Infiltration (in)**	2168.8
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	30.2

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	1.06
Imperviousness %	0.4

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.56

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	537.32
Stormceptor Outlet Invert Elev (ft)	537.22
Stormceptor Rim Elev (ft)	542.30
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

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Site Name	Colony Homes - Phase 1 - WQU-1

Site Details

Drainage Area	
Total Area (acres)	1.06
Imperviousness %	0.4

Surface Characteristics	
Width (ft)	430.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow	
Dry Weather Flow (cfs)	0

Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	

Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

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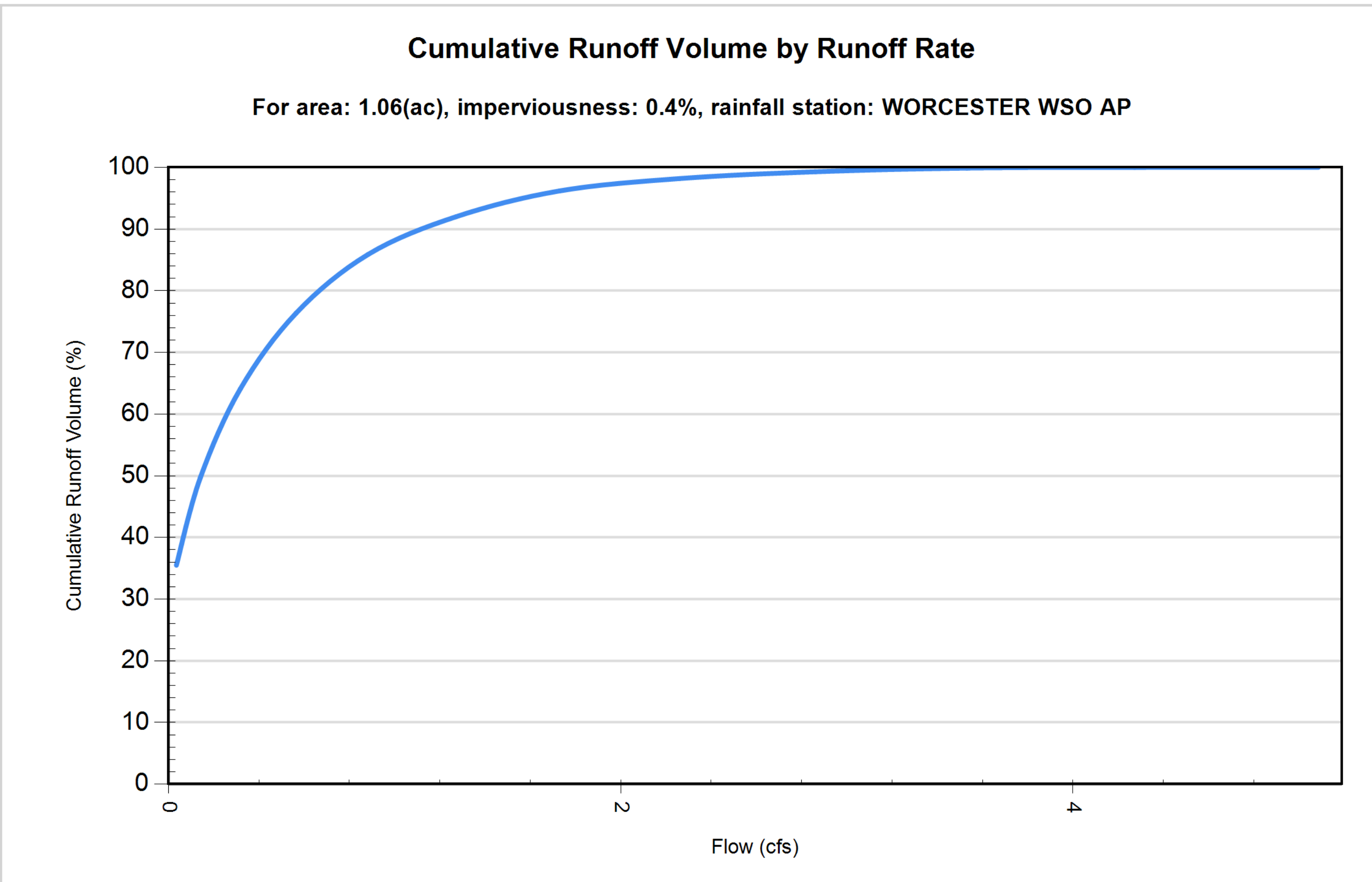
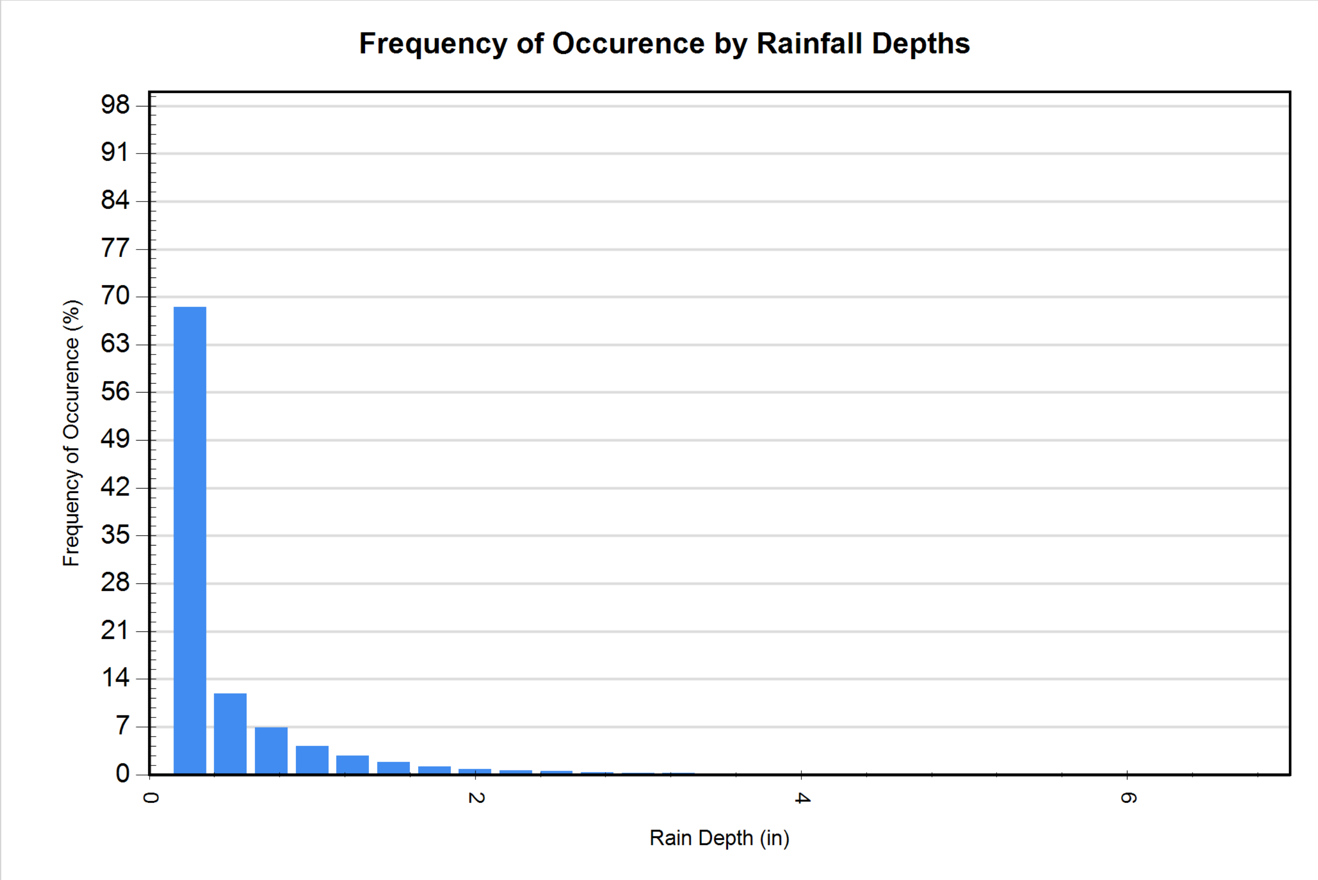
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	Runoff Volume (ft³)	Volume Over (ft³)	Cumulative Runoff Volume (%)
0.035	45108	82054	35.5
0.141	63154	64003	49.7
0.318	81522	45640	64.1
0.565	97170	30001	76.4
0.883	109189	17987	85.9
1.271	116995	10184	92.0
1.730	122359	4824	96.2
2.260	124896	2288	98.2
2.860	126283	902	99.3
3.531	127049	136	99.9
4.273	127185	0	100.0
5.085	127185	0	100.0



Rainfall Event Analysis

Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	4856	68.5	310	14.1
0.50	841	11.9	306	13.9
0.75	490	6.9	302	13.7
1.00	296	4.2	261	11.8
1.25	199	2.8	224	10.2
1.50	126	1.8	172	7.8
1.75	83	1.2	134	6.1
2.00	54	0.8	100	4.6
2.25	43	0.6	92	4.2
2.50	33	0.5	78	3.6
2.75	22	0.3	58	2.6
3.00	11	0.2	32	1.4
3.25	12	0.2	37	1.7
3.50	5	0.1	17	0.8
3.75	3	0.0	11	0.5
4.00	5	0.1	20	0.9
4.25	2	0.0	8	0.4
4.50	0	0.0	0	0.0
4.75	3	0.0	14	0.6
5.00	3	0.0	15	0.7
5.25	0	0.0	0	0.0
5.50	0	0.0	0	0.0
5.75	0	0.0	0	0.0
6.00	1	0.0	6	0.3
6.25	1	0.0	6	0.3
6.50	0	0.0	0	0.0
6.75	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Summary for Subcatchment #2: WQU-2

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.26 cfs @ 12.12 hrs, Volume= 887 cf, Depth> 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D WQU-2 Rainfall=1.52"

Area (sf)	CN	Description
10,517	98	Paved parking, HSG C
10,564	74	>75% Grass cover, Good, HSG C
21,081	86	Weighted Average
10,564		50.11% Pervious Area
10,517		49.89% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	200		0.67		**Direct Entry, A-B**

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Detailed Stormceptor Sizing Report – Colony Homes - Phase 1 - WQU-2

Project Information & Location			
Project Name	Colony Homes - Phase 1 - WQU-2	**Project Number**	50199
City	Worcester	**State/ Province**	Massachusetts
Country	United States of America	**Date**	1/23/2024
Designer Information		**EOR Information (optional)**	
Name	Ronald Mendez	**Name**	
Company	Graves Engineering, Inc.	**Company**	
Phone #	508-856-0321	**Phone #**	
Email	rmendez@gravesengineering.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Colony Homes - Phase 1 - WQU-2
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	100
PSD	Fine Distribution
Rainfall Station	WORCESTER WSO AP

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	100
STC 900	100
STC 1200	100
STC 1800	100
STC 2400	100
STC 3600	100
STC 4800	100
STC 6000	100
STC 7200	100
STC 11000	100
STC 13000	100
STC 16000	100

Stormceptor
The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology
Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:
• Site parameters
• Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
• Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
• TSS load
• Detention time of the system

Hydrology Analysis

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour).
Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

State/Province	Massachusetts	**Total Number of Rainfall Events**	7089
Rainfall Station Name	WORCESTER WSO AP	**Total Rainfall (in)**	2201.4
Station ID #	9923	**Average Annual Rainfall (in)**	38.0
Coordinates	42°16'2"N, 71°52'34"W	**Total Evaporation (in)**	2.4
Elevation (ft)	986	**Total Infiltration (in)**	2163.1
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	35.9

Notes

• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules.
• Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed.
• For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

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Drainage Area	
Total Area (acres)	0.48
Imperviousness %	0.5

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.26

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	535.80
Stormceptor Outlet Invert Elev (ft)	535.70
Stormceptor Rim Elev (ft)	539.20
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	12
Pipe Material	HDPE - plastic
Multiple Inlets (Y/N)	Yes
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

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Site Name	Colony Homes - Phase 1 - WQU-2

Site Details

Drainage Area

Total Area (acres)	0.48
Imperviousness %	0.5

Surface Characteristics

Width (ft)	289.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Maintenance Frequency (months) >	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation

Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow

Dry Weather Flow (cfs)	0

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	

Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters

Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

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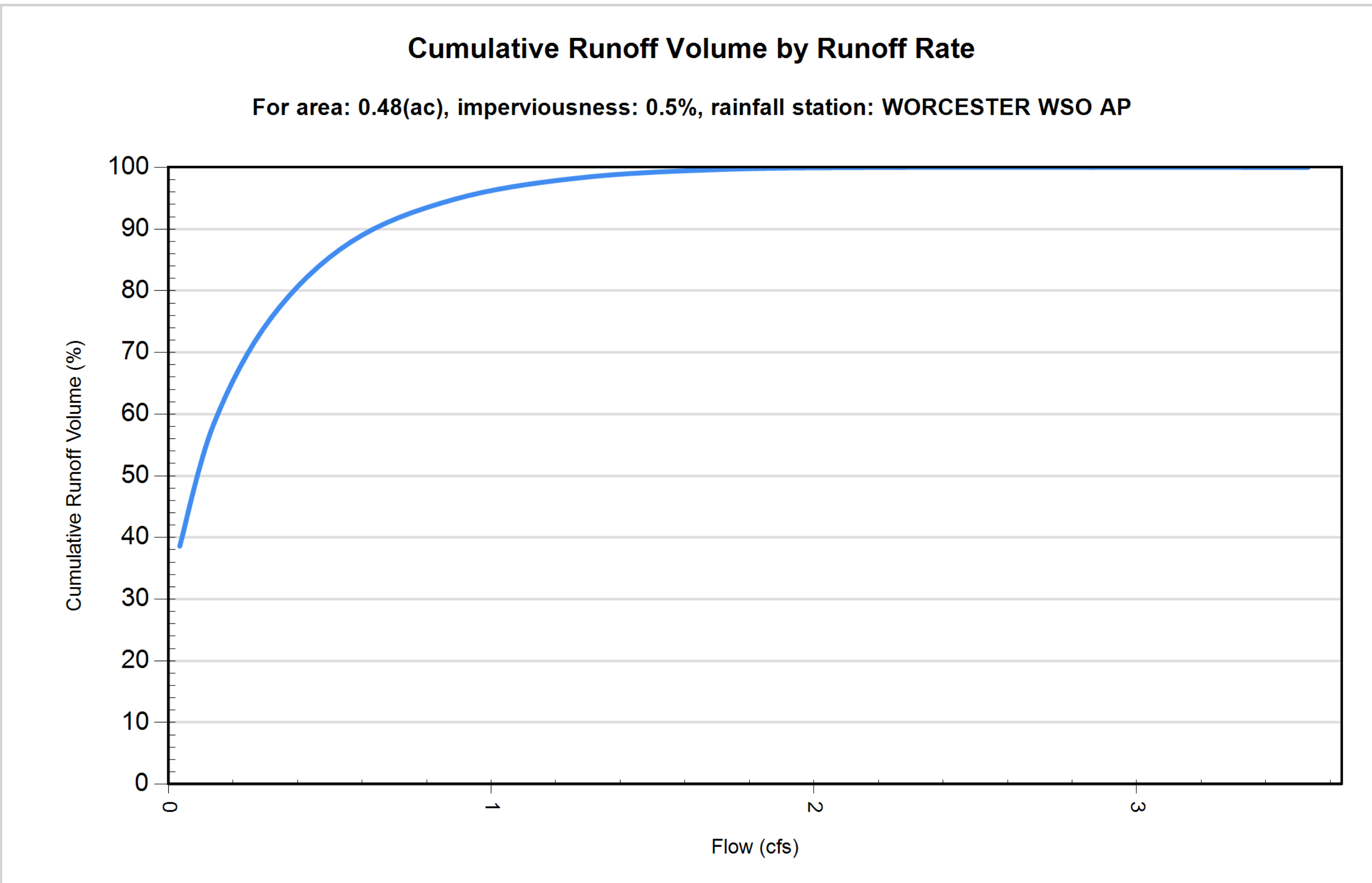
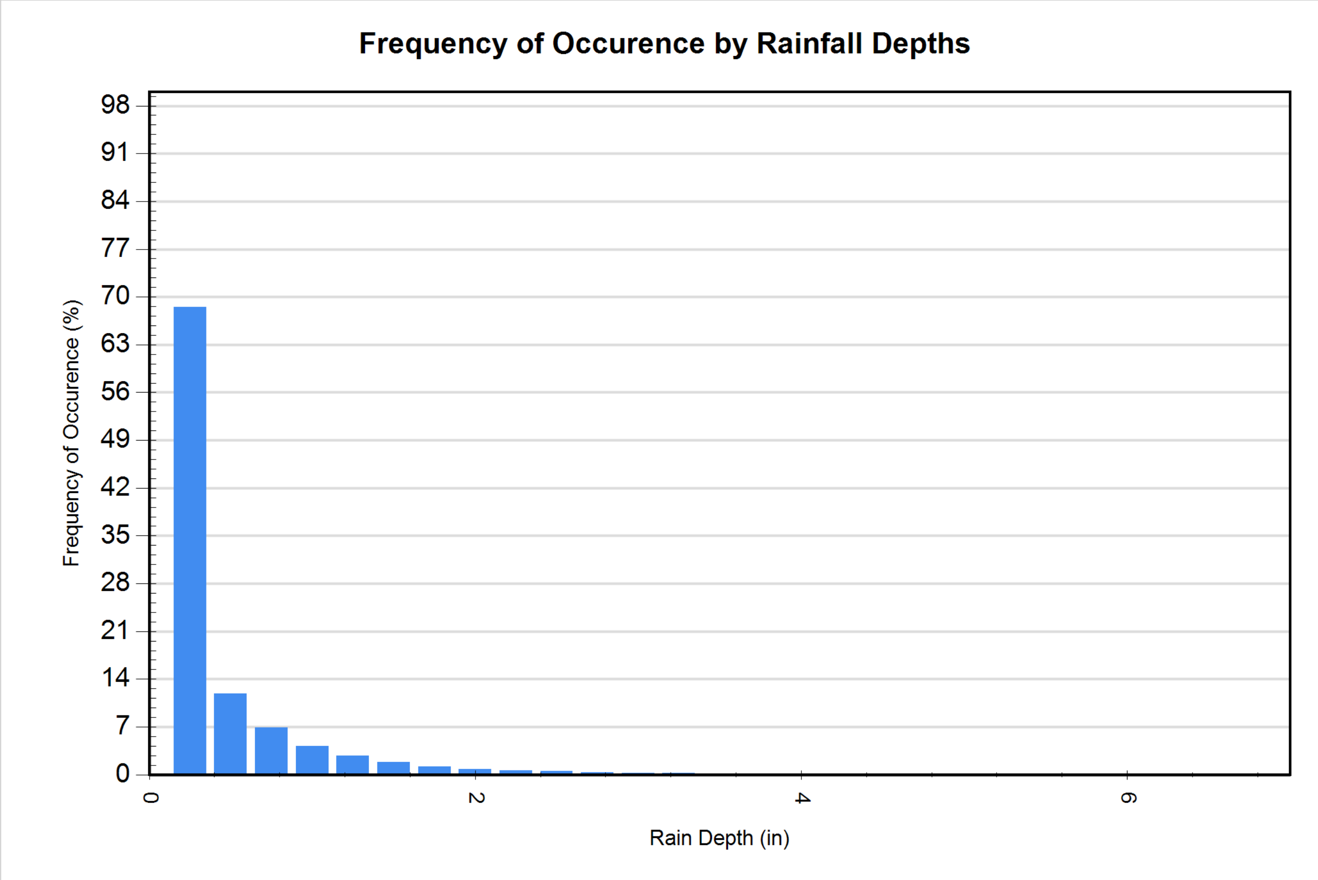
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	**Runoff Volume (ft^3)**	**Volume Over (ft^3)**	**Cumulative Runoff Volume (%)**
0.035	25056	39800	38.6
0.141	37943	26907	58.5
0.318	49028	15830	75.6
0.565	56989	7873	87.9
0.883	61525	3339	94.8
1.271	63747	1118	98.3
1.730	64663	202	99.7
2.260	64866	0	100.0
2.860	64866	0	100.0
3.531	64866	0	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	4856	68.5	310	14.1
0.50	841	11.9	306	13.9
0.75	490	6.9	302	13.7
1.00	296	4.2	261	11.8
1.25	199	2.8	224	10.2
1.50	126	1.8	172	7.8
1.75	83	1.2	134	6.1
2.00	54	0.8	100	4.6
2.25	43	0.6	92	4.2
2.50	33	0.5	78	3.6
2.75	22	0.3	58	2.6
3.00	11	0.2	32	1.4
3.25	12	0.2	37	1.7
3.50	5	0.1	17	0.8
3.75	3	0.0	11	0.5
4.00	5	0.1	20	0.9
4.25	2	0.0	8	0.4
4.50	0	0.0	0	0.0
4.75	3	0.0	14	0.6
5.00	3	0.0	15	0.7
5.25	0	0.0	0	0.0
5.50	0	0.0	0	0.0
5.75	0	0.0	0	0.0
6.00	1	0.0	6	0.3
6.25	1	0.0	6	0.3
6.50	0	0.0	0	0.0
6.75	0	0.0	0	0.0



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

APPENDIX A

MASSDEP STORMWATER REPORT CHECKLIST

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

Electronically stamped by
Michael Andrade, PE:
02/26/24

Signature and Date

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 (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 (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 (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 (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 (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 (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

