January 24, 2024

Sturbridge Conservation Commission
301 Main Street
Sturbridge, MA 01566

Subject: **Revised Site Plans**
Notice of Intent: Multi-Family Residential Project
505 Main Street
Sturbridge, MA 01518

Dear Members of the Commission,

On behalf of the STL Group, Graves Engineering, Inc. (GEI) is submitting these revised site plans pursuant to ongoing discussions with Rebecca Gendreau to address concerns relative to the proposed bioretention area. In summary, the site plans have been revised as follows:

- The bioretention area has been revised from an "exfiltrating" design to a "filtering" design. While the volume of the biorientation area has not changed from the original design, it's construction will now include an impervious liner and underdrain such that it provides only stormwater attenuation and treatment and no infiltration. The design is consistent with that as outlined in the DEP Massachusetts Stormwater Handbook (the "Handbook"), Volume 2, Chapter 2, pages 23 through 35. With this change, there is no longer any proposed infiltration within the DEP-recommended 50-foot wetland setback.

- In order to maintain full compliance with the DEP Stormwater Standards and in particular Standard 3-Recharge to Groundwater, a new subsurface infiltration system has been designed. This system is located well out of the 50-foot wetland setback and will collect 100% of the proposed roof area and then overflow to the bioretention area. The location, piping, and construction details for this system are included on the revised site plans. GEI notes that although the system captures only the roof area and none of the other proposed site impervious surfaces, the required recharge volume is so small for this project (34 cubic feet) that a storm event of just 0.32 inches over 24 hours generates this volume of runoff. Thus, the system will see a realized recharge volume on an *average annual basis* as required by the Handbook. We have gone even further and designed the system with a volume of 90 cubic feet below the lowest to provide even more recharge volume, about 2.5 times that as required.

- Signage has been added to the back side of the bioretention area at the northerly edge of the "25-foot Buffer Restoration Area" to inform of the protected area and that it shall not be mowed. The project's Long-Term Drainage System Operation and Maintenance Plan has been updated to include this protection.

We realize that the delivery of these materials is on short notice ahead of the next Conservation Commission meeting however the Applicant is under real pressure from the seller and hopes to secure approval tomorrow night to move forward with the purchase and sale of the property. If you have any questions, please feel free to contact our office.

Respectfully Submitted,
Graves Engineering, Inc.

Michael Andrade, P.E.
Principal

cc: STL Group

Attachments:

Stormwater Report Narrative (revised 1/24/24)
Long-Term O&M Plan (revised 1/24/24)
HydroCAD Stormwater Calculations

NARRATIVE
REVISED 01/24/24

Project Description

Site Location: Multi-Family Residential Project
505 Main Street, Sturbridge, MA 01518

Development Type: Residential

Project Summary:

The proposed project consists of the construction of a free-standing two-story 2,632 square foot multi-family residential building and associated paved parking area. The subject property is currently developed with one two-story building and paved parking areas previously utilized for commercial purposes. The existing building and paved parking areas will be demolished to accommodate the new building and new paved parking area. A bioretention area will be constructed to treat and attenuate runoff from the new building's roof and the new parking area. The proposed drainage and stormwater management system for the project 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 505 Main Street in Sturbridge, MA.

Ground Cover: The ground cover in the drainage study area is a mix of impervious surfaces (roof and pavement), lawn, and brush.

Slopes: The project area generally slopes from north to south towards an existing wetland located south of the property.

Soil Types: Site soil types as mapped by the USDA-NRCS are primarily Pootatuck fine sandy loam and Canton fine sandy loam (map unit symbols 2A and 420B respectively). These soils are classified as hydrologic soil group (HSG) "B". Refer to Appendix D for more detailed USDA-NRCS soil information and to the site plans for onsite soil testing logs.

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**
3.13	4.64	5.81	8.18

Pre-Development

The total pre-development drainage area studied in this report consists of approximately 0.40 acres. The pre-development hydrology has been modeled as two subcatchment areas that ultimately drain to two separate discharge points (design points).