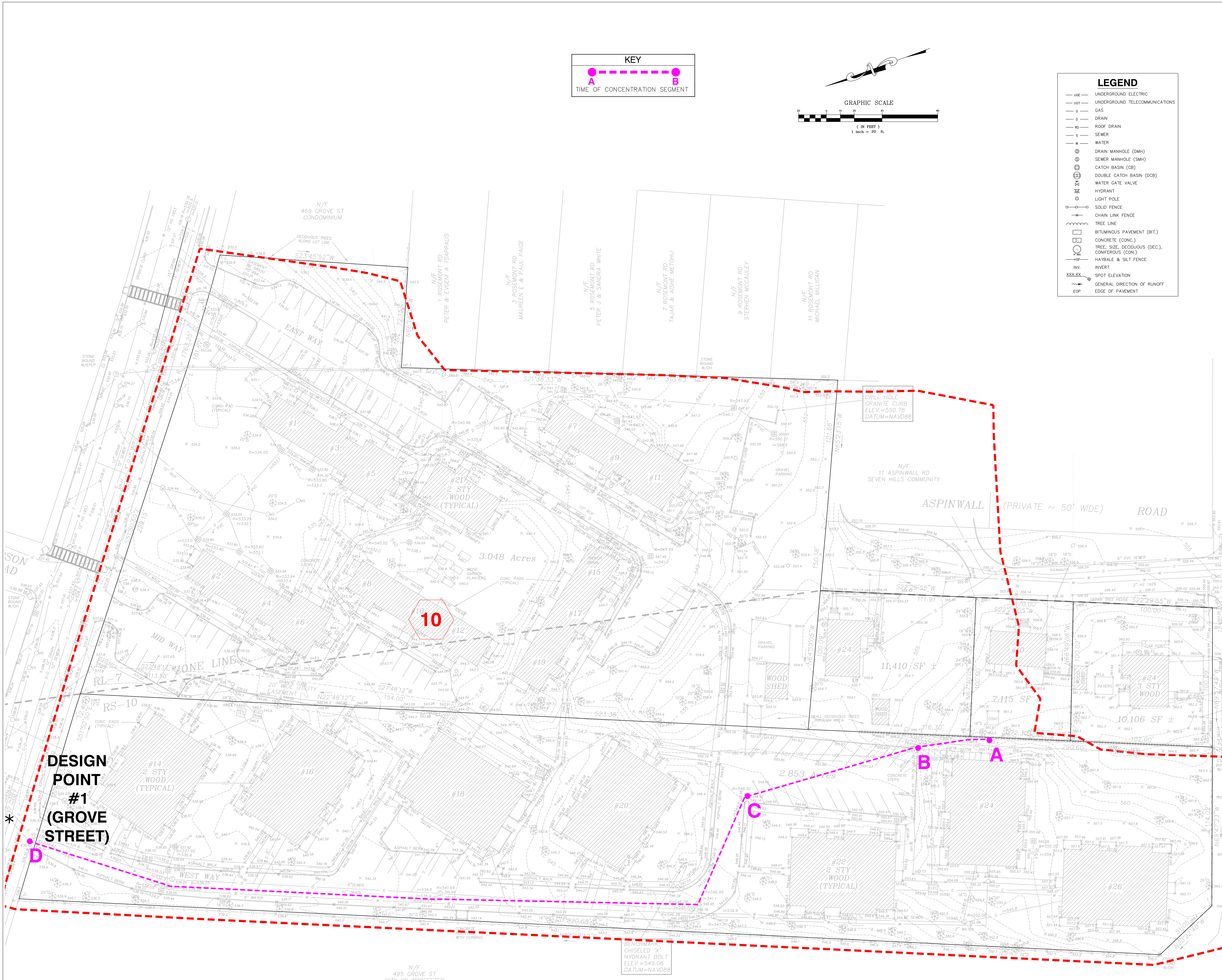
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ 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 B

HYDROCAD REPORTS
PRE-DEVELOPMENT



ARCHITECT:
PCA, INC.
221 Hampshire Street
Cambridge, MA 02139
617-547-8120

COLONY RETIREMENT HOMES
485 GROVE STREET
WORCESTER, MA 01605
508-852-5285

CONTRACTOR:

CIVIL ENGINEER:
GRAVES ENGINEERING, Inc.
100 GROVE ST | WORCESTER MA 01605
T 508-856-0321 | F 508-856-0357
gravesengineering.com

PCA PROJECT #: 23010.00
GEI PROJECT #: 23108

COLONY RETIREMENT HOMES - PHASE 1

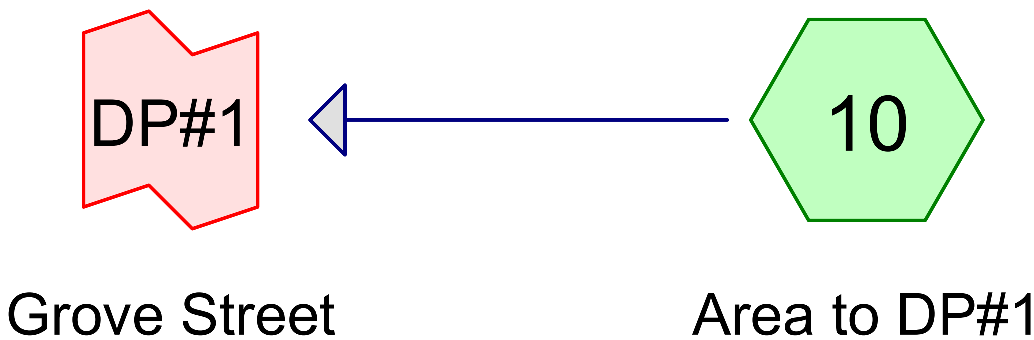
485 GROVE STREET, WORCESTER MA 01605

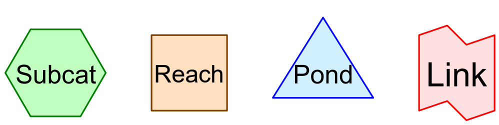
REVISIONS

SCALE:

PRE-DEVELOPMENT DRAINAGE AREAS

PRE-DA





Routing Diagram for Phase 1_Pre
Prepared by Graves Engineering, Inc, Printed 2/5/2024
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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 10: Area to DP#1 Runoff Area=304,845 sf 43.13% Impervious Runoff Depth>1.80"
Flow Length=780' Tc=6.0 min CN=85 Runoff=13.54 cfs 45,667 cf

Link DP#1: Grove Street Inflow=13.54 cfs 45,667 cf
Primary=13.54 cfs 45,667 cf

Total Runoff Area = 304,845 sf Runoff Volume = 45,667 cf Average Runoff Depth = 1.80"
56.87% Pervious = 173,353 sf 43.13% Impervious = 131,492 sf

Summary for Subcatchment 10: Area to DP#1

Runoff = 13.54 cfs @ 12.13 hrs, Volume= 45,667 cf, Depth> 1.80"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-year Rainfall=3.25"

Area (sf)	CN	Description
54,357	98	Unconnected roofs, HSG C
75,626	98	Paved parking, HSG C
6,961	96	Gravel surface, HSG C
1,509	98	Unconnected pavement, HSG C
166,392	74	>75% Grass cover, Good, HSG C
304,845	85	Weighted Average
173,353		56.87% Pervious Area
131,492		43.13% Impervious Area
55,866		42.49% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Link DP#1: Grove Street

Inflow Area = 304,845 sf, 43.13% Impervious, Inflow Depth > 1.80" for 2-year event
Inflow = 13.54 cfs @ 12.13 hrs, Volume= 45,667 cf
Primary = 13.54 cfs @ 12.13 hrs, Volume= 45,667 cf, Atten= 0%, Lag= 0.0 min

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

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

Subcatchment 10: Area to DP#1 Runoff Area=304,845 sf 43.13% Impervious Runoff Depth>3.26"
Flow Length=780' Tc=6.0 min CN=85 Runoff=24.11 cfs 82,869 cf

Link DP#1: Grove Street Inflow=24.11 cfs 82,869 cf
Primary=24.11 cfs 82,869 cf

Total Runoff Area = 304,845 sf Runoff Volume = 82,869 cf Average Runoff Depth = 3.26"
56.87% Pervious = 173,353 sf 43.13% Impervious = 131,492 sf

Summary for Subcatchment 10: Area to DP#1

Runoff = 24.11 cfs @ 12.13 hrs, Volume= 82,869 cf, Depth> 3.26"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-year Rainfall=4.89"

Area (sf)	CN	Description
54,357	98	Unconnected roofs, HSG C
75,626	98	Paved parking, HSG C
6,961	96	Gravel surface, HSG C
1,509	98	Unconnected pavement, HSG C
166,392	74	>75% Grass cover, Good, HSG C
304,845	85	Weighted Average
173,353		56.87% Pervious Area
131,492		43.13% Impervious Area
55,866		42.49% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Link DP#1: Grove Street

Inflow Area = 304,845 sf, 43.13% Impervious, Inflow Depth > 3.26" for 10-year event
Inflow = 24.11 cfs @ 12.13 hrs, Volume= 82,869 cf
Primary = 24.11 cfs @ 12.13 hrs, Volume= 82,869 cf, Atten= 0%, Lag= 0.0 min

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

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

Subcatchment 10: Area to DP#1 Runoff Area=304,845 sf 43.13% Impervious Runoff Depth>4.47"
Flow Length=780' Tc=6.0 min CN=85 Runoff=32.50 cfs 113,473 cf

Link DP#1: Grove Street Inflow=32.50 cfs 113,473 cf
Primary=32.50 cfs 113,473 cf

Total Runoff Area = 304,845 sf Runoff Volume = 113,473 cf Average Runoff Depth = 4.47"
56.87% Pervious = 173,353 sf 43.13% Impervious = 131,492 sf

Summary for Subcatchment 10: Area to DP#1

Runoff = 32.50 cfs @ 12.13 hrs, Volume= 113,473 cf, Depth> 4.47"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-year Rainfall=6.18"

Area (sf)	CN	Description
54,357	98	Unconnected roofs, HSG C
75,626	98	Paved parking, HSG C
6,961	96	Gravel surface, HSG C
1,509	98	Unconnected pavement, HSG C
166,392	74	>75% Grass cover, Good, HSG C
304,845	85	Weighted Average
173,353		56.87% Pervious Area
131,492		43.13% Impervious Area
55,866		42.49% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Link DP#1: Grove Street

Inflow Area = 304,845 sf, 43.13% Impervious, Inflow Depth > 4.47" for 25-year event
Inflow = 32.50 cfs @ 12.13 hrs, Volume= 113,473 cf
Primary = 32.50 cfs @ 12.13 hrs, Volume= 113,473 cf, Atten= 0%, Lag= 0.0 min

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

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

Subcatchment 10: Area to DP#1 Runoff Area=304,845 sf 43.13% Impervious Runoff Depth>7.00"
Flow Length=780' Tc=6.0 min CN=85 Runoff=49.59 cfs 177,783 cf

Link DP#1: Grove Street Inflow=49.59 cfs 177,783 cf
Primary=49.59 cfs 177,783 cf

Total Runoff Area = 304,845 sf Runoff Volume = 177,783 cf Average Runoff Depth = 7.00"
56.87% Pervious = 173,353 sf 43.13% Impervious = 131,492 sf

Summary for Subcatchment 10: Area to DP#1

Runoff = 49.59 cfs @ 12.13 hrs, Volume= 177,783 cf, Depth> 7.00"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-year Rainfall=8.82"

Area (sf)	CN	Description
54,357	98	Unconnected roofs, HSG C
75,626	98	Paved parking, HSG C
6,961	96	Gravel surface, HSG C
1,509	98	Unconnected pavement, HSG C
166,392	74	>75% Grass cover, Good, HSG C
304,845	85	Weighted Average
173,353		56.87% Pervious Area
131,492		43.13% Impervious Area
55,866		42.49% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

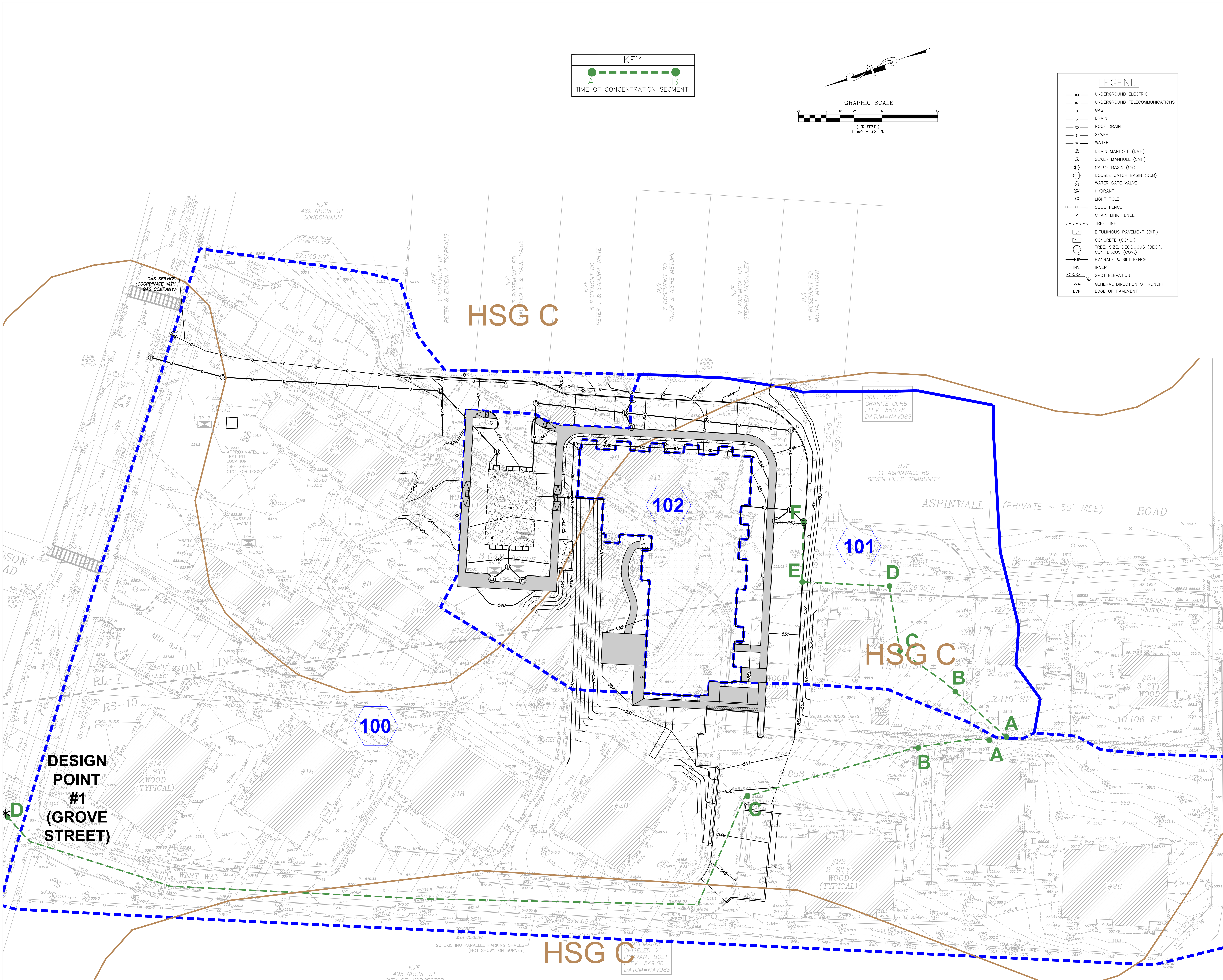
Summary for Link DP#1: Grove Street

Inflow Area = 304,845 sf, 43.13% Impervious, Inflow Depth > 7.00" for 100-year event
Inflow = 49.59 cfs @ 12.13 hrs, Volume= 177,783 cf
Primary = 49.59 cfs @ 12.13 hrs, Volume= 177,783 cf, Atten= 0%, Lag= 0.0 min

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

APPENDIX C

HYDROCAD REPORTS
POST-DEVELOPMENT



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PCA PROJECT #: 23010.00
GEI PROJECT #: 23108

COLONY RETIREMENT HOMES - PHASE 1

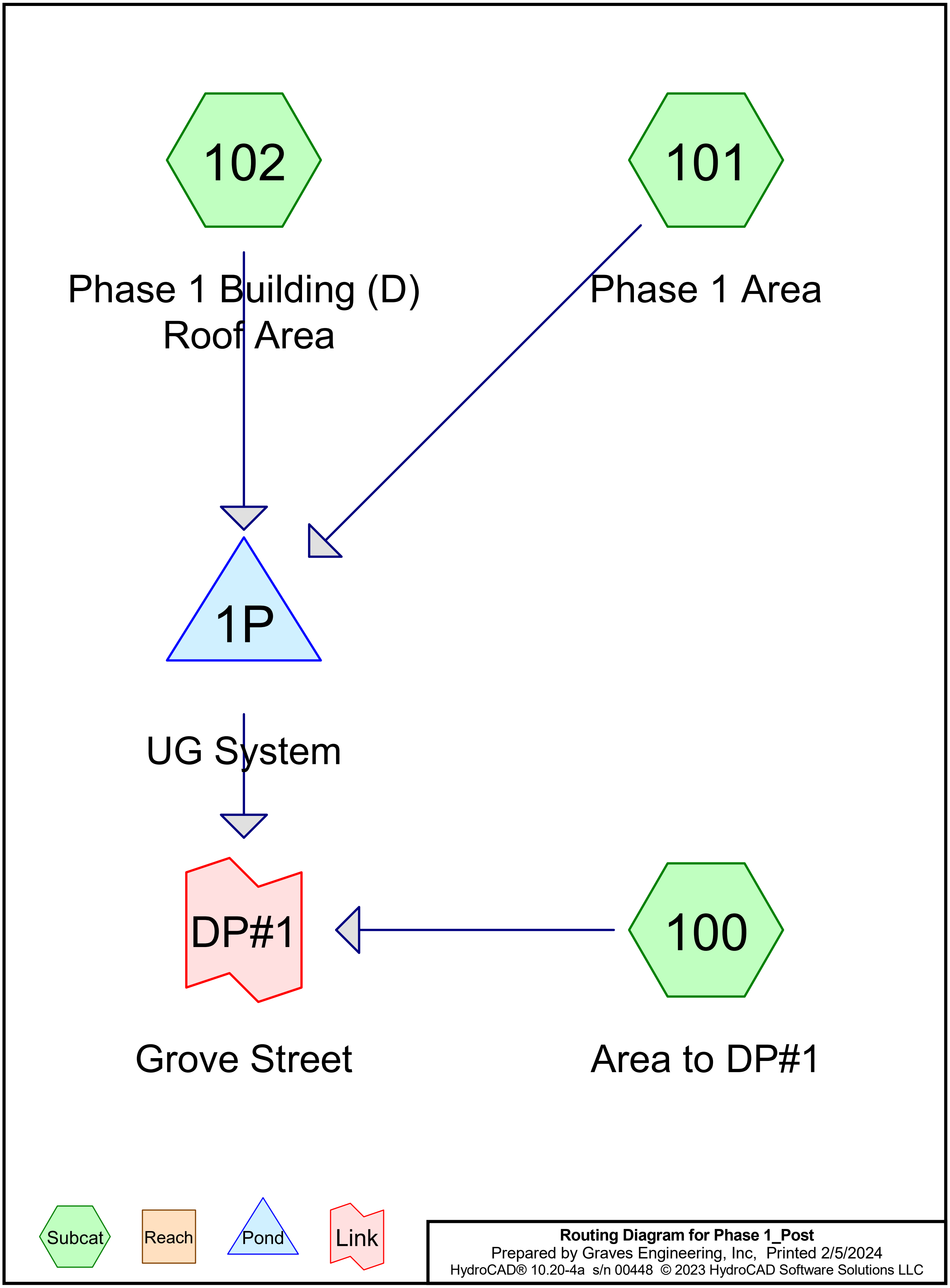
485 GROVE STREET, WORCESTER MA 01605

REVISIONS

SCALE:

POST-DEVELOPMENT DRAINAGE AREAS

POST-DA



Routing Diagram for Phase 1_Post
Prepared by Graves Engineering, Inc, Printed 2/5/2024
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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 100: Area to DP#1 Runoff Area=222,735 sf 46.11% Impervious Runoff Depth>1.80"
Flow Length=780' Tc=6.0 min CN=85 Runoff=9.89 cfs 33,366 cf

Subcatchment 101: Phase 1 Area Runoff Area=67,410 sf 47.05% Impervious Runoff Depth>1.80"
Flow Length=252' Tc=6.0 min CN=85 Runoff=2.99 cfs 10,098 cf

Subcatchment 102: Phase 1 Building (D) Runoff Area=14,700 sf 100.00% Impervious Runoff Depth>3.01"
Flow Length=100' Tc=6.0 min CN=98 Runoff=0.95 cfs 3,692 cf

Pond 1P: UG System Peak Elev=535.37' Storage=936 cf Inflow=3.95 cfs 13,791 cf
24.0" Round Culvert n=0.013 L=60.1' S=0.0105 '/' Outflow=3.31 cfs 13,698 cf

Link DP#1: Grove Street Inflow=12.98 cfs 47,065 cf
Primary=12.98 cfs 47,065 cf

Total Runoff Area = 304,845 sf Runoff Volume = 47,157 cf Average Runoff Depth = 1.86"
51.08% Pervious = 155,729 sf 48.92% Impervious = 149,116 sf

Summary for Subcatchment 100: Area to DP#1

Runoff = 9.89 cfs @ 12.13 hrs, Volume= 33,366 cf, Depth> 1.80"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-year Rainfall=3.25"

Area (sf)	CN	Description
42,463	98	Unconnected roofs, HSG C
59,467	98	Paved parking, HSG C
769	98	Unconnected pavement, HSG C
120,036	74	>75% Grass cover, Good, HSG C
222,735	85	Weighted Average
120,036		53.89% Pervious Area
102,699		46.11% Impervious Area
43,232		42.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Subcatchment 101: Phase 1 Area

Runoff = 2.99 cfs @ 12.13 hrs, Volume= 10,098 cf, Depth> 1.80"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-year Rainfall=3.25"

Area (sf)	CN	Description
4,361	98	Unconnected roofs, HSG C
26,921	98	Paved parking, HSG C
435	98	Unconnected pavement, HSG C
35,693	74	>75% Grass cover, Good, HSG C
67,410	85	Weighted Average
35,693		52.95% Pervious Area
31,717		47.05% Impervious Area
4,796		15.12% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	252		0.70		**Direct Entry, A-D**

Summary for Subcatchment 102: Phase 1 Building (D) Roof Area

Runoff = 0.95 cfs @ 12.13 hrs, Volume= 3,692 cf, Depth> 3.01"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 2-year Rainfall=3.25"

Area (sf)	CN	Description
14,700	98	Unconnected roofs, HSG C
14,700		100.00% Impervious Area
14,700		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100		0.28		**Direct Entry, A-D**

Summary for Pond 1P: UG System

Inflow Area = 82,110 sf, 56.53% Impervious, Inflow Depth > 2.02" for 2-year event
Inflow = 3.95 cfs @ 12.13 hrs, Volume= 13,791 cf
Outflow = 3.31 cfs @ 12.17 hrs, Volume= 13,698 cf, Atten= 16%, Lag= 2.7 min
Primary = 3.31 cfs @ 12.17 hrs, Volume= 13,698 cf
Routed to Link DP#1 : Grove Street

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 535.37' @ 12.17 hrs Surf.Area= 1,858 sf Storage= 936 cf
Flood Elev= 538.00' Surf.Area= 1,858 sf Storage= 3,951 cf

Plug-Flow detention time= 11.1 min calculated for 13,670 cf (99% of inflow)
Center-of-Mass det. time= 7.1 min (830.9 - 823.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	534.50'	1,700 cf	**34.75'W x 53.46'L x 3.50'H Field A** 6,502 cf Overall - 2,251 cf Embedded = 4,251 cf x 40.0% Voids
#2A	535.00'	2,251 cf	**ADS_StormTech SC-740 +Cap** x 49 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 49 Chambers in 7 Rows
		3,951 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	534.50'	**24.0" Round Culvert** L= 60.1' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 534.50' / 533.87' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=3.22 cfs @ 12.17 hrs HW=535.36' (Free Discharge)
└**1=Culvert** (Inlet Controls 3.22 cfs @ 2.49 fps)

Summary for Link DP#1: Grove Street

Inflow Area =	304,845 sf,	48.92% Impervious,	Inflow Depth > 1.85"	for 2-year event
Inflow =	12.98 cfs @	12.14 hrs, Volume=	47,065 cf	
Primary =	12.98 cfs @	12.14 hrs, Volume=	47,065 cf,	Atten= 0%, Lag= 0.0 min

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

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

Subcatchment 100: Area to DP#1 Runoff Area=222,735 sf 46.11% Impervious Runoff Depth>3.26"
Flow Length=780' Tc=6.0 min CN=85 Runoff=17.61 cfs 60,548 cf

Subcatchment 101: Phase 1 Area Runoff Area=67,410 sf 47.05% Impervious Runoff Depth>3.26"
Flow Length=252' Tc=6.0 min CN=85 Runoff=5.33 cfs 18,325 cf

Subcatchment 102: Phase 1 Building (D) Runoff Area=14,700 sf 100.00% Impervious Runoff Depth>4.65"
Flow Length=100' Tc=6.0 min CN=98 Runoff=1.44 cfs 5,694 cf

Pond 1P: UG System Peak Elev=535.72' Storage=1,444 cf Inflow=6.77 cfs 24,019 cf
24.0" Round Culvert n=0.013 L=60.1' S=0.0105 '/' Outflow=5.94 cfs 23,902 cf

Link DP#1: Grove Street Inflow=23.24 cfs 84,450 cf
Primary=23.24 cfs 84,450 cf

Total Runoff Area = 304,845 sf Runoff Volume = 84,568 cf Average Runoff Depth = 3.33"
51.08% Pervious = 155,729 sf 48.92% Impervious = 149,116 sf

Summary for Subcatchment 100: Area to DP#1

Runoff = 17.61 cfs @ 12.13 hrs, Volume= 60,548 cf, Depth> 3.26"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-year Rainfall=4.89"

Area (sf)	CN	Description
42,463	98	Unconnected roofs, HSG C
59,467	98	Paved parking, HSG C
769	98	Unconnected pavement, HSG C
120,036	74	>75% Grass cover, Good, HSG C
222,735	85	Weighted Average
120,036		53.89% Pervious Area
102,699		46.11% Impervious Area
43,232		42.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Subcatchment 101: Phase 1 Area

Runoff = 5.33 cfs @ 12.13 hrs, Volume= 18,325 cf, Depth> 3.26"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-year Rainfall=4.89"

Area (sf)	CN	Description
4,361	98	Unconnected roofs, HSG C
26,921	98	Paved parking, HSG C
435	98	Unconnected pavement, HSG C
35,693	74	>75% Grass cover, Good, HSG C
67,410	85	Weighted Average
35,693		52.95% Pervious Area
31,717		47.05% Impervious Area
4,796		15.12% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	252		0.70		**Direct Entry, A-D**

Summary for Subcatchment 102: Phase 1 Building (D) Roof Area

Runoff = 1.44 cfs @ 12.13 hrs, Volume= 5,694 cf, Depth> 4.65"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 10-year Rainfall=4.89"

Area (sf)	CN	Description
14,700	98	Unconnected roofs, HSG C
14,700		100.00% Impervious Area
14,700		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100		0.28		**Direct Entry, A-D**

Summary for Pond 1P: UG System

Inflow Area = 82,110 sf, 56.53% Impervious, Inflow Depth > 3.51" for 10-year event
Inflow = 6.77 cfs @ 12.13 hrs, Volume= 24,019 cf
Outflow = 5.94 cfs @ 12.17 hrs, Volume= 23,902 cf, Atten= 12%, Lag= 2.2 min
Primary = 5.94 cfs @ 12.17 hrs, Volume= 23,902 cf
Routed to Link DP#1 : Grove Street

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 535.72' @ 12.17 hrs Surf.Area= 1,858 sf Storage= 1,444 cf
Flood Elev= 538.00' Surf.Area= 1,858 sf Storage= 3,951 cf

Plug-Flow detention time= 8.9 min calculated for 23,902 cf (100% of inflow)
Center-of-Mass det. time= 5.8 min (813.4 - 807.5)

Volume	Invert	Avail.Storage	Storage Description
#1A	534.50'	1,700 cf	**34.75'W x 53.46'L x 3.50'H Field A** 6,502 cf Overall - 2,251 cf Embedded = 4,251 cf x 40.0% Voids
#2A	535.00'	2,251 cf	**ADS_StormTech SC-740 +Cap** x 49 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 49 Chambers in 7 Rows
		3,951 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	534.50'	**24.0" Round Culvert** L= 60.1' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 534.50' / 533.87' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=5.79 cfs @ 12.17 hrs HW=535.70' (Free Discharge)
└─**1=Culvert** (Inlet Controls 5.79 cfs @ 2.94 fps)

Summary for Link DP#1: Grove Street

Inflow Area =	304,845 sf,	48.92% Impervious,	Inflow Depth > 3.32"	for 10-year event
Inflow =	23.24 cfs @	12.14 hrs, Volume=	84,450 cf	
Primary =	23.24 cfs @	12.14 hrs, Volume=	84,450 cf,	Atten= 0%, Lag= 0.0 min

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

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

Subcatchment 100: Area to DP#1 Runoff Area=222,735 sf 46.11% Impervious Runoff Depth>4.47"
Flow Length=780' Tc=6.0 min CN=85 Runoff=23.75 cfs 82,909 cf

Subcatchment 101: Phase 1 Area Runoff Area=67,410 sf 47.05% Impervious Runoff Depth>4.47"
Flow Length=252' Tc=6.0 min CN=85 Runoff=7.19 cfs 25,092 cf

Subcatchment 102: Phase 1 Building (D) Runoff Area=14,700 sf 100.00% Impervious Runoff Depth>5.94"
Flow Length=100' Tc=6.0 min CN=98 Runoff=1.83 cfs 7,271 cf

Pond 1P: UG System Peak Elev=535.97' Storage=1,800 cf Inflow=9.01 cfs 32,363 cf
24.0" Round Culvert n=0.013 L=60.1' S=0.0105 '/' Outflow=8.04 cfs 32,229 cf

Link DP#1: Grove Street Inflow=31.41 cfs 115,139 cf
Primary=31.41 cfs 115,139 cf

Total Runoff Area = 304,845 sf Runoff Volume = 115,273 cf Average Runoff Depth = 4.54"
51.08% Pervious = 155,729 sf 48.92% Impervious = 149,116 sf

Summary for Subcatchment 100: Area to DP#1

Runoff = 23.75 cfs @ 12.13 hrs, Volume= 82,909 cf, Depth> 4.47"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-year Rainfall=6.18"

Area (sf)	CN	Description
42,463	98	Unconnected roofs, HSG C
59,467	98	Paved parking, HSG C
769	98	Unconnected pavement, HSG C
120,036	74	>75% Grass cover, Good, HSG C
222,735	85	Weighted Average
120,036		53.89% Pervious Area
102,699		46.11% Impervious Area
43,232		42.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Subcatchment 101: Phase 1 Area

Runoff = 7.19 cfs @ 12.13 hrs, Volume= 25,092 cf, Depth> 4.47"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-year Rainfall=6.18"

Area (sf)	CN	Description
4,361	98	Unconnected roofs, HSG C
26,921	98	Paved parking, HSG C
435	98	Unconnected pavement, HSG C
35,693	74	>75% Grass cover, Good, HSG C
67,410	85	Weighted Average
35,693		52.95% Pervious Area
31,717		47.05% Impervious Area
4,796		15.12% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	252		0.70		**Direct Entry, A-D**

Summary for Subcatchment 102: Phase 1 Building (D) Roof Area

Runoff = 1.83 cfs @ 12.13 hrs, Volume= 7,271 cf, Depth> 5.94"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 25-year Rainfall=6.18"

Area (sf)	CN	Description
14,700	98	Unconnected roofs, HSG C
14,700		100.00% Impervious Area
14,700		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100		0.28		**Direct Entry, A-D**

Summary for Pond 1P: UG System

Inflow Area = 82,110 sf, 56.53% Impervious, Inflow Depth > 4.73" for 25-year event
Inflow = 9.01 cfs @ 12.13 hrs, Volume= 32,363 cf
Outflow = 8.04 cfs @ 12.16 hrs, Volume= 32,229 cf, Atten= 11%, Lag= 2.1 min
Primary = 8.04 cfs @ 12.16 hrs, Volume= 32,229 cf
Routed to Link DP#1 : Grove Street

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 535.97' @ 12.16 hrs Surf.Area= 1,858 sf Storage= 1,800 cf
Flood Elev= 538.00' Surf.Area= 1,858 sf Storage= 3,951 cf

Plug-Flow detention time= 7.9 min calculated for 32,229 cf (100% of inflow)
Center-of-Mass det. time= 5.3 min (803.9 - 798.6)

Volume	Invert	Avail.Storage	Storage Description
#1A	534.50'	1,700 cf	**34.75'W x 53.46'L x 3.50'H Field A** 6,502 cf Overall - 2,251 cf Embedded = 4,251 cf x 40.0% Voids
#2A	535.00'	2,251 cf	**ADS_StormTech SC-740 +Cap** x 49 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 49 Chambers in 7 Rows
		3,951 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	534.50'	**24.0" Round Culvert** L= 60.1' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 534.50' / 533.87' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=7.85 cfs @ 12.16 hrs HW=535.94' (Free Discharge)
└─**1=Culvert** (Inlet Controls 7.85 cfs @ 3.23 fps)

Summary for Link DP#1: Grove Street

Inflow Area =	304,845 sf,	48.92% Impervious,	Inflow Depth > 4.53"	for 25-year event	
Inflow =	31.41 cfs @	12.14 hrs,	Volume=	115,139 cf	
Primary =	31.41 cfs @	12.14 hrs,	Volume=	115,139 cf,	Atten= 0%, Lag= 0.0 min

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

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

Subcatchment 100: Area to DP#1 Runoff Area=222,735 sf 46.11% Impervious Runoff Depth>7.00"
Flow Length=780' Tc=6.0 min CN=85 Runoff=36.23 cfs 129,897 cf

Subcatchment 101: Phase 1 Area Runoff Area=67,410 sf 47.05% Impervious Runoff Depth>7.00"
Flow Length=252' Tc=6.0 min CN=85 Runoff=10.97 cfs 39,313 cf

Subcatchment 102: Phase 1 Building (D) Runoff Area=14,700 sf 100.00% Impervious Runoff Depth>8.57"
Flow Length=100' Tc=6.0 min CN=98 Runoff=2.61 cfs 10,500 cf

Pond 1P: UG System Peak Elev=536.50' Storage=2,517 cf Inflow=13.58 cfs 49,812 cf
24.0" Round Culvert n=0.013 L=60.1' S=0.0105 '/' Outflow=11.97 cfs 49,650 cf

Link DP#1: Grove Street Inflow=47.68 cfs 179,547 cf
Primary=47.68 cfs 179,547 cf

Total Runoff Area = 304,845 sf Runoff Volume = 179,709 cf Average Runoff Depth = 7.07"
51.08% Pervious = 155,729 sf 48.92% Impervious = 149,116 sf

Summary for Subcatchment 100: Area to DP#1

Runoff = 36.23 cfs @ 12.13 hrs, Volume= 129,897 cf, Depth> 7.00"
Routed to Link DP#1 : Grove Street

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-year Rainfall=8.82"

Area (sf)	CN	Description
42,463	98	Unconnected roofs, HSG C
59,467	98	Paved parking, HSG C
769	98	Unconnected pavement, HSG C
120,036	74	>75% Grass cover, Good, HSG C
222,735	85	Weighted Average
120,036		53.89% Pervious Area
102,699		46.11% Impervious Area
43,232		42.10% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	780		2.17		**Direct Entry, A-D**

Summary for Subcatchment 101: Phase 1 Area

Runoff = 10.97 cfs @ 12.13 hrs, Volume= 39,313 cf, Depth> 7.00"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-year Rainfall=8.82"

Area (sf)	CN	Description
4,361	98	Unconnected roofs, HSG C
26,921	98	Paved parking, HSG C
435	98	Unconnected pavement, HSG C
35,693	74	>75% Grass cover, Good, HSG C
67,410	85	Weighted Average
35,693		52.95% Pervious Area
31,717		47.05% Impervious Area
4,796		15.12% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	252		0.70		**Direct Entry, A-D**

Summary for Subcatchment 102: Phase 1 Building (D) Roof Area

Runoff = 2.61 cfs @ 12.13 hrs, Volume= 10,500 cf, Depth> 8.57"
Routed to Pond 1P : UG System

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
NRCC 24-hr D 100-year Rainfall=8.82"

Area (sf)	CN	Description
14,700	98	Unconnected roofs, HSG C
14,700		100.00% Impervious Area
14,700		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	100		0.28		**Direct Entry, A-D**

Summary for Pond 1P: UG System

Inflow Area = 82,110 sf, 56.53% Impervious, Inflow Depth > 7.28" for 100-year event
Inflow = 13.58 cfs @ 12.13 hrs, Volume= 49,812 cf
Outflow = 11.97 cfs @ 12.16 hrs, Volume= 49,650 cf, Atten= 12%, Lag= 2.2 min
Primary = 11.97 cfs @ 12.16 hrs, Volume= 49,650 cf
Routed to Link DP#1 : Grove Street

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 536.50' @ 12.16 hrs Surf.Area= 1,858 sf Storage= 2,517 cf
Flood Elev= 538.00' Surf.Area= 1,858 sf Storage= 3,951 cf

Plug-Flow detention time= 6.7 min calculated for 49,547 cf (99% of inflow)
Center-of-Mass det. time= 4.6 min (790.6 - 785.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	534.50'	1,700 cf	**34.75'W x 53.46'L x 3.50'H Field A** 6,502 cf Overall - 2,251 cf Embedded = 4,251 cf x 40.0% Voids
#2A	535.00'	2,251 cf	**ADS_StormTech SC-740 +Cap** x 49 Inside #1 Effective Size= 44.6"W x 30.0"H => 6.45 sf x 7.12'L = 45.9 cf Overall Size= 51.0"W x 30.0"H x 7.56'L with 0.44' Overlap 49 Chambers in 7 Rows
		3,951 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	534.50'	**24.0" Round Culvert** L= 60.1' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 534.50' / 533.87' S= 0.0105 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 3.14 sf

Primary OutFlow Max=11.76 cfs @ 12.16 hrs HW=536.46' (Free Discharge)
└─**1=Culvert** (Inlet Controls 11.76 cfs @ 3.76 fps)

Summary for Link DP#1: Grove Street

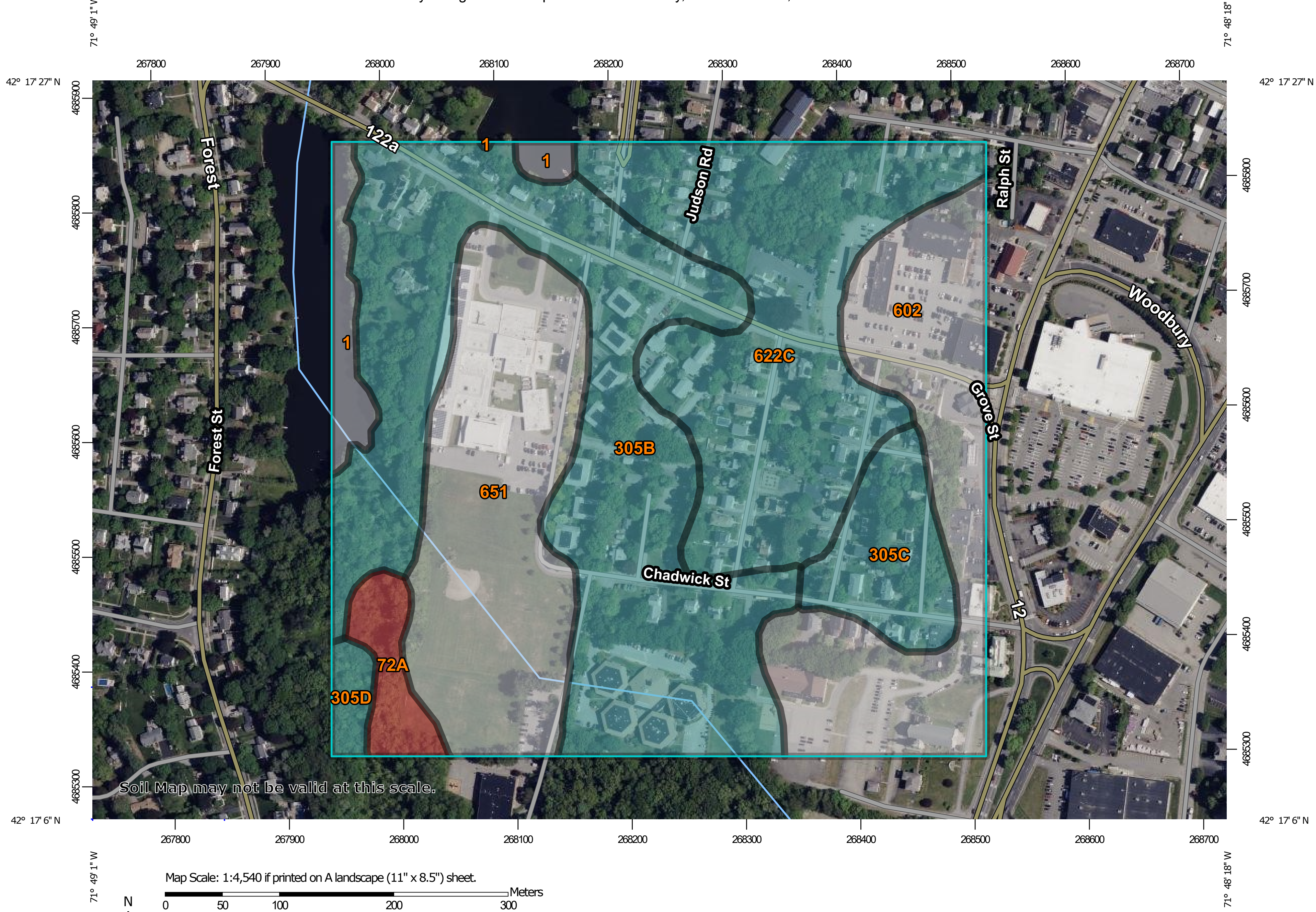
Inflow Area =	304,845 sf,	48.92% Impervious,	Inflow Depth > 7.07"	for 100-year event
Inflow =	47.68 cfs @	12.13 hrs, Volume=	179,547 cf	
Primary =	47.68 cfs @	12.13 hrs, Volume=	179,547 cf,	Atten= 0%, Lag= 0.0 min

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

APPENDIX D

USDA-NRCS SITE SOILS MAP

Hydrologic Soil Group—Worcester County, Massachusetts, Northeastern Part



Map Scale: 1:4,540 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 50, 100, 200, 300

Feet: 0, 200, 400, 800, 1200

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 Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

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 1:20,000.