Design Point #1 - Wetland: This design point represents runoff from the site flowing towards the existing wetland located south of the property.

Design Point #2 - Main Street: This design point represents runoff from a northeasterly portion of the site flowing in a northerly direction towards the existing municipal drainage system in Main 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 points for each storm is as follows:

Pre-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Wetland	0.54	1.04	1.44	2.26
Design Point #2 – Main Street	0.04	0.08	0.10	0.15

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 points for each storm is as follows:

Post-Development Peak Rate of Runoff (cfs)				
	2 Year	**10 Year**	**25 Year**	**100 Year**
Design Point #1 – Wetland	0.53	0.94	1.29	2.21
Design Point #2 – Main Street	0.02	0.04	0.06	0.11

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 – Wetland	-0.01	-0.10	-0.15	-0.05
Design Point #2 – Main Street	-0.02	-0.04	-0.04	-0.04

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 is one drain outfall proposed for this project. The drain outfall is for the outlet of the bioretention area, comprised of two 8" diameter pipes.

$La = 1.8Q/(Do^{1.5}) + 7Do$

$W = 3Do + La$

$D_{50} = (0.02 \times Q^{1.3})/(TW \times Do)$

Bioretention Area

$La = (1.8 \times 2.03)/(0.833^{1.5}) + 7(0.833) = 10.6$ ft. (10.5 ft. proposed)

$W = 3(0.833) + 10.6 = 13.1$ ft. (13 ft. proposed)

$D_{50} = (0.02 \times 2.03^{1.3})/(0.417 \times 0.833) = 0.14$ ft. (6" diameter proposed)

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 group B soils. The recharge calculations are as follows:

Required Recharge Volume for Bioretention Area

Required Recharge Volume (R_v) = F x Impervious Area where, F = Target Depth Factor (in.)
F = 0.35" for 'B' Soils

Net increase in site impervious area (pre to post conditions) = 1,164 ft²

$R_v = (0.35"/12") \times 1{,}164$ ft² = 33.95 ft³

The proposed subsurface infiltration system has total volume of 90 ft³ below the outlet, thus Standard 3 is satisfied. See attached HydroCAD Stage-Area-Storage worksheet demonstrating the volume of the system.

Based upon an exfiltration rate of 2.41 in./hr. (Rawls rate for sandy loam as witnessed during soil testing; conservatively using 2.41 in./hr. rate in light of presence of sand and gravel witnessed during soil testing; logs provided on the plans), the drawdown time is calculated as follows:

$Time_{drawdown} = R_v / (K \times Bottom\ Area)$ where, R_v= recharge BMP storage volume
K= Saturated Hydraulic Conductivity (Rawls) Rate

Bioretention Area
$Time_{drawdown} =$ 90 ft³ / (2.41 in./hr./12" x 126 ft²) = 3.5 hours < 72 hours

Water Quality Calculations (Stormwater Management Standard 4)

The underlying soils for portions of the site are classified by NRCS as Hydrologic Soil Group "B" soils, and the presence of sand and gravel in the native "C" soil horizon was observed during soil testing. Based upon this information, the area is within soils with a rapid infiltration rate and requires pretreatment of 44% TSS removal prior to infiltration. Infiltration is proposed only from roof runoff and as roof runoff is considered "clean", there is no pretreatment required.

The proposed runoff flow path to the bioretention area entails runoff directed to a sediment forebay and then into the bioretention area. The proposed treatment train of a sediment forebay and the bioretention area is anticipated to have a TSS removal rate of 90%. By the time stormwater passes through the bioretention area soil media, it will have been treated to remove 90% of TSS. Refer to Appendix G for detailed TSS calculations that demonstrate the TSS removal rates for the site.