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: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 18, Sep 10, 2023

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

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		2.1	2.7%
72A	Whitman fine sandy loam, 0 to 3 percent slopes	D	1.8	2.4%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	C	24.4	32.1%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	C	4.0	5.3%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	C	0.9	1.1%
602	Urban land		12.1	15.9%
622C	Paxton-Urban land complex, 8 to 15 percent slopes	C	17.0	22.4%
651	Udorthents, smoothed		13.8	18.1%
Totals for Area of Interest			**76.1**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

APPENDIX E

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN

System

The drainage system associated with Phase 1 of the overall site at 485 Grove Street is a closed drainage system consisting of deep sump and hooded catch basins, manholes, proprietary stormwater treatment (water quality) units, and one subsurface detention system.

Responsible Parties

The drainage system located on the site property will be operated and maintained by the owner, Colony Retirement Homes, post-construction. Drainage system maintenance tasks shall include routine cleaning of the overall drainage network and specific duties as listed below.

The responsible party must designate a "qualified personnel" to perform the inspections associated with this plan. This means a person knowledgeable of the layout and overall function of the stormwater system. As necessary, this "qualified personnel" shall employ the services of a registered professional engineer when inspections reveal a failing stormwater system component or when similar attention is needed beyond the knowledge or experience of the inspector.

Operation and Maintenance Duties

The following duties shall be considered the minimum required and may be supplemented by additional measures as necessary to maintain the function of the drainage system. This operation and maintenance plan shall serve as a supplement to any and all existing drainage system duties.

Sweeping:
Sweeping of the impervious areas, parking lots and driveways should be done at least 2 times annually, namely in the spring and fall. It is imperative that sweeping take place immediately following final winter snowmelt to remove winter sand. All sediments containing hydrocarbons shall be handled properly and disposed of in accordance with local, state and federal guidelines and regulations.

Culverts and pipes:
All culverts and pipes shall be inspected four times per year and cleaned when drainage impediments are discovered. Flushing of pipes may be required to remove accumulated sediment.

Deep Sump and Hooded Catch Basins:
Catch basins shall be inspected and sediment removed at least four times per year and at the end of the foliage and snow removal seasons. Sediment must be removed at the required interval or whenever the depth of deposits is greater than or equal to one half the depth of the sump (2 feet). Care must be exercised to not damage the outlet hood when using a clamshell type cleaning bucket. A damaged or dislodged hood must be repaired or replaced immediately. Outlet pipes shall be visually inspected and cleaned if found to be obstructed in any way.

Proprietary Stormwater Treatment (Water Quality) Units:
Inspection and maintenance of these devices must follow the recommendations of the manufacturer (see attached documentation for the Stormceptor units). Please note that the cleaning of these devices requires use of a vacuum truck.

Subsurface Detention System:
There is no routine maintenance of such a subsurface detention system therefore an overall aggressive inspection and maintenance schedule of all upstream BMPs must be maintained to prolong its operational life. Utilizing the observation ports and monitoring well, the system shall be inspected after the first several rain events upon installation. A log shall be kept noting the date and time of the inspection and the level of standing water or sediment (if any) observed within each observation port. The system must be inspected at least every 6 months or after every rainfall event exceeding the 2-year storm frequency (3 inches within 24 hours) and the log must estimate the volume of discharge (depth of outflow in inches will suffice) from the system either by observing the outlet structure or the drain outfall.

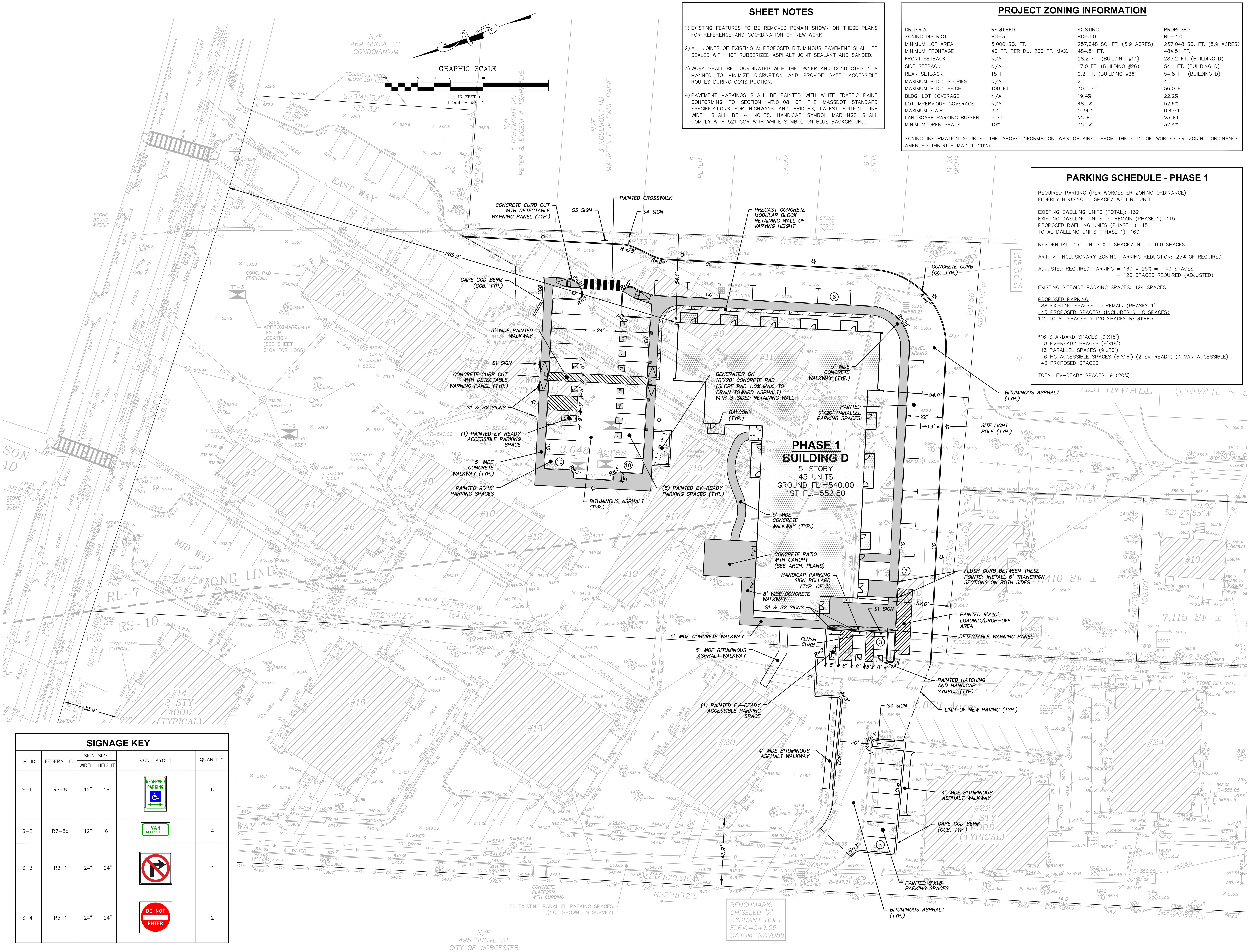
The detention system is designed to fully drain after a storm event therefore if standing water is observed within the system beyond 24 hours since the cessation of inflow to the system from a rainstorm, this may indicate a problem and should be noted on the inspection log and further inspected for repairs. The Owner may need to contact a Registered Professional Engineer to evaluate the system in the event of major problems.

Annual Budget

An annual budget for the operation and maintenance tasks describe above is estimated at $5,000.

Records

A copy of the O&M Plan will be kept by Colony Retirement Homes.



SHEET NOTES

1) EXISTING FEATURES TO BE REMOVED REMAIN SHOWN ON THESE PLANS FOR REFERENCE AND COORDINATION OF NEW WORK.
2) ALL JOINTS OF EXISTING & PROPOSED BITUMINOUS PAVEMENT SHALL BE SEALED WITH HOT RUBBERIZED ASPHALT JOINT SEALANT AND SANDED.
3) WORK SHALL BE COORDINATED WITH THE OWNER AND CONDUCTED IN A MANNER TO MINIMIZE DISRUPTION AND PROVIDE SAFE, ACCESSIBLE ROUTES DURING CONSTRUCTION.
4) PAVEMENT MARKINGS SHALL BE PAINTED WITH WHITE TRAFFIC PAINT CONFORMING TO SECTION M7.01.08 OF THE MASSDOT STANDARD SPECIFICATIONS FOR HIGHWAYS AND BRIDGES, LATEST EDITION. LINE WIDTH SHALL BE 4 INCHES. HANDICAP SYMBOL MARKINGS SHALL COMPLY WITH 521 CMR WITH WHITE SYMBOL ON BLUE BACKGROUND.

PROJECT ZONING INFORMATION

CRITERIA	REQUIRED	EXISTING	PROPOSED
ZONING DISTRICT	BG-3.0	BG-3.0	BG-3.0
MINIMUM LOT AREA	5,000 SQ. FT.	257,048 SQ. FT. (5.9 ACRES)	257,048 SQ. FT. (5.9 ACRES)
MINIMUM FRONTAGE	40 FT. PER DU, 200 FT. MAX.	484.51 FT.	484.51 FT.
FRONT SETBACK	N/A	28.2 FT. (BUILDING #14)	285.2 FT. (BUILDING D)
SIDE SETBACK	N/A	17.0 FT. (BUILDING #26)	54.1 FT. (BUILDING D)
REAR SETBACK	15 FT.	9.2 FT. (BUILDING #26)	54.8 FT. (BUILDING D)
MAXIMUM BLDG. STORIES	N/A	2	4
MAXIMUM BLDG. HEIGHT	100 FT.	30.0 FT.	56.0 FT.
BLDG. LOT COVERAGE	N/A	19.4%	22.2%
LOT IMPERVIOUS COVERAGE	N/A	48.5%	52.6%
MAXIMUM F.A.R.	3:1	0.34:1	0.47:1
LANDSCAPE PARKING BUFFER	5 FT.	>5 FT.	>5 FT.
MINIMUM OPEN SPACE	10%	35.5%	32.4%

ZONING INFORMATION SOURCE: THE ABOVE INFORMATION WAS OBTAINED FROM THE CITY OF WORCESTER ZONING ORDINANCE, AMENDED THROUGH MAY 9, 2023.

PARKING SCHEDULE - PHASE 1

REQUIRED PARKING (PER WORCESTER ZONING ORDINANCE)
ELDERLY HOUSING: 1 SPACE/DWELLING UNIT

EXISTING DWELLING UNITS (TOTAL): 139
EXISTING DWELLING UNITS TO REMAIN (PHASE 1): 115
PROPOSED DWELLING UNITS (PHASE 1): 45
TOTAL DWELLING UNITS (PHASE 1): 160

RESIDENTIAL: 160 UNITS X 1 SPACE/UNIT = 160 SPACES

ART. VII INCLUSIONARY ZONING PARKING REDUCTION: 25% OF REQUIRED

ADJUSTED REQUIRED PARKING = 160 X 25% = -40 SPACES
= 120 SPACES REQUIRED (ADJUSTED)

EXISTING SITEWIDE PARKING SPACES: 124 SPACES

PROPOSED PARKING
88 EXISTING SPACES TO REMAIN (PHASES 1)
43 PROPOSED SPACES* (INCLUDES 6 HC SPACES)
131 TOTAL SPACES > 120 SPACES REQUIRED

*16 STANDARD SPACES (9'X18')
8 EV-READY SPACES (9'X18')
13 PARALLEL SPACES (9'x20')
6 HC ACCESSIBLE SPACES (8'X18') (2 EV-READY) (4 VAN ACCESSIBLE)
43 PROPOSED SPACES

TOTAL EV-READY SPACES: 9 (20%)

SIGNAGE KEY

GEI ID	FEDERAL ID	SIGN SIZE WIDTH	SIGN SIZE HEIGHT	SIGN LAYOUT	QUANTITY
S-1	R7-8	12"	18"	RESERVED PARKING	6
S-2	R7-8a	12"	6"	VAN ACCESSIBLE	4
S-3	R3-1	24"	24"		1
S-4	R5-1	24"	24"	DO NOT ENTER	2

PCA

ARCHITECT:
PCA, INC.
221 Hampshire Street
Cambridge, MA 02139
617-547-8120

OWNER:
COLONY RETIREMENT HOMES
485 GROVE STREET
WORCESTER, MA 01605

CONTRACTOR:

CIVIL ENGINEER:
GRAVES ENGINEERING, Inc.
100 GROVE ST | WORCESTER MA 01605
T 508-856-0321 | F 508-856-0357
gravesengineering.com

PCA PROJECT #: 23010.00
GEI PROJECT #: 23108

COLONY RETIREMENT HOMES - PHASE 1

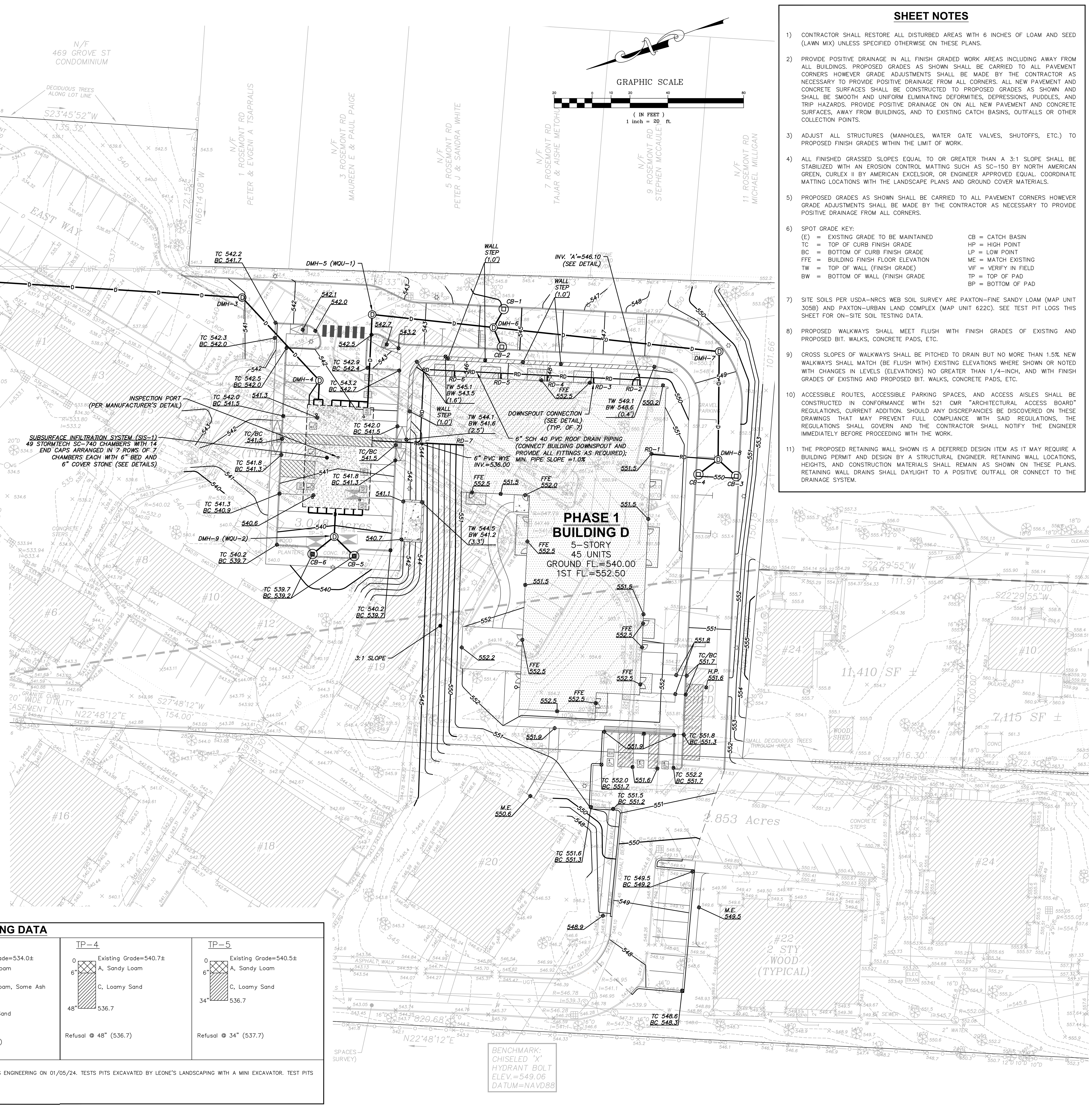
485 GROVE STREET, WORCESTER, MA 01605

REVISIONS:

ORIGINAL ISSUE:
ISSUED FOR PERMITTING
02/26/2024
SCALE: 1"=20'

LAYOUT PLAN

C102



SHEET NOTES

1) CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS WITH 6 INCHES OF LOAM AND SEED (LAWN MIX) UNLESS SPECIFIED OTHERWISE ON THESE PLANS.

2) PROVIDE POSITIVE DRAINAGE IN ALL FINISH GRADED WORK AREAS INCLUDING AWAY FROM ALL BUILDINGS. PROPOSED GRADES AS SHOWN SHALL BE CARRIED TO ALL PAVEMENT CORNERS HOWEVER GRADE ADJUSTMENTS SHALL BE MADE BY THE CONTRACTOR AS NECESSARY TO PROVIDE POSITIVE DRAINAGE FROM ALL CORNERS. ALL NEW PAVEMENT AND CONCRETE SURFACES SHALL BE CONSTRUCTED TO PROPOSED GRADES AS SHOWN AND SHALL BE SMOOTH AND UNIFORM ELIMINATING DEFORMITIES, DEPRESSIONS, PUDDLES, AND TRIP HAZARDS. PROVIDE POSITIVE DRAINAGE ON ON ALL NEW PAVEMENT AND CONCRETE SURFACES, AWAY FROM BUILDINGS, AND TO EXISTING CATCH BASINS, OUTFALLS OR OTHER COLLECTION POINTS.

3) ADJUST ALL STRUCTURES (MANHOLES, WATER GATE VALVES, SHUTOFFS, ETC.) TO PROPOSED FINISH GRADES WITHIN THE LIMIT OF WORK.

4) ALL FINISHED GRASSED SLOPES EQUAL TO OR GREATER THAN A 3:1 SLOPE SHALL BE STABILIZED WITH AN EROSION CONTROL MATTING SUCH AS SC-150 BY NORTH AMERICAN GREEN, CURLEX II BY AMERICAN EXCELSIOR, OR ENGINEER APPROVED EQUAL. COORDINATE MATTING LOCATIONS WITH THE LANDSCAPE PLANS AND GROUND COVER MATERIALS.

5) PROPOSED GRADES AS SHOWN SHALL BE CARRIED TO ALL PAVEMENT CORNERS HOWEVER GRADE ADJUSTMENTS SHALL BE MADE BY THE CONTRACTOR AS NECESSARY TO PROVIDE POSITIVE DRAINAGE FROM ALL CORNERS.

6) SPOT GRADE KEY:

(E) = EXISTING GRADE TO BE MAINTAINED	CB = CATCH BASIN
TC = TOP OF CURB FINISH GRADE	HP = HIGH POINT
BC = BOTTOM OF CURB FINISH GRADE	LP = LOW POINT
FFE = BUILDING FINISH FLOOR ELEVATION	ME = MATCH EXISTING
TW = TOP OF WALL (FINISH GRADE)	VIF = VERIFY IN FIELD
BW = BOTTOM OF WALL (FINISH GRADE	TP = TOP OF PAD
	BP = BOTTOM OF PAD

7) SITE SOILS PER USDA-NRCS WEB SOIL SURVEY ARE PAXTON-FINE SANDY LOAM (MAP UNIT 305B) AND PAXTON-URBAN LAND COMPLEX (MAP UNIT 622C). SEE TEST PIT LOGS THIS SHEET FOR ON-SITE SOIL TESTING DATA.

8) PROPOSED WALKWAYS SHALL MEET FLUSH WITH FINISH GRADES OF EXISTING AND PROPOSED BIT. WALKS, CONCRETE PADS, ETC.

9) CROSS SLOPES OF WALKWAYS SHALL BE PITCHED TO DRAIN BUT NO MORE THAN 1.5%. NEW WALKWAYS SHALL MATCH (BE FLUSH WITH) EXISTING ELEVATIONS WHERE SHOWN OR NOTED WITH CHANGES IN LEVELS (ELEVATIONS) NO GREATER THAN 1/4-INCH, AND WITH FINISH GRADES OF EXISTING AND PROPOSED BIT. WALKS, CONCRETE PADS, ETC.

10) ACCESSIBLE ROUTES, ACCESSIBLE PARKING SPACES, AND ACCESS AISLES SHALL BE CONSTRUCTED IN CONFORMANCE WITH 521 CMR "ARCHITECTURAL ACCESS BOARD" REGULATIONS, CURRENT ADDITION. SHOULD ANY DISCREPANCIES BE DISCOVERED ON THESE DRAWINGS THAT MAY PREVENT FULL COMPLIANCE WITH SAID REGULATIONS, THE REGULATIONS SHALL GOVERN AND THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY BEFORE PROCEEDING WITH THE WORK.

11) THE PROPOSED RETAINING WALL SHOWN IS A DEFERRED DESIGN ITEM AS IT MAY REQUIRE A BUILDING PERMIT AND DESIGN BY A STRUCTURAL ENGINEER. RETAINING WALL LOCATIONS, HEIGHTS, AND CONSTRUCTION MATERIALS SHALL REMAIN AS SHOWN ON THESE PLANS. RETAINING WALL DRAINS SHALL DAYLIGHT TO A POSITIVE OUTFALL OR CONNECT TO THE DRAINAGE SYSTEM.

DRAINAGE TABLE KEY:

INV: PIPE INVERT ELEVATION
ID: INSIDE DIAMETER
CB-#: CATCH BASIN-NUMBER
DMH-#: DRAIN MANHOLE-NUMBER
HDPE: HIGH DENSITY POLYETHYLENE PIPE
PVC: POLYVINYL CHLORIDE PIPE
TBD: TO BE DETERMINED
WQU: STORMWATER WATER QUALITY UNIT

PROPOSED STORM DRAIN ELEVATION TABLE

STRUCTURE ELEVATIONS					PIPE DATA			
STRUCTURE	RIM ELEV.	PENETRATIONS	INVERT	NOTES	FROM	TO	LENGTH (ft).	SLOPE (%)
CB-1	544.6	8" C900 PVC OUT (DMH-6)	540.10		CB-1	DMH-6	6.7	6.00
CB-2	544.6	8" C900 PVC OUT (DMH-6)	540.10		CB-2	DMH-6	6.7	6.00
CB-3	550.0	8" C900 PVC OUT (DMH-8)	545.50		CB-3	DMH-8	8.5	6.00
CB-4	550.0	8" C900 PVC OUT (DMH-8)	545.50		CB-4	DMH-8	8.5	6.00
CB-5	539.2	8" C900 PVC OUT (DMH-9)	536.00		CB-5	DMH-9	10.1	2.00
CB-6	539.2	8" C900 PVC OUT (DMH-9)	536.00		CB-6	DMH-9	10.1	2.00
DMH-1	533.3	24" RCP IN (DMH-2)	527.15	DOGHOUSE				
		EXISTING 12" DRAIN IN/OUT	527.10					
DMH-2	534.2	24" HDPE IN (DMH-3)	528.74					
		24" HDPE OUT (DMH-1)	528.64		DMH-2	DMH-1	49.6	3.00
DMH-3	541.0	24" HDPE IN (DMH-4)	533.42					
		24" HDPE OUT (DMH-2)	533.32		DMH-3	DMH-2	152.6	3.00
DMH-4	541.8	24" HDPE IN (SIS-1)	534.38		SIS-1	DMH-4	8.0	1.50
		6" PVC UNDERDRAIN IN (SIS-1)	534.38					
		24" HDPE OUT (DMH-3)	534.28		DMH-4	DMH-3	55.8	1.54
DMH-5	542.3	12" HDPE IN (DMH-6)	537.32	WQU-1				
		12" HDPE OUT (SIS-1)	537.22	(SEE DETAIL)	DMH-5	SIS-1	44.2	2.75
DMH-6	544.3	8" C900 PVC IN (CB-1)	539.70					
		8" C900 PVC IN (CB-2)	539.70					
		12" HDPE IN (DMH-7)	539.24					
		12" HDPE OUT (DMH-5)	539.14		DMH-6	DMH-5	60.5	3.00
DMH-7	548.8	12" HDPE IN (DMH-8)	542.82					
		12" HDPE OUT (DMH-6)	542.72		DMH-7	DMH-6	115.9	3.00
DMH-8	549.8	6" SCH 40 PVC IN (RD-1)	545.50					
		8" C900 PVC IN (CB-3)	544.99					
		8" C900 PVC IN (CB-4)	544.99					
		12" HDPE OUT (DMH-7)	544.41		DMH-8	DMH-7	53.0	3.00
DMH-9	539.6	8" C900 PVC IN (CB-5)	535.80	WQU-2				
		8" C900 PVC IN (CB-6)	535.80	(SEE DETAIL)				
		12" HDPE OUT (SIS-1)	535.70		DMH-9	SIS-1	10.0	1.00
RD-1	N/A	6" SCH 40 PVC OUT (DMH-8)	545.50	AT DMH-8	RD-1	DMH-8	33.0	7.00
RD-7	N/A	6" SCH 40 PVC OUT (SIS)	536.00	AT SIS-1	RD-7	SIS-1	48.1	10.00
SIS-1	N/A	SEE DETAIL						

SOIL TESTING DATA

TP-1	TP-2	TP-3	TP-4	TP-5
Existing Grade=540.9±	Existing Grade=534.0±	Existing Grade=534.0±	Existing Grade=540.7±	Existing Grade=540.5±
0–7": A, Sandy Loam	0–10": A, Sandy Loam	0–6": A, Sandy Loam	0–6": A, Sandy Loam	0–6": A, Sandy Loam
7"–82": C, Loamy Sand (30–40%), Gravel (–6")	10"–25": C1, Loamy Sand	6"–36": F, Sandy Loam, Some Ash	6"–48": C, Loamy Sand	6"–34": C, Loamy Sand
82": 534.1	25"–40": C2, Gray Fine Sand	36"–84": C, Loamy Sand	48": 536.7	34": 536.7
	40"–84": C3, Loamy Sand	84": 527.0		
	84": 527.0			
Weeping @ 64" (535.6) ESHGWT @ 55" (536.3) Standing @ 76" (534.6) No Refusal	Weeping @ 45" (530.2) ESHGWT @ 45" (530.2) No Refusal	No Weeping ESHGWT @ 40" (530.7) No Refusal	Refusal @ 48" (536.7)	Refusal @ 34" (537.7)

NOTES:

1) SOIL TESTING TEST PITS WERE CONDUCTED BY MICHAEL ANDRADE, P.E., MASSDEP SOIL EVALUATOR #SE2681, OF GRAVES ENGINEERING ON 01/05/24. TESTS PITS EXCAVATED BY LEONE'S LANDSCAPING WITH A MINI EXCAVATOR. TEST PITS WERE PERFORMED FOR STORMWATER MANAGEMENT DESIGN PURPOSES ONLY.

2) ESHGWT= ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

PRINTED: 10/30/2023 9:04:46 AM

PCA

ARCHITECT:
PCA, INC.
221 Hampshire Street
Cambridge, MA 02139
617-547-8120

OWNER:
COLONY RETIREMENT HOMES
485 GROVE STREET
WORCESTER, MA 01605

CONTRACTOR:

CIVIL ENGINEER:
GRAVES ENGINEERING, Inc.
100 GROVE ST | WORCESTER MA 01605
T 508-856-0321 | F 508-856-0357
gravesengineering.com

COLONY RETIREMENT HOMES - PHASE 1

485 GROVE STREET, WORCESTER, MA 01605

PCA PROJECT #: 23010.00
GEI PROJECT #: 23108

REVISIONS:

ORIGINAL ISSUE:
ISSUED FOR PERMITTING
02/26/2024
SCALE: 1"=20'

GRADING AND DRAINAGE PLAN

C103

SHEET NOTES

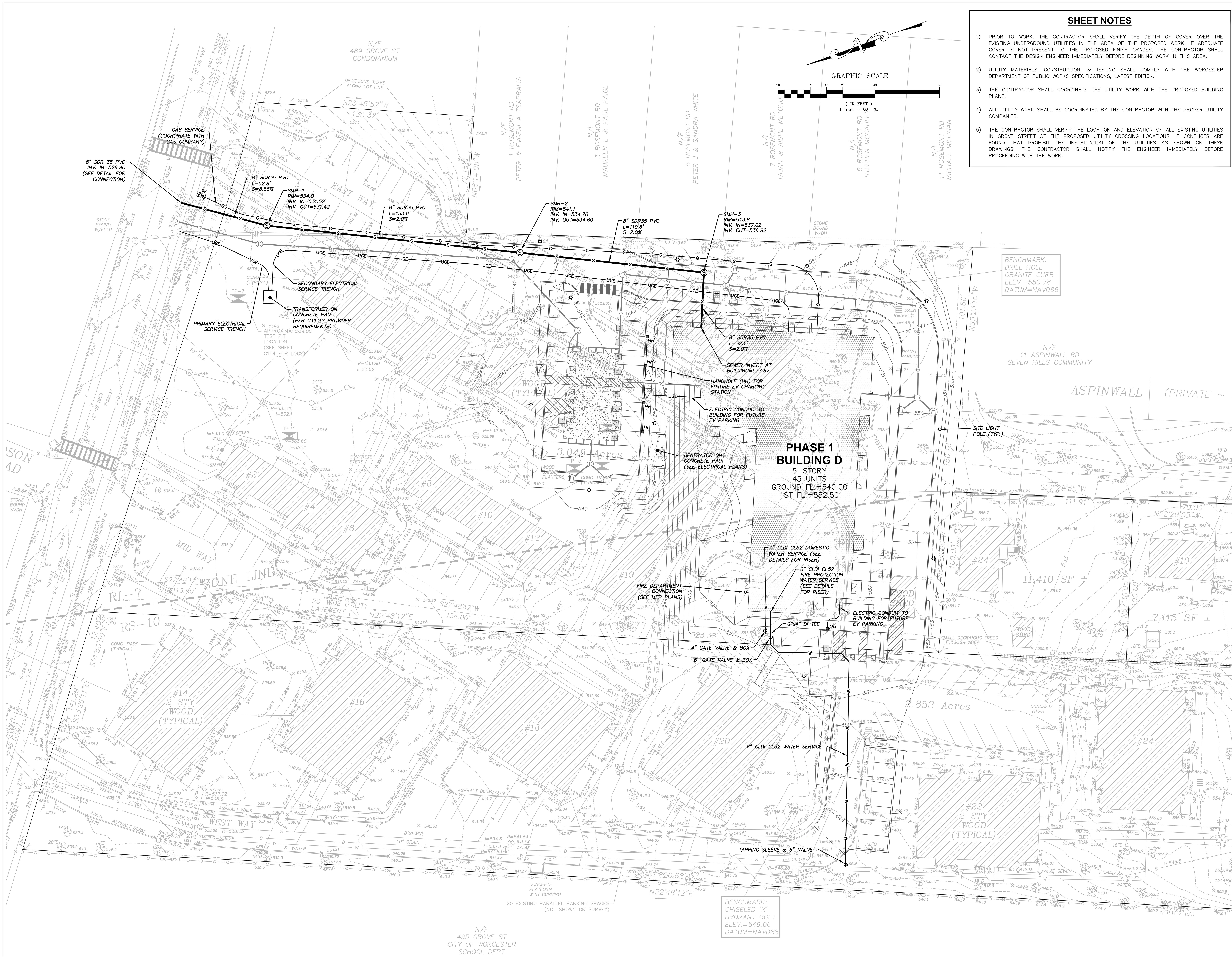
1) PRIOR TO WORK, THE CONTRACTOR SHALL VERIFY THE DEPTH OF COVER OVER THE EXISTING UNDERGROUND UTILITIES IN THE AREA OF THE PROPOSED WORK. IF ADEQUATE COVER IS NOT PRESENT TO THE PROPOSED FINISH GRADES, THE CONTRACTOR SHALL CONTACT THE DESIGN ENGINEER IMMEDIATELY BEFORE BEGINNING WORK IN THIS AREA.

2) UTILITY MATERIALS, CONSTRUCTION, & TESTING SHALL COMPLY WITH THE WORCESTER DEPARTMENT OF PUBLIC WORKS SPECIFICATIONS, LATEST EDITION.

3) THE CONTRACTOR SHALL COORDINATE THE UTILITY WORK WITH THE PROPOSED BUILDING PLANS.

4) ALL UTILITY WORK SHALL BE COORDINATED BY THE CONTRACTOR WITH THE PROPER UTILITY COMPANIES.

5) THE CONTRACTOR SHALL VERIFY THE LOCATION AND ELEVATION OF ALL EXISTING UTILITIES IN GROVE STREET AT THE PROPOSED UTILITY CROSSING LOCATIONS. IF CONFLICTS ARE FOUND THAT PROHIBIT THE INSTALLATION OF THE UTILITIES AS SHOWN ON THESE DRAWINGS, THE CONTRACTOR SHALL NOTIFY THE ENGINEER IMMEDIATELY BEFORE PROCEEDING WITH THE WORK.



PCA

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221 Hampshire Street
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WORCESTER, MA 01605

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GRAVES ENGINEERING, INC.

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COLONY RETIREMENT HOMES - PHASE 1

485 GROVE STREET, WORCESTER, MA 01605

REVISIONS:

ORIGINAL ISSUE:
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02/26/2024

SCALE: 1"=20'

SITE UTILITIES PLAN

C104

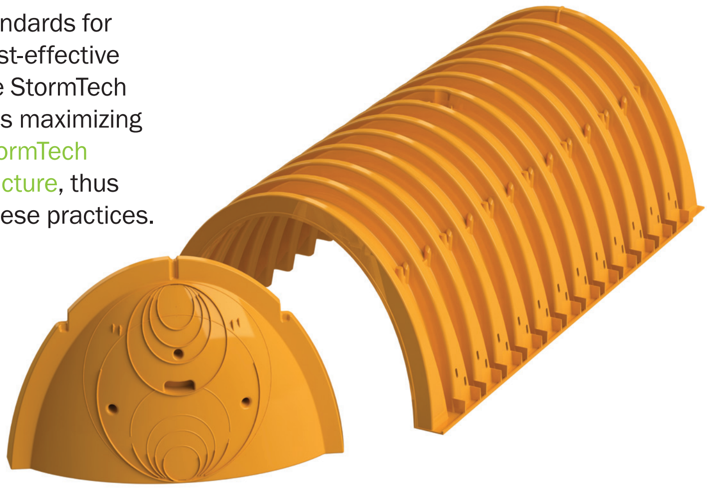
O&M LOG

PROJECT: Colony Retirement Homes - Phase 1
ADDRESS: 485 Grove Street, Worcester, MA 01605

					ACTION		
LOG #	BY	DATE	BMP FEATURE	OBSERVATIONS	CORRECTIVE ACTION TAKEN (IF NEEDED)	DATE	NOTES

STORMTECH SC-740 CHAMBER

Designed to meet the most stringent industry performance standards for superior structural integrity while providing designers with a cost-effective method to save valuable land and protect water resources. The StormTech system is designed primarily to be used under parking lots, thus maximizing land usage for private (commercial) and public applications. StormTech chambers can also be used in conjunction with Green Infrastructure, thus enhancing the performance and extending the service life of these practices.



STORMTECH SC-740 CHAMBER
(not to scale)

Nominal Chamber Specifications

Size (L x W x H)
85.4” x 51” x 30”
2,170 mm x 1,295 mm x 762 mm

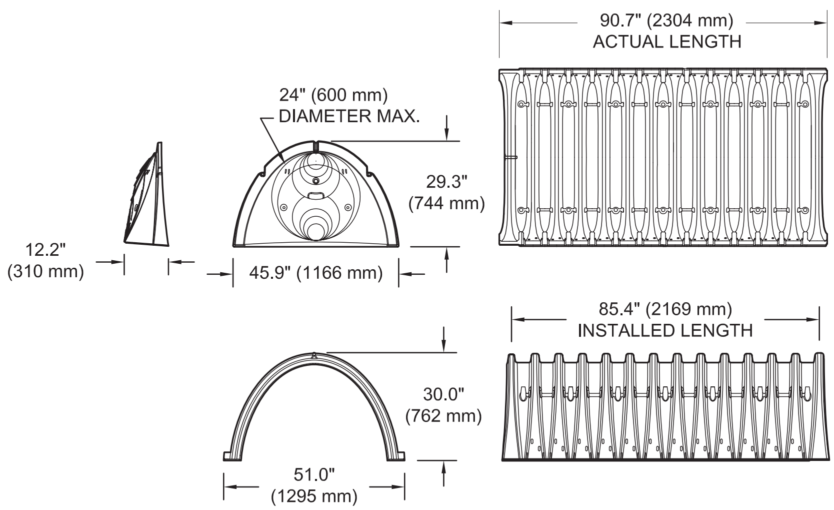
Chamber Storage
45.9 ft^3 (1.30 m^3)

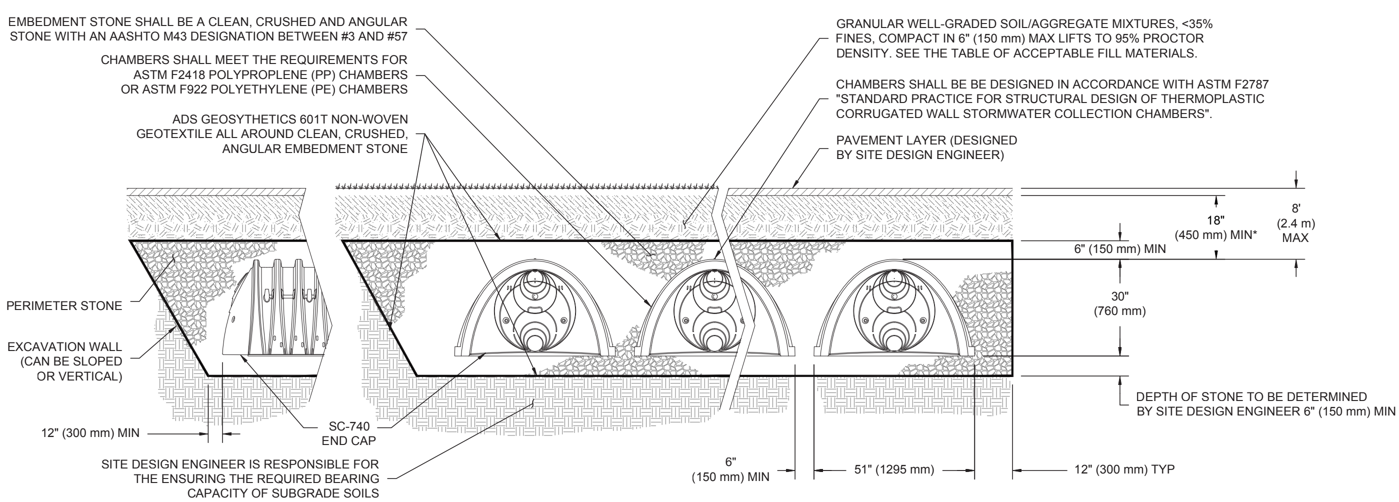
Min. Installed Storage*
74.9 ft^3 (2.12 m^3)

Weight
74.0 lbs (33.6 kg)

Shipping
30 chambers/pallet
60 end caps/pallet
12 pallets/truck

*Assumes 6” (150 mm) stone above, below and between chambers and 40% stone porosity.





*MINIMUM COVER TO BOTTOM OF FLEXIBLE PAVEMENT. FOR UNPAVED INSTALLATIONS WHERE RUTTING FROM VEHICLES MAY OCCUR, INCREASE COVER TO 24" (600 mm).

SC-740 CUMULATIVE STORAGE VOLUMES PER CHAMBER

Assumes 40% Stone Porosity. Calculations are Based Upon a 6" (150 mm) Stone Base Under Chambers.

Depth of Water in System Inches (mm)	Cumulative Chamber Storage ft³ (m³)	Total System Cumulative Storage ft³ (m³)
42 (1067)	45.90 (1.300)	74.90 (2.121)
41 (1041)	45.90 (1.300)	73.77 (2.089)
40 (1016)	Stone 45.90 (1.300)	72.64 (2.057)
39 (991)	Cover 45.90 (1.300)	71.52 (2.025)
38 (965)	45.90 (1.300)	70.39 (1.993)
37 (940)	45.90 (1.300)	69.26 (1.961)
36 (914)	45.90 (1.300)	68.14 (1.929)
35 (889)	45.85 (1.298)	66.98 (1.897)
34 (864)	45.69 (1.294)	65.75 (1.862)
33 (838)	45.41 (1.286)	64.46 (1.825)
32 (813)	44.81 (1.269)	62.97 (1.783)
31 (787)	44.01 (1.246)	61.36 (1.737)
30 (762)	43.06 (1.219)	59.66 (1.689)
29 (737)	41.98 (1.189)	57.89 (1.639)
28 (711)	40.80 (1.155)	56.05 (1.587)
27 (686)	39.54 (1.120)	54.17 (1.534)
26 (660)	38.18 (1.081)	52.23 (1.479)
25 (635)	36.74 (1.040)	50.23 (1.422)
24 (610)	35.22 (0.977)	48.19 (1.365)
23 (584)	33.64 (0.953)	46.11 (1.306)
22 (559)	31.99 (0.906)	44.00 (1.246)
21 (533)	30.29 (0.858)	1.85 (1.185)
20 (508)	28.54 (0.808)	39.67 (1.123)
19 (483)	26.74 (0.757)	37.47 (1.061)
18 (457)	24.89 (0.705)	35.23 (0.997)
17 (432)	23.00 (0.651)	32.96 (0.939)
16 (406)	21.06 (0.596)	30.68 (0.869)
15 (381)	19.09 (0.541)	28.36 (0.803)
14 (356)	17.08 (0.484)	26.03 (0.737)
13 (330)	15.04 (0.426)	23.68 (0.670)
12 (305)	12.97 (0.367)	21.31 (0.608)
11 (279)	10.87 (0.309)	18.92 (0.535)
10 (254)	8.74 (0.247)	16.51 (0.468)
9 (229)	6.58 (0.186)	14.09 (0.399)
8 (203)	4.41 (0.125)	11.66 (0.330)
7 (178)	2.21 (0.063)	9.21 (0.264)
6 (152)	0 (0)	6.76 (0.191)
5 (127)	0 (0)	5.63 (0.160)
4 (102)	Stone 0 (0)	4.51 (0.128)
3 (76)	Foundation 0 (0)	3.38 (0.096)
2 (51)	0 (0)	2.25 (0.064)
1 (25)	0 (0)	1.13 (0.032)

Note: Add 1.13 ft³ (0.032 m³) of storage for each additional inch (25 mm) of stone foundation.