Bioretention Area (has a TSS removal rate of 0.90) (90%)
Starting TSS Load = 1.00 (100%)
TSS Removal = 1.00 x 0.90 = 0.10 (remaining load)

Total TSS Removal = 0.90 (90%)

The site is within a Zone II Wellhead Protection Area per the Massachusetts Department of Environmental Protection, which is classified as a Critical Area, thus the required Water Quality Volume shall be calculated using 1.0 inch of runoff times the impervious area. Additionally, the Town of Sturbridge requires the use of a minimum of 0.8 inch for calculations.

Water Quality Volume: $V= 1.0"/12 \times A_{IMP}$

Bioretention Area
$V= 1.0"/12 \times 1{,}164\ ft^2 =$ 97 ft^3 required volume per MassDEP
Provided volume = 215 ft^3 (below outlet in bioretention area)

(see HydroCAD stage-storage-volume sheet following this Narrative)

Forebay Sizing:

$V= 0.1"/12 \times A_{IMP}$

Forebay (Bioretention Area)
$V= 0.1"/12 \times 10{,}678\ ft^2 = 89\ ft^3$
Provided volume = 148 ft^3

(see HydroCAD stage-storage-volume sheet following this Narrative)

Additionally, a Long-Term Pollution Prevention Plan has 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 is within the Zone II Wellhead Protection Area per MassDEP, which is classified as a Critical Area. A Long-Term Pollution Prevention Plan has been developed for the site.

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.

Phosphorus Removal (Sturbridge Stormwater Management Regulations)

Per the Stormwater Management Regulations for the town of Sturbridge, stormwater management systems shall be designed to meet specific average annual pollutant removal rates. For a redevelopment project, the removal requirement is 50% for total phosphorus. Utilizing the method to calculate phosphorus reduction for the proposed treatment train per Attachment 3 to Appendix F of the 2016 Massachusetts MS4 General Permit, the proposed phosphorus load reduction is 51% (the supporting calculations, such as the BATT worksheet, are included in Appendix H).

BMP Load = (IA x PLER) + (PA x PLER)
= (0.245 acre x 1.96) + (0.129 acre x 0.12) = 0.496 lbs/yr

BMP Volume (IA-in) = (111 ft^3/0.245 acre) x (12 in/ft x 1 acre/43,560 ft^2) = 0.12 inch

BMP Volume (PA- ft^3) = (0.129 acre x 0.00 inch) x 3,630 ft^3/acre-inch = 0.0 ft^3

BMP Volume (IA- ft^3) = 111 ft^3 - 0 ft^3 = 111 ft^3 (No change)

BMP Volume (IA-in)2 = (111 ft^3/0.245 acre) x (12 in/ft x 1 acre/43,560 ft^2) = 0.12 inch (No Change)

% Difference = ((0.12 – 0.12)/0.12) x 100 = 0.0% (No Change)

Per Table 3-14 and Figure 3-11 (Infiltration rate = 2.41 inch/hour), phosphorus reduction = 51%

BMP Reduction = 0.496 x 0.51 = 0.25 lbs/yr

LONG-TERM DRAINAGE SYSTEM OPERATION & MAINTENANCE PLAN
REVISED 01/24/24

System

The drainage system associated with the site at 505 Main Street is an open drainage system consisting of a sediment forebay and a bioretention area (also known as a rain garden).

Responsible Parties

The drainage system located on the site property will be operated and maintained by the applicant, STL Group, LLC, 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.

Owner: Jenny Bounphasaysonh
Responsible Party for O&M, Financing, and Records: STL Group, LLC (P.O. Box 638, Sturbridge, MA 01566)

Point of Contact:
Nick St. Laurent
nbmrealty@gmail.com
Telephone: 617-300-0245

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.

Sediment Forebay:
The sediment forebay shall be inspected every month. If necessary, remove any accumulated sediment and replace or repair dislodged riprap.