STORAGE VOLUME PER CHAMBER FT³ (M³)

	Bare Chamber Storage ft³ (m³)	Chamber and Stone Foundation Depth in. (mm)		
		6 (150)	12 (300)	18 (450)
SC-740 Chamber	45.9 (1.3)	74.9 (2.1)	81.7 (2.3)	88.4 (2.5)

Note: Assumes 6" (150 mm) stone above chambers, 6" (150 mm) row spacing and 40% stone porosity.

AMOUNT OF STONE PER CHAMBER

ENGLISH TONS (yds³)	Stone Foundation Depth		
	6"	12"	16"
SC-740	3.8 (2.8)	4.6 (3.3)	5.5 (3.9)
METRIC KILOGRAMS (m³)	150 mm	300 mm	450 mm
SC-740	3,450 (2.1)	4,170 (2.5)	4,490 (3.0)

Note: Assumes 6" (150 mm) of stone above and between chambers.

VOLUME EXCAVATION PER CHAMBER YD³ (M³)

	Stone Foundation Depth		
	6 (150)	12 (300)	18 (450)
SC-740	5.5 (4.2)	6.2 (4.7)	6.8 (5.2)

Note: Assumes 6" (150 mm) of row separation and 18" (450 mm) of cover. The volume of excavation will vary as depth of cover increases.

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For more information on the StormTech SC-740 Chamber and other ADS products, please contact our Customer Service Representatives at 1-800-821-6710

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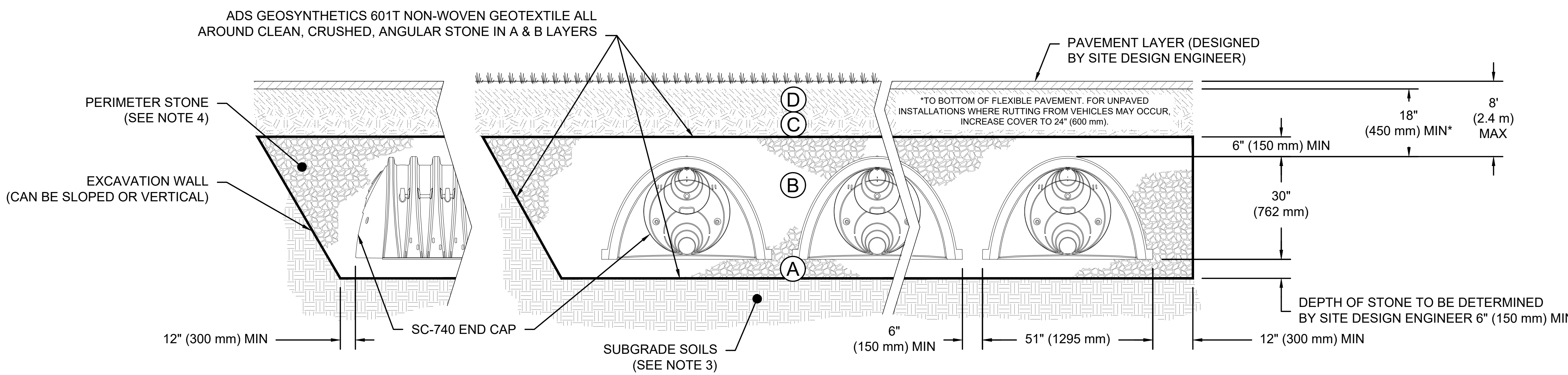
ACCEPTABLE FILL MATERIALS: STORMTECH SC-740 CHAMBER SYSTEMS

MATERIAL LOCATION		DESCRIPTION	AASHTO MATERIAL CLASSIFICATIONS	COMPACTION / DENSITY REQUIREMENT
D	**FINAL FILL:** FILL MATERIAL FOR LAYER 'D' STARTS FROM THE TOP OF THE 'C' LAYER TO THE BOTTOM OF FLEXIBLE PAVEMENT OR UNPAVED FINISHED GRADE ABOVE. NOTE THAT PAVEMENT SUBBASE MAY BE PART OF THE 'D' LAYER.	ANY SOIL/ROCK MATERIALS, NATIVE SOILS, OR PER ENGINEER'S PLANS. CHECK PLANS FOR PAVEMENT SUBGRADE REQUIREMENTS.	N/A	PREPARE PER SITE DESIGN ENGINEER'S PLANS. PAVED INSTALLATIONS MAY HAVE STRINGENT MATERIAL AND PREPARATION REQUIREMENTS.
C	**INITIAL FILL:** FILL MATERIAL FOR LAYER 'C' STARTS FROM THE TOP OF THE EMBEDMENT STONE ('B' LAYER) TO 18" (450 mm) ABOVE THE TOP OF THE CHAMBER. NOTE THAT PAVEMENT SUBBASE MAY BE A PART OF THE 'C' LAYER.	GRANULAR WELL-GRADED SOIL/AGGREGATE MIXTURES, <35% FINES OR PROCESSED AGGREGATE. MOST PAVEMENT SUBBASE MATERIALS CAN BE USED IN LIEU OF THIS LAYER.	AASHTO M145[1] A-1, A-2-4, A-3 OR AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	BEGIN COMPACTIONS AFTER 12" (300 mm) OF MATERIAL OVER THE CHAMBERS IS REACHED. COMPACT ADDITIONAL LAYERS IN 6" (150 mm) MAX LIFTS TO A MIN. 95% PROCTOR DENSITY FOR WELL GRADED MATERIAL AND 95% RELATIVE DENSITY FOR PROCESSED AGGREGATE MATERIALS. ROLLER GROSS VEHICLE WEIGHT NOT TO EXCEED 12,000 lbs (53 kN). DYNAMIC FORCE NOT TO EXCEED 20,000 lbs (89 kN).
B	**EMBEDMENT STONE:** FILL SURROUNDING THE CHAMBERS FROM THE FOUNDATION STONE ('A' LAYER) TO THE 'C' LAYER ABOVE.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	NO COMPACTION REQUIRED.
A	**FOUNDATION STONE:** FILL BELOW CHAMBERS FROM THE SUBGRADE UP TO THE FOOT (BOTTOM) OF THE CHAMBER.	CLEAN, CRUSHED, ANGULAR STONE	AASHTO M43[1] 3, 357, 4, 467, 5, 56, 57	PLATE COMPACT OR ROLL TO ACHIEVE A FLAT SURFACE.[2,3]

PLEASE NOTE:
1. THE LISTED AASHTO DESIGNATIONS ARE FOR GRADATIONS ONLY. THE STONE MUST ALSO BE CLEAN, CRUSHED, ANGULAR. FOR EXAMPLE, A SPECIFICATION FOR #4 STONE WOULD STATE: "CLEAN, CRUSHED, ANGULAR NO. 4 (AASHTO M43) STONE".
2. STORMTECH COMPACTION REQUIREMENTS ARE MET FOR 'A' LOCATION MATERIALS WHEN PLACED AND COMPACTED IN 6" (150 mm) (MAX) LIFTS USING TWO FULL COVERAGES WITH A VIBRATORY COMPACTOR.
3. WHERE INFILTRATION SURFACES MAY BE COMPROMISED BY COMPACTION, FOR STANDARD DESIGN LOAD CONDITIONS, A FLAT SURFACE MAY BE ACHIEVED BY RAKING OR DRAGGING WITHOUT COMPACTION EQUIPMENT. FOR SPECIAL LOAD DESIGNS, CONTACT STORMTECH FOR COMPACTION REQUIREMENTS.
4. ONCE LAYER 'C' IS PLACED, ANY SOIL/MATERIAL CAN BE PLACED IN LAYER 'D' UP TO THE FINISHED GRADE. MOST PAVEMENT SUBBASE SOILS CAN BE USED TO REPLACE THE MATERIAL REQUIREMENTS OF LAYER 'C' OR 'D' AT THE SITE DESIGN ENGINEER'S DISCRETION.



NOTES:

1. CHAMBERS SHALL MEET THE REQUIREMENTS OF ASTM F2418-16a, "STANDARD SPECIFICATION FOR POLYPROPYLENE (PP) CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
2. SC-740 CHAMBERS SHALL BE DESIGNED IN ACCORDANCE WITH ASTM F2787 "STANDARD PRACTICE FOR STRUCTURAL DESIGN OF THERMOPLASTIC CORRUGATED WALL STORMWATER COLLECTION CHAMBERS".
3. THE SITE DESIGN ENGINEER IS RESPONSIBLE FOR ASSESSING THE BEARING RESISTANCE (ALLOWABLE BEARING CAPACITY) OF THE SUBGRADE SOILS AND THE DEPTH OF FOUNDATION STONE WITH CONSIDERATION FOR THE RANGE OF EXPECTED SOIL MOISTURE CONDITIONS.
4. PERIMETER STONE MUST BE EXTENDED HORIZONTALLY TO THE EXCAVATION WALL FOR BOTH VERTICAL AND SLOPED EXCAVATION WALLS.
5. REQUIREMENTS FOR HANDLING AND INSTALLATION:
   - TO MAINTAIN THE WIDTH OF CHAMBERS DURING SHIPPING AND HANDLING, CHAMBERS SHALL HAVE INTEGRAL, INTERLOCKING STACKING LUGS.
   - TO ENSURE A SECURE JOINT DURING INSTALLATION AND BACKFILL, THE HEIGHT OF THE CHAMBER JOINT SHALL NOT BE LESS THAN 2".
   - TO ENSURE THE INTEGRITY OF THE ARCH SHAPE DURING INSTALLATION, a) THE ARCH STIFFNESS CONSTANT AS DEFINED IN SECTION 6.2.8 OF ASTM F2418 SHALL BE GREATER THAN OR EQUAL TO 550 LBS/IN/IN. AND b) TO RESIST CHAMBER DEFORMATION DURING INSTALLATION AT ELEVATED TEMPERATURES (ABOVE 73° F / 23° C), CHAMBERS SHALL BE PRODUCED FROM REFLECTIVE GOLD OR YELLOW COLORS.

SC-740
STANDARD CROSS SECTION
DATE: 05-10-19
DRAWN: KR
PROJECT #:
CHECKED: KR

DATE	DRWN	CHKD	DESCRIPTION

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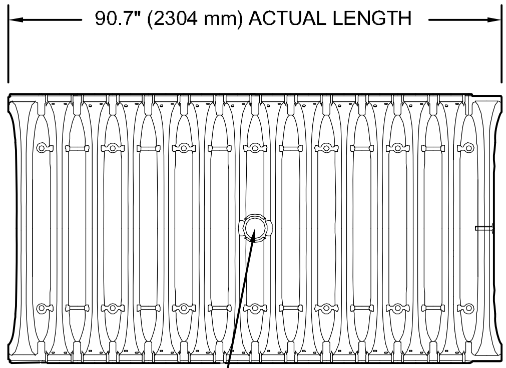
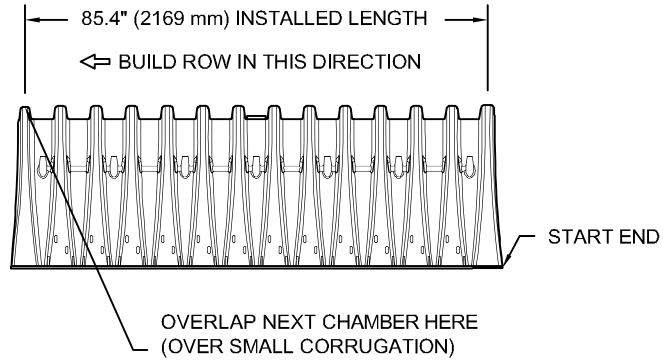
ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026

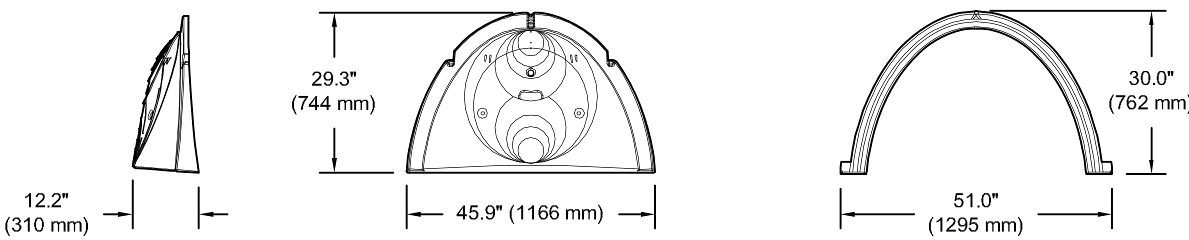
SC-740 TECHNICAL SPECIFICATION

NTS





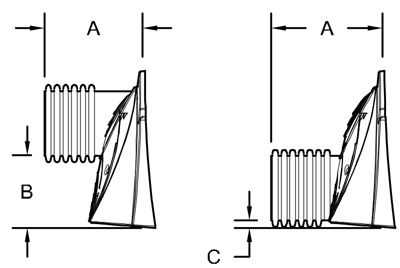
ACCEPTS 4" (100 mm) SCH 40 PVC PIPE FOR INSPECTION PORT. FOR PIPE SIZES LARGER THAN 4" (100 mm) UP TO 10" (250 mm) USE INSERTA TEE CONNECTION CENTERED ON A CHAMBER CREST CORRUGATION



NOMINAL CHAMBER SPECIFICATIONS

SIZE (W X H X INSTALLED LENGTH)	51.0" X 30.0" X 85.4"	(1295 mm X 762 mm X 2169 mm)
CHAMBER STORAGE	45.9 CUBIC FEET	(1.30 m³)
MINIMUM INSTALLED STORAGE*	74.9 CUBIC FEET	(2.12 m³)
WEIGHT	75.0 lbs.	(33.6 kg)

*ASSUMES 6" (152 mm) STONE ABOVE, BELOW, AND BETWEEN CHAMBERS



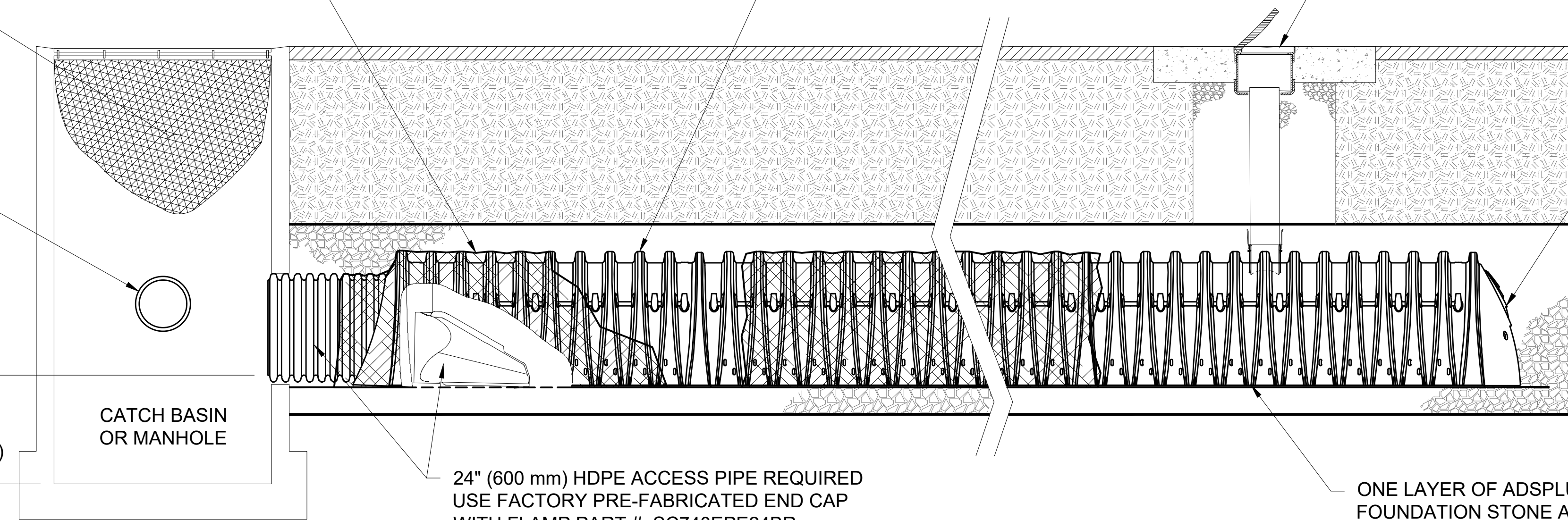
STUBS AT BOTTOM OF END CAP FOR PART NUMBERS ENDING WITH "B"
STUBS AT TOP OF END CAP FOR PART NUMBERS ENDING WITH "T"

PART #	STUB	A	B	C
SC740EPE06T / SC740EPE06TPC	6" (150 mm)	10.9" (277 mm)	18.5" (470 mm)	---
SC740EPE06B / SC740EPE06BPC			---	0.5" (13 mm)
SC740EPE08T /SC740EPE08TPC	8" (200 mm)	12.2" (310 mm)	16.5" (419 mm)	---
SC740EPE08B / SC740EPE08BPC			---	0.6" (15 mm)
SC740EPE10T / SC740EPE10TPC	10" (250 mm)	13.4" (340 mm)	14.5" (368 mm)	---
SC740EPE10B / SC740EPE10BPC			---	0.7" (18 mm)
SC740EPE12T / SC740EPE12TPC	12" (300 mm)	14.7" (373 mm)	12.5" (318 mm)	---
SC740EPE12B / SC740EPE12BPC			---	1.2" (30 mm)
SC740EPE15T / SC740EPE15TPC	15" (375 mm)	18.4" (467 mm)	9.0" (229 mm)	---
SC740EPE15B / SC740EPE15BPC			---	1.3" (33 mm)
SC740EPE18T / SC740EPE18TPC	18" (450 mm)	19.7" (500 mm)	5.0" (127 mm)	---
SC740EPE18B / SC740EPE18BPC			---	1.6" (41 mm)
SC740EPE24B*	24" (600 mm)	18.5" (470 mm)	---	0.1" (3 mm)

ALL STUBS, EXCEPT FOR THE SC740EPE24B ARE PLACED AT BOTTOM OF END CAP SUCH THAT THE OUTSIDE DIAMETER OF THE STUB IS FLUSH WITH THE BOTTOM OF THE END CAP. FOR ADDITIONAL INFORMATION CONTACT STORMTECH AT 1-888-892-2694.

* FOR THE SC740EPE24B THE 24" (600 mm) STUB LIES BELOW THE BOTTOM OF THE END CAP APPROXIMATELY 1.75" (44 mm). BACKFILL MATERIAL SHOULD BE REMOVED FROM BELOW THE N-12 STUB SO THAT THE FITTING SITS LEVEL.

NOTE: ALL DIMENSIONS ARE NOMINAL



SC-740 ISOLATOR ROW PLUS DETAIL

NTS

INSPECTION & MAINTENANCE

STEP 1) INSPECT ISOLATOR ROW PLUS FOR SEDIMENT

- A. INSPECTION PORTS (IF PRESENT)
  - A.1. REMOVE/OPEN LID ON NYLOPLAST INLINE DRAIN
  - A.2. REMOVE AND CLEAN FLEXSTORM FILTER IF INSTALLED
  - A.3. USING A FLASHLIGHT AND STADIA ROD, MEASURE DEPTH OF SEDIMENT AND RECORD ON MAINTENANCE LOG
  - A.4. LOWER A CAMERA INTO ISOLATOR ROW PLUS FOR VISUAL INSPECTION OF SEDIMENT LEVELS (OPTIONAL)
  - A.5. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.
- B. ALL ISOLATOR PLUS ROWS
  - B.1. REMOVE COVER FROM STRUCTURE AT UPSTREAM END OF ISOLATOR ROW PLUS
  - B.2. USING A FLASHLIGHT, INSPECT DOWN THE ISOLATOR ROW PLUS THROUGH OUTLET PIPE
    - i) MIRRORS ON POLES OR CAMERAS MAY BE USED TO AVOID A CONFINED SPACE ENTRY
    - ii) FOLLOW OSHA REGULATIONS FOR CONFINED SPACE ENTRY IF ENTERING MANHOLE
  - B.3. IF SEDIMENT IS AT, OR ABOVE, 3" (80 mm) PROCEED TO STEP 2. IF NOT, PROCEED TO STEP 3.

STEP 2) CLEAN OUT ISOLATOR ROW PLUS USING THE JETVAC PROCESS

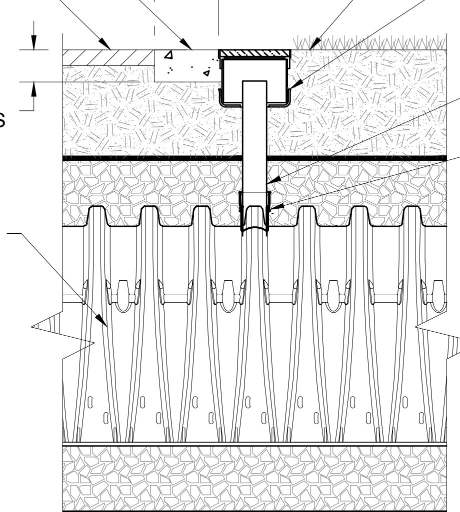
- A. A FIXED CULVERT CLEANING NOZZLE WITH REAR FACING SPREAD OF 45" (1.1 m) OR MORE IS PREFERRED
- B. APPLY MULTIPLE PASSES OF JETVAC UNTIL BACKFLUSH WATER IS CLEAN
- C. VACUUM STRUCTURE SUMP AS REQUIRED

STEP 3) REPLACE ALL COVERS, GRATES, FILTERS, AND LIDS; RECORD OBSERVATIONS AND ACTIONS.

STEP 4) INSPECT AND CLEAN BASINS AND MANHOLES UPSTREAM OF THE STORMTECH SYSTEM.

NOTES

1. INSPECT EVERY 6 MONTHS DURING THE FIRST YEAR OF OPERATION. ADJUST THE INSPECTION INTERVAL BASED ON PREVIOUS OBSERVATIONS OF SEDIMENT ACCUMULATION AND HIGH WATER ELEVATIONS.
2. CONDUCT JETTING AND VACTORING ANNUALLY OR WHEN INSPECTION SHOWS THAT MAINTENANCE IS NECESSARY.



NOTE:
INSPECTION PORTS MAY BE CONNECTED THROUGH ANY CHAMBER CORRUGATION CREST.

4" PVC INSPECTION PORT DETAIL (SC SERIES CHAMBER)

NTS

SC-740
ISOLATOR ROW PLUS DETAILS

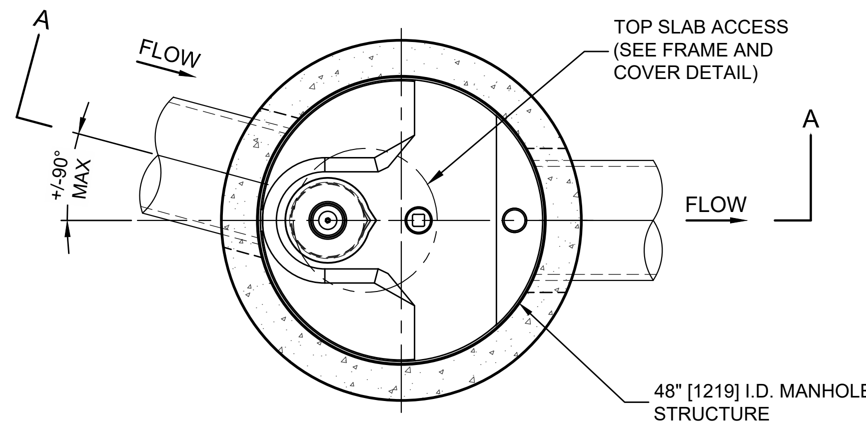
DATE: 08/26/20 | DRAWN: ALI
PROJECT #: ---- | CHECKED: ALI

DATE	DRWN	CHKD	DESCRIPTION

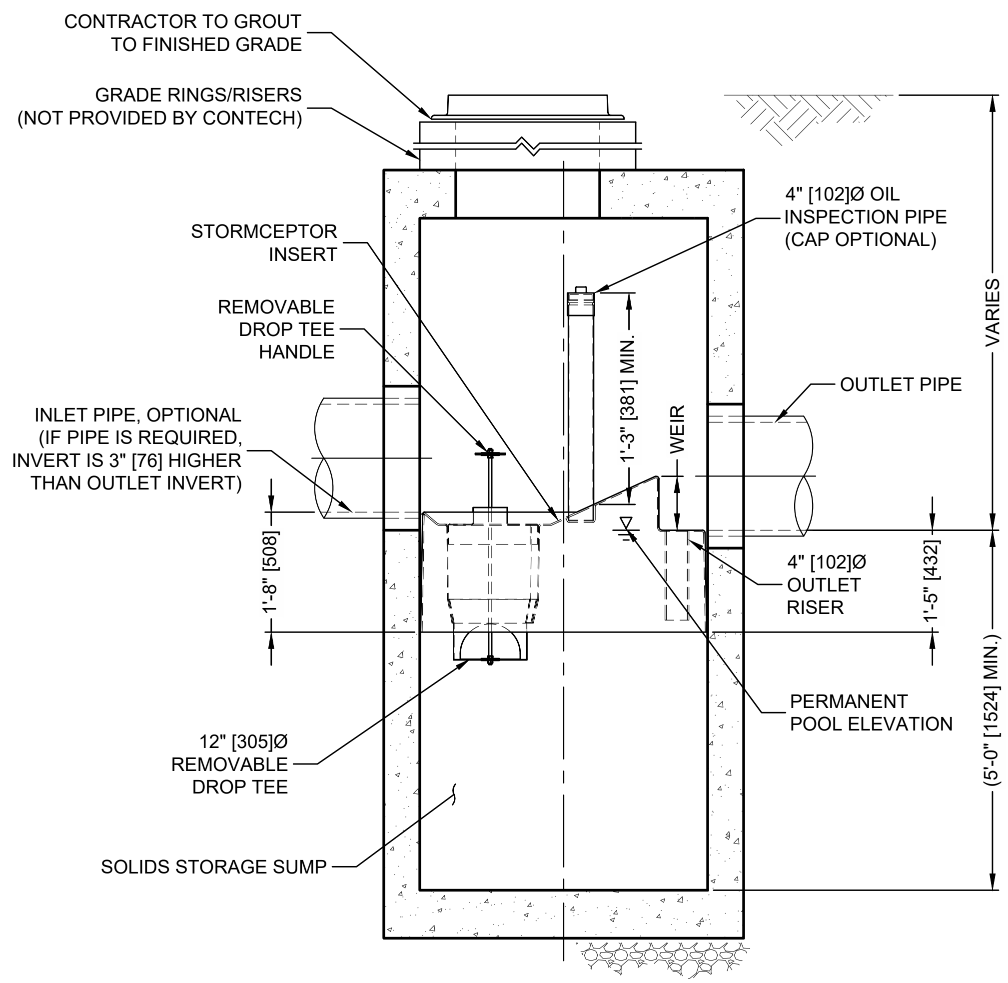
StormTech® Detention • Retention • Water Quality
520 CROMWELL AVENUE | ROCKY HILL | CT | 06067
860-529-8188 | 888-892-2694 | WWW.STORMTECH.COM

ADS® ADVANCED DRAINAGE SYSTEMS, INC.
4640 TRUEMAN BLVD
HILLIARD, OH 43026

SHEET 1 OF 1



PLAN VIEW
TOP SLAB NOT SHOWN



SECTION A-A

Stormceptor®

FOR PATENT INFORMATION, GO TO www.ContechES.com/IP

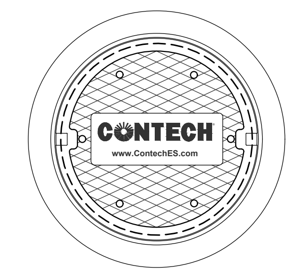
STORMCEPTOR DESIGN NOTES

THE STANDARD STC450I CONFIGURATION WITH ROUND, SOLID FRAME AND COVER, AND INLET PIPE IS SHOWN. ALTERNATE CONFIGURATIONS ARE AVAILABLE AND ARE LISTED BELOW. SOME CONFIGURATIONS MAY BE COMBINED TO SUIT SITE REQUIREMENTS.

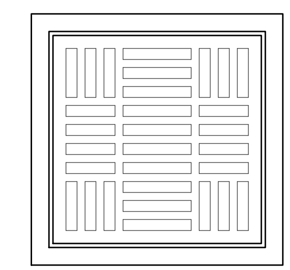
CONFIGURATION DESCRIPTION
GRATED INLET ONLY (NO INLET PIPE)
GRATED INLET WITH INLET PIPE OR PIPES
CURB INLET ONLY (NO INLET PIPE)
CURB INLET WITH INLET PIPE OR PIPES

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID			
WATER QUALITY FLOW RATE (cfs [L/s])			
PEAK FLOW RATE (cfs [L/s])			
RETURN PERIOD OF PEAK FLOW (yrs)			
RIM ELEVATION			
PIPE DATA:	INVERT	MATERIAL	DIAMETER
INLET PIPE 1			
INLET PIPE 2			
OUTLET PIPE			
NOTES / SPECIAL REQUIREMENTS:			



FRAME AND COVER
(MAY VARY)
NOT TO SCALE



FRAME AND GRATE
(MAY VARY)
NOT TO SCALE

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. STORMCEPTOR 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. STORMCEPTOR STRUCTURE SHALL MEET AASHTO HS20 LOAD RATING, ASSUMING EARTH COVER OF 0' - 2' [610], 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. STORMCEPTOR STRUCTURE SHALL BE PRECAST CONCRETE CONFORMING TO ASTM C478 AND AASHTO LOAD FACTOR DESIGN METHOD.
6. ALTERNATE UNITS ARE SHOWN IN MILLIMETERS [mm].

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 STORMCEPTOR 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
www.contechES.com
9025 Centre Pointe Dr., Suite 400, West Chester, OH 45069
800-338-1122 513-645-7000 513-645-7993 FAX

STC450i
STORMCEPTOR
STANDARD DETAIL

CONTECH®
ENGINEERED SOLUTIONS

Stormceptor® STC
Operation and Maintenance Guide

Stormceptor® STC

Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
- Top of grade elevation
- Stormceptor inlet and outlet pipe diameters and invert elevations
- Standing water elevation
- Stormceptor head loss, K = 1.3 (for submerged condition, K = 4)

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE
Table of Content

1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 •2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

2. Stormceptor Design Overview

2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18” (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.

3. Key Operation Features

3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

v_{SC} = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$Ø_H$ = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

4. Stormceptor Product Line

4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

Table 1. Stormceptor Models

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft^3 (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

4.2. Inline Stormceptor

The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.

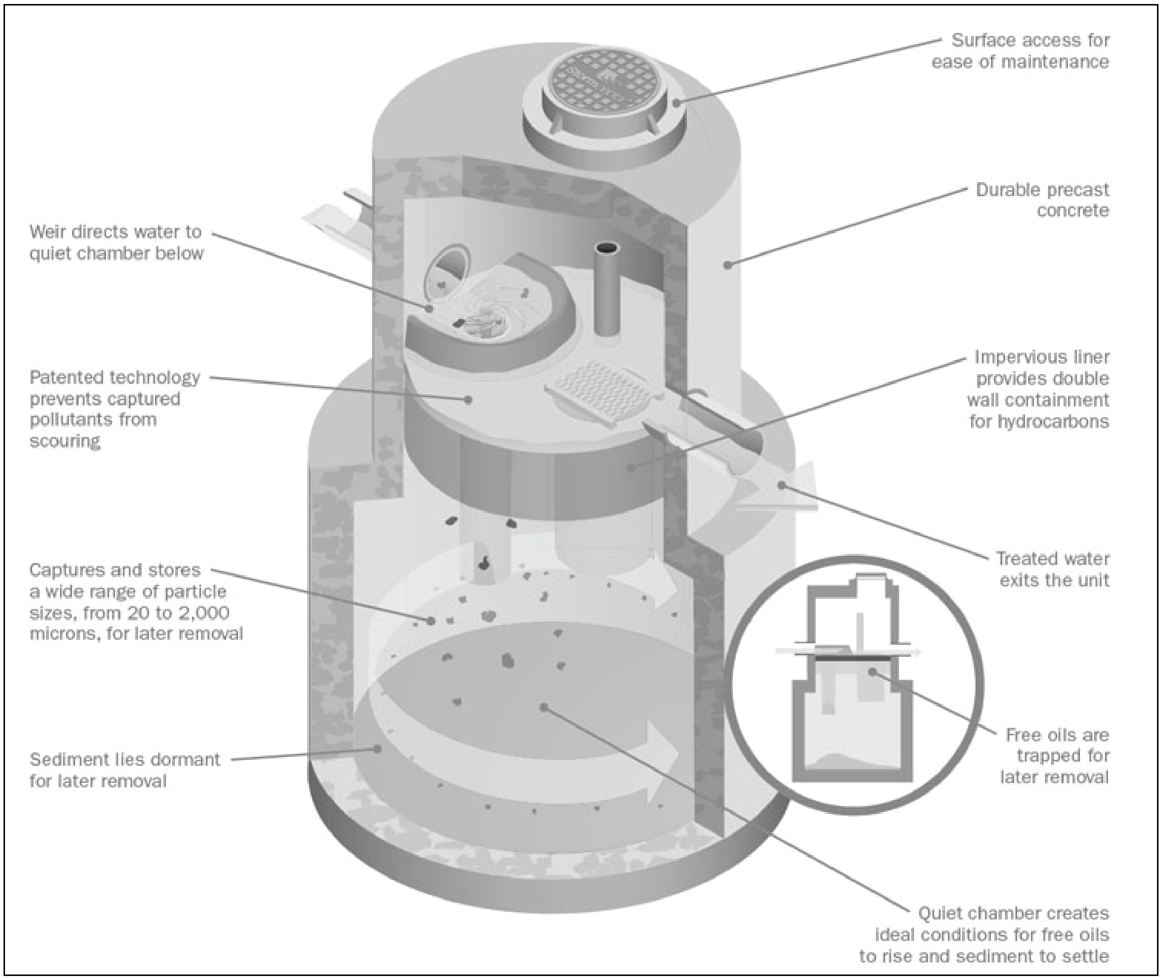


Figure 1. Inline Stormceptor

Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.

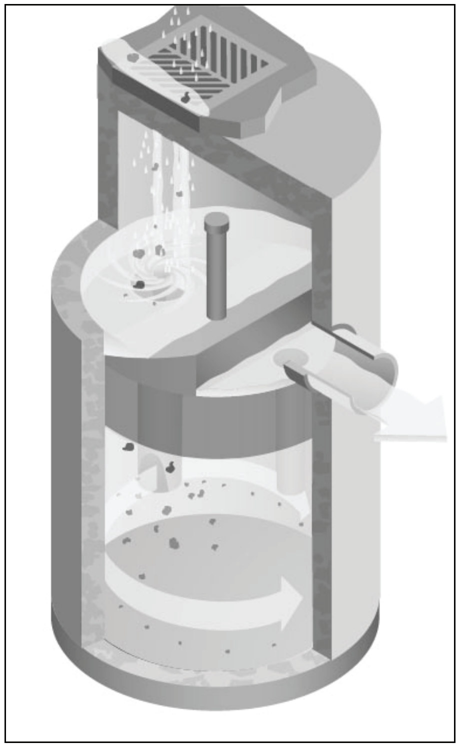


Figure 2. Inlet Stormceptor

4.3. Inlet Stormceptor

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

4.4. Series Stormceptor

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.

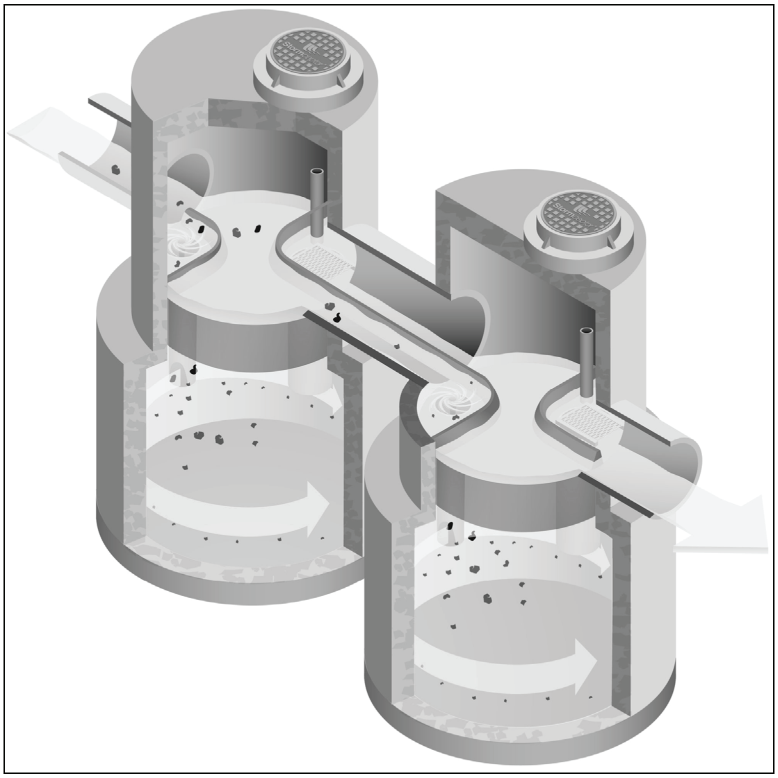


Figure 3. Series System

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

Table 2. Fine Distribution

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
   - The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
   - The distribution of TSS with the hydrology is properly and accurately considered in the sizing
   - Particle size distribution is properly considered in the sizing
   - The sizing can be optimized for TSS removal
   - The cost benefit of alternate TSS removal criteria can be easily assessed
   - The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit www.imbriumsystems.com to download a free copy of the program.

5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

‘Spill Capture’ describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit’s available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

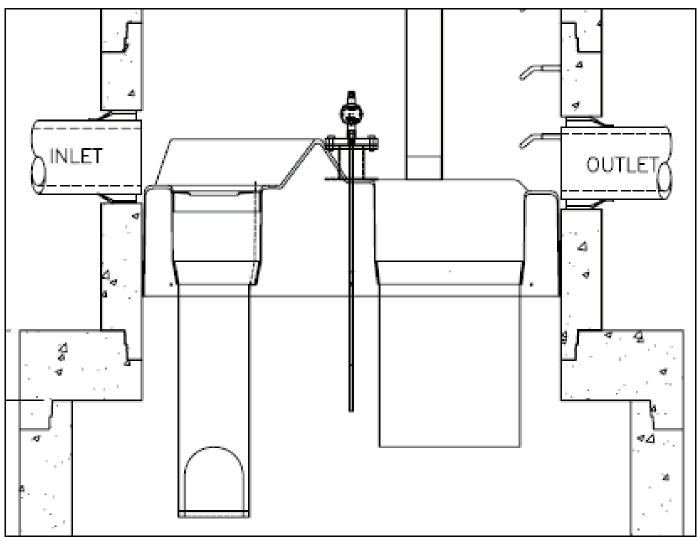


Figure 4. Oil level alarm

6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.

7. Stormceptor Options

The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

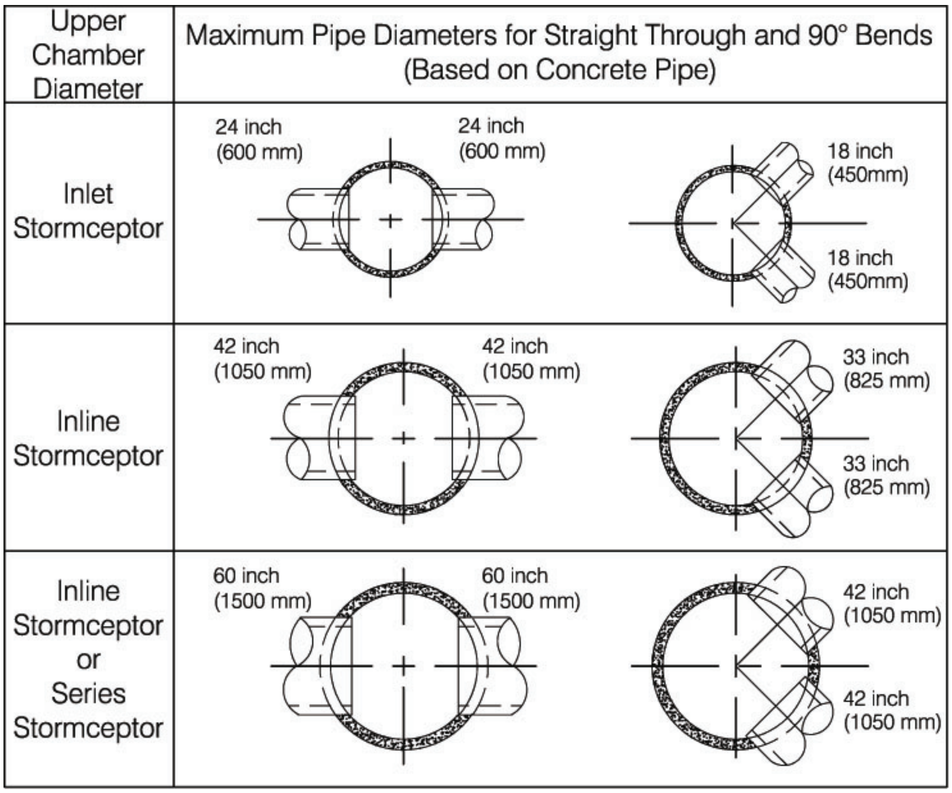


Figure 5. Maximum pipe diameters for straight through and bend applications

*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.

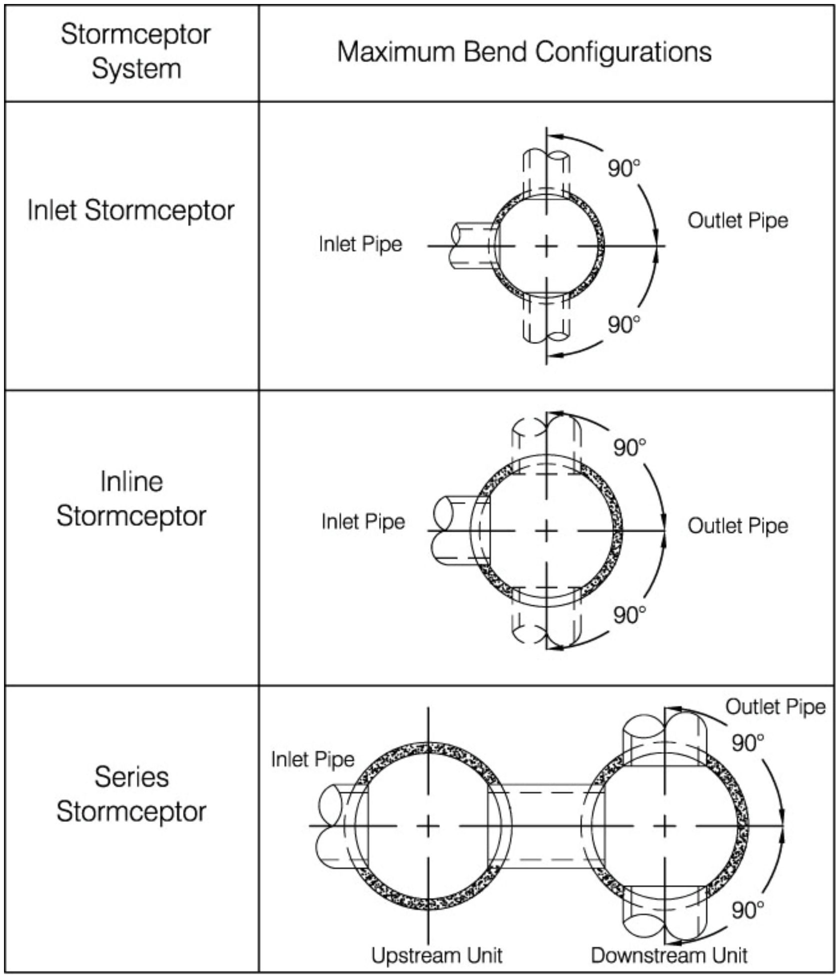


Figure 6. Maximum bend angles

7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life- cycle maintenance cost.

7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss = k*1.3v2/2g).

However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation

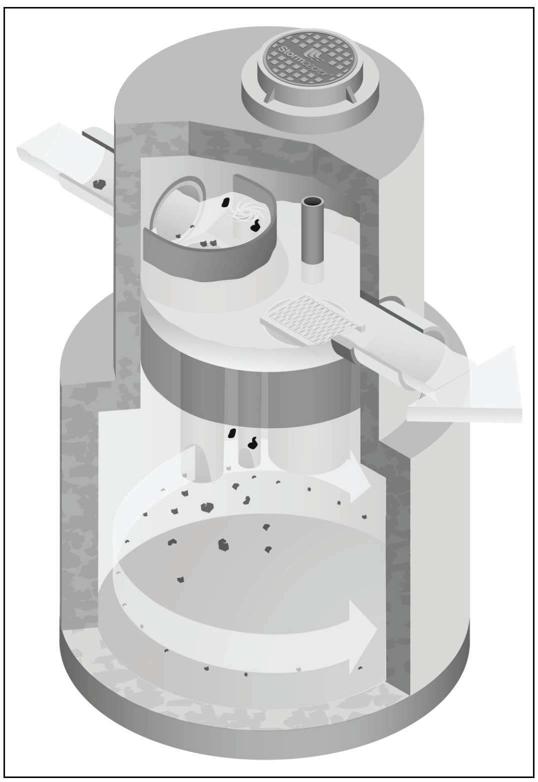


Figure 7. Submerged Stormceptor

8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between "approved alternatives". The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system's performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product's performance claims.

8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system's design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

12. Maintenance

12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well- established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

Table 4. Sediment Depths Indicating Required Servicing*

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit’s total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction

12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.

SUPPORT

Drawings and specifications are available at www.ContechES.com.
Site-specific design support is available from our engineers.

CONTECH ENGINEERED SOLUTIONS
800-925-5240
www.ContechES.com

APPENDIX F

LONG-TERM POLLUTION PREVENTION PLAN

LONG-TERM POLLUTION PREVENTION PLAN

Pollution Prevention and Source Control Plan

Colony Retirement Homes shall designate a pollution prevention team whose responsibilities are the following:

- Good housekeeping: General trash and litter cleanup of the site, inspect all vehicles on a regular basis for detention of leaking oil, gas and other fluids, provide routine visual inspections of potential pollution sources, maintain an inventory of potential pollution sources stored on site (i.e. paints, solvents, etc.). Initiate and maintain record keeping of activity regarding the contents of this plan.
- Storing materials and waste products inside or under cover: All materials and waste products shall be stored within a building or within a covered dumpster.
- Routine inspections and maintenance of stormwater BMPs: Follow the requirements of the site *Long-Term Drainage System Operation & Maintenance Plan*. Be aware of site drainage components and Best Management Practices (BMPs) and their locations including the catch basins, manholes, proprietary stormwater treatment (water quality) units, and the subsurface detention system.
- Spill prevention and response: In the event of a spill outside of the building, immediately initiate containment and cleanup procedures appropriate for the material including but not limited to sorbent media, towels, barriers, catch basin inlet seals, etc. as well as notifying the proper authorities. All attempts must be made to prevent spilled material from entering the drainage system or infiltrating into the ground.
- Maintenance of lawns and landscaped areas: Regularly mow lawn areas and weed landscaped areas.
- Storage and use of fertilizers, herbicides, and pesticides: All such materials shall be stored inside a building. It is recommended not to store such materials in large quantities.

Colony Retirement Homes shall be responsible for training designated staff in the procedures described herein. Note that this Plan does not indemnify the condominium association from the requirements of any local, state, or federal requirements of regulations regarding the storage or release of potentially hazardous materials.

Snow Management Plan

The goal of this plan is to employ proper management of snow and snow melt, in terms of snow removal and storage, use of de-icing compounds, and other practices that can prevent or minimize runoff pollutant loading impacts. The following measures shall be taken:

- *Use of de-icing compounds:*
  - Use alternative de-icing compounds such as calcium chloride ($CaCl_2$) and calcium magnesium acetate (CMA).
  - Reduce the use of de-icing compounds through better training and careful application.

- *Storage of de-icing compounds:*
  - Store compounds on sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.

- *Snow removal and storage:*
  - Place snow in designated areas so that the snowmelt can be collected by the site's drainage system. If snow storage cannot be accommodated on site, it shall be hauled offsite as necessary.

APPENDIX G

TSS REMOVAL CALCULATION WORKSHEET

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

Version 1, Automated: Mar. 4, 2008

Location: To Design Point (Grove Street)

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Treatment Practice	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = 85%

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

Project: **Colony Retirements Homes - Phase 1**
Prepared By: **ROM**
Date: **2/5/2024**

*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 H

PIPE SIZING CALCULATIONS (RATIONAL METHOD)

GRAVES ENGINEERING, Inc.
100 GROVE ST | WORCESTER MA 01605
T 508-856-0321 | F 508-856-0357
gravesengineering.com

SELECT STORM FREQENCY

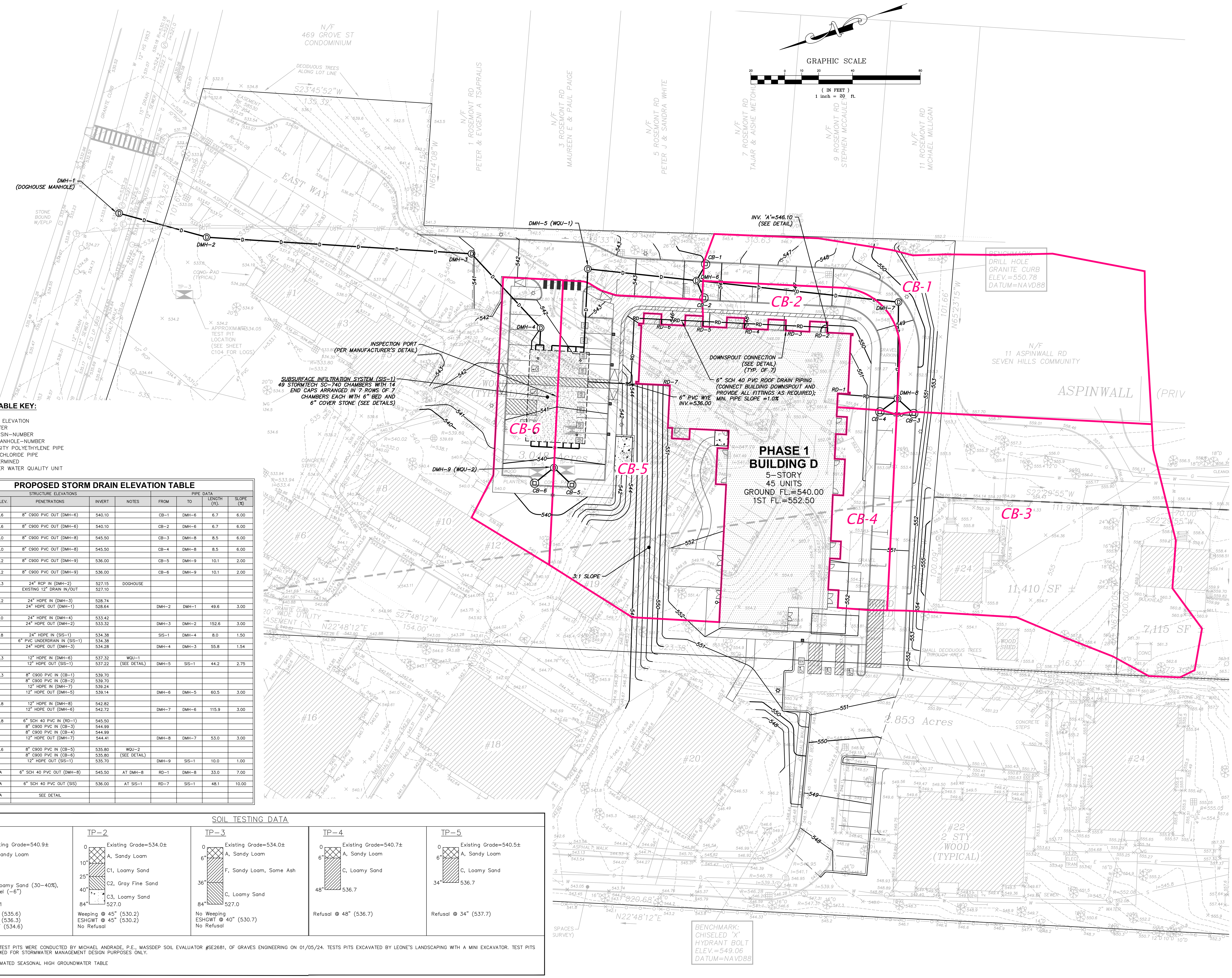
DESIRED DESIGN STORM (Yrs):			25
Yrs	2	10	25
B	30.3166	34.7773	39.1500
D	7.3000	7.0000	7.0000
E	0.7879	0.7099	0.6925

STORM DRAINAGE DESIGN RATIONAL CALCULATIONS
PROJECT: Colony Homes - Phase 1
DATE: January 30, 2024

Worcester Rainfall Intensity = B/((Tc+D)^E)	
Storm (Yrs)	25
B	39.1500
D	7.0000
E	0.6925

LOCATION		RUNOFF												PIPE DESIGN								
		IMPERVIOUS			OTHER				TIME OF CONCENTRATION										DESIGN CONDITIONS		FULL CONDITIONS	
FROM	TO	AREA A (acre)	C	CA	AREA A (acre)	C	CA	SUM OF CA's	TO INLET (min.)	IN PIPE (min.)	TOTAL (min.)	RAINFALL INTENSITY (in.)	DESIGN FLOW Qd (cfs)	LENGTH OF PIPE (ft.)	PIPE SIZE D (in.)	PIPE SLOPE (ft./ft.)	ROUGH-NESS COEFF. "n"	DEPTH d (in.)	VELOCITY Vd (fps)	FLOW Qd (cfs)	VELOCITY Vf (fps)	FLOW Qf (cfs)
CB-3	DMH-8	0.14	0.90	0.13	0.34	0.22	0.08	0.21	2.4	0.1	2.45	7.0	1.44	8.5	8.0	0.0600	0.010	3.44	10.33	1.48	11.05	3.86
CB-4	DMH-8	0.05	0.90	0.04	0.04	0.22	0.01	0.05	0.8	0.1	0.90	7.0	0.37	8.5	8.0	0.0600	0.010	1.68	7.00	0.37	11.05	3.86
RD-1	DMH-8	0.01	0.90	0.01	0.00	0.00	0.00	0.01	5.0		5.00	7.0	0.07	33.0	6.0	0.0700	0.010	0.78	4.66	0.07	9.86	1.94
DMH-8	DMH-7			0.00			0.00	0.27		0.1	0.10	7.0	1.89	53.0	12.0	0.0300	0.013	4.56	6.93	1.90	7.88	6.19
DMH-7	DMH-6			0.00			0.00	0.27		0.1	0.10	7.0	1.89	115.9	12.0	0.0300	0.013	4.56	6.93	1.90	7.88	6.19
CB-1	DMH-6	0.25	0.90	0.22	0.15	0.22	0.03	0.25	1.3	0.1	1.36	7.0	1.78	6.7	8.0	0.0600	0.010	3.84	10.86	1.80	11.05	3.86
CB-2	DMH-6	0.06	0.90	0.05	0.03	0.22	0.01	0.06	0.7	0.1	0.77	7.0	0.43	6.7	8.0	0.0600	0.010	1.84	7.38	0.45	11.05	3.86
DMH-6	DMH-5			0.00			0.00	0.58		0.1	0.10	7.0	4.06	60.5	12.0	0.0300	0.013	7.08	8.40	4.05	7.88	6.19
DMH-5	SIS-1			0.00			0.00	0.58		0.1	0.10	7.0	4.06	44.2	12.0	0.0275	0.013	7.32	8.13	4.08	7.54	5.92
RD (#2-#7)	SIS-1	0.07	0.90	0.06	0.00	0.00	0.00	0.06	5.0		5.00	7.0	0.44	178.0	6.0	0.0500	0.010	2.16	7.12	0.45	8.33	1.64
CB-5	DMH-9	0.14	0.90	0.13	0.21	0.22	0.05	0.17	1.0	0.1	1.06	7.0	1.22	10.1	8.0	0.0200	0.010	4.24	6.54	1.23	6.38	2.23
CB-6	DMH-9	0.10	0.90	0.09	0.03	0.22	0.01	0.10	0.6	0.1	0.72	7.0	0.68	10.1	8.0	0.0200	0.010	3.04	5.61	0.68	6.38	2.23
DMH-9	SIS-1			0.00			0.00	0.27		0.1	0.10	7.0	1.89	10.0	12.0	0.0100	0.013	6.24	4.62	1.91	4.55	3.57
SIS-1	DMH-4			0.00			0.00	0.91		0.1	0.10	7.0	14.82	8.0	24.0	0.0150	0.013	12.48	8.99	14.84	8.84	27.78

DMH-4	DMH-3			0.00			0.00	0.91		0.1	0.10	7.0	14.82	55.8	24.0	0.0154	0.013	12.48	9.11	15.03	8.96	28.15
DMH-3	DMH-2			0.00			0.00	0.91		0.1	0.10	7.0	14.82	152.6	24.0	0.0300	0.013	10.32	11.68	15.09	12.51	39.29
DMH-2	DMH-1			0.00			0.00	0.91		0.1	0.10	7.0	14.82	49.6	24.0	0.0300	0.013	10.32	11.68	15.09	12.51	39.29
				0.00			0.00	0.00			0.00	0.0	0.00					0.00	0.00	0.00	0.00	0.00
				0.00			0.00	0.00			0.00	0.0	0.00					0.00	0.00	0.00	0.00	0.00
				0.00			0.00	0.00			0.00	0.0	0.00					0.00	0.00	0.00	0.00	0.00
				0.00			0.00	0.00			0.00	0.0	0.00					0.00	0.00	0.00	0.00	0.00
				0.00			0.00	0.00			0.00	0.0	0.00					0.00	0.00	0.00	0.00	0.00
				0.00			0.00	0.00			0.00	0.0	0.00					0.00	0.00	0.00	0.00	0.00



DRAINAGE TABLE KEY:

INV: PIPE INVERT ELEVATION
ID: INSIDE DIAMETER
CB-#: CATCH BASIN-NUMBER
DMH-#: DRAIN MANHOLE-NUMBER
HDPE: HIGH DENSITY POLYETHYLENE PIPE
PVC: POLYVINYL CHLORIDE PIPE
TBD: TO BE DETERMINED
WQU: STORMWATER WATER QUALITY UNIT

PROPOSED STORM DRAIN ELEVATION TABLE

STRUCTURE ELEVATIONS					PIPE DATA			
STRUCTURE	RIM ELEV.	PENETRATIONS	INVERT	NOTES	FROM	TO	LENGTH (ft).	SLOPE (%)
CB-1	544.6	8" C900 PVC OUT (DMH-6)	540.10		CB-1	DMH-6	6.7	6.00
CB-2	544.6	8" C900 PVC OUT (DMH-6)	540.10		CB-2	DMH-6	6.7	6.00
CB-3	550.0	8" C900 PVC OUT (DMH-8)	545.50		CB-3	DMH-8	8.5	6.00
CB-4	550.0	8" C900 PVC OUT (DMH-8)	545.50		CB-4	DMH-8	8.5	6.00
CB-5	539.2	8" C900 PVC OUT (DMH-9)	536.00		CB-5	DMH-9	10.1	2.00
CB-6	539.2	8" C900 PVC OUT (DMH-9)	536.00		CB-6	DMH-9	10.1	2.00
DMH-1	533.3	24" RCP IN (DMH-2)	527.15	DOGHOUSE				
		EXISTING 12" DRAIN IN/OUT	527.10					
DMH-2	534.2	24" HDPE IN (DMH-3)	528.74					
		24" HDPE OUT (DMH-1)	528.64		DMH-2	DMH-1	49.6	3.00
DMH-3	541.0	24" HDPE IN (DMH-4)	533.42					
		24" HDPE OUT (DMH-2)	533.32		DMH-3	DMH-2	152.6	3.00
DMH-4	541.8	24" HDPE IN (SIS-1)	534.38		SIS-1	DMH-4	8.0	1.50
		6" PVC UNDERDRAIN IN (SIS-1)	534.38					
		24" HDPE OUT (DMH-3)	534.28		DMH-4	DMH-3	55.8	1.54
DMH-5	542.3	12" HDPE IN (DMH-6)	537.32	WQU-1				
		12" HDPE OUT (SIS-1)	537.22	(SEE DETAIL)	DMH-5	SIS-1	44.2	2.75
DMH-6	544.3	8" C900 PVC IN (CB-1)	539.70					
		8" C900 PVC IN (CB-2)	539.70					
		12" HDPE IN (DMH-7)	539.24					
		12" HDPE OUT (DMH-5)	539.14		DMH-6	DMH-5	60.5	3.00
DMH-7	548.8	12" HDPE IN (DMH-8)	542.82					
		12" HDPE OUT (DMH-6)	542.72		DMH-7	DMH-6	115.9	3.00
DMH-8	549.8	6" SCH 40 PVC IN (RD-1)	545.50					
		8" C900 PVC IN (CB-3)	544.99					
		8" C900 PVC IN (CB-4)	544.99					
		12" HDPE OUT (DMH-7)	544.41		DMH-8	DMH-7	53.0	3.00
DMH-9	539.6	8" C900 PVC IN (CB-5)	535.80	WQU-2				
		8" C900 PVC IN (CB-6)	535.80	(SEE DETAIL)				
		12" HDPE OUT (SIS-1)	535.70		DMH-9	SIS-1	10.0	1.00
RD-1	N/A	6" SCH 40 PVC OUT (DMH-8)	545.50	AT DMH-8	RD-1	DMH-8	33.0	7.00
RD-7	N/A	6" SCH 40 PVC OUT (SIS)	536.00	AT SIS-1	RD-7	SIS-1	48.1	10.00
SIS-1	N/A	SEE DETAIL						

SOIL TESTING DATA

TP-1

0 Existing Grade=540.9±
A, Sandy Loam
7"
C, Loamy Sand (30–40%), Gravel (-6")
82" 534.1

Weeping @ 64" (535.6)
ESHGWT @ 55" (536.3)
Standing @ 76" (534.6)
No Refusal

TP-2

0 Existing Grade=534.0±
A, Sandy Loam
10"
C1, Loamy Sand
25"
C2, Gray Fine Sand
40"
C3, Loamy Sand
84" 527.0

Weeping @ 45" (530.2)
ESHGWT @ 45" (530.2)
No Refusal

TP-3

0 Existing Grade=534.0±
A, Sandy Loam
6"
F, Sandy Loam, Some Ash
36"
C, Loamy Sand
84" 527.0

No Weeping
ESHGWT @ 40" (530.7)
No Refusal

TP-4

0 Existing Grade=540.7±
A, Sandy Loam
6"
C, Loamy Sand
48" 536.7

Refusal @ 48" (536.7)

TP-5

0 Existing Grade=540.5±
A, Sandy Loam
6"
C, Loamy Sand
34" 536.7

Refusal @ 34" (537.7)

NOTES:
1) SOIL TESTING TEST PITS WERE CONDUCTED BY MICHAEL ANDRADE, P.E., MASSDEP SOIL EVALUATOR #SE2681, OF GRAVES ENGINEERING ON 01/05/24. TESTS PITS EXCAVATED BY LEONE'S LANDSCAPING WITH A MINI EXCAVATOR. TEST PITS WERE PERFORMED FOR STORMWATER MANAGEMENT DESIGN PURPOSES ONLY.

2) ESHGWT= ESTIMATED SEASONAL HIGH GROUNDWATER TABLE

PRINTED: 10/30/2023 9:04:46 AM

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PCA PROJECT #: 23010.00
GEI PROJECT #: 23108

COLONY RETIREMENT HOMES - PHASE 1

485 GROVE STREET, WORCESTER, MA 01605

REVISIONS:

ORIGINAL ISSUE:
FOR REFERENCE
01/30/2024

SCALE: 1"=20'

CATCH BASIN AREAS

CB