Bioretention Area:
Bioretention area maintenance begins with education of the function and purpose of the structure; namely that of stormwater management and treatment. It is imperative that sand used in winter

conditions not be allowed to enter the bioretention area as it will clog the soil media. Reduced sanding should be employed in the area draining to the bioretention area and any accumulated sand should be removed immediately. Snow must not be stored in the bioretention area. Deicing chemicals should not be used in the area draining to the bioretention area.

Inspections should be performed monthly and/or after every rain event of more than 2 inches of rainfall in 24 hours; there should be no ponding water within the bioretention area after 72 hours following a rainstorm. Inspect the bioretention area for signs of erosion and repair immediately if found. Re-mulch void areas as needed (use only shredded hardwood mulch, 3" depth). The mulch needs to be replaced every two years, in the early spring. Monthly inspections must also include the following:

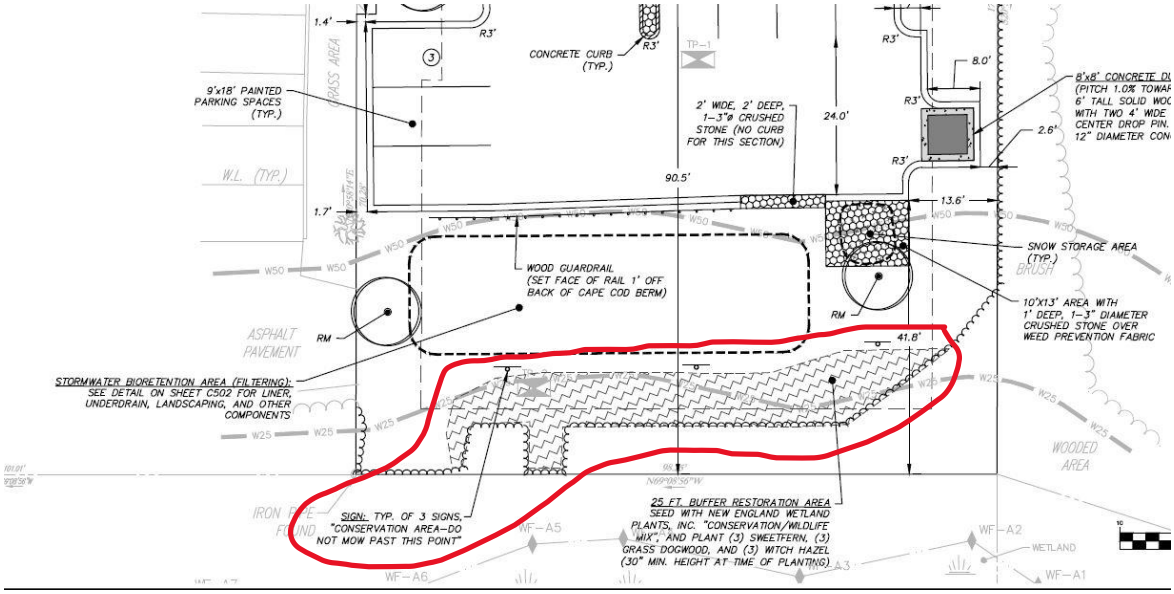
- Remove litter and debris.
- Treat diseased plantings as needed; prune and replace dead vegetation with like material.
- Remove invasive vegetation and weeds.
- Maintain all culverts, outlet structures, and piping free of debris and blockages.

Subsurface Infiltration System:
There is no routine maintenance for a subsurface system therefore an aggressive inspection and maintenance schedule of all upstream BMPs must be maintained to prolong its operational life. Utilizing the observation ports, 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 by observing the outflow from the outlet control structure.

The subsurface 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.

25-Foot Wetland Buffer Restoration Area

This project includes restoration of previously disturbed areas within 25 feet of the southerly wetlands. Refert to Sheet C103 of the site plans and the capture below for the location and signage associated with the Restoration Area:



The restoration area must be allowed to be in a natural state with no mowing, pesticide or herbicide treatments. Signage shall remain as shown in perpetuity.

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 in sheltered (protected from precipitation and wind) impervious pads or in original shipment containers if possible.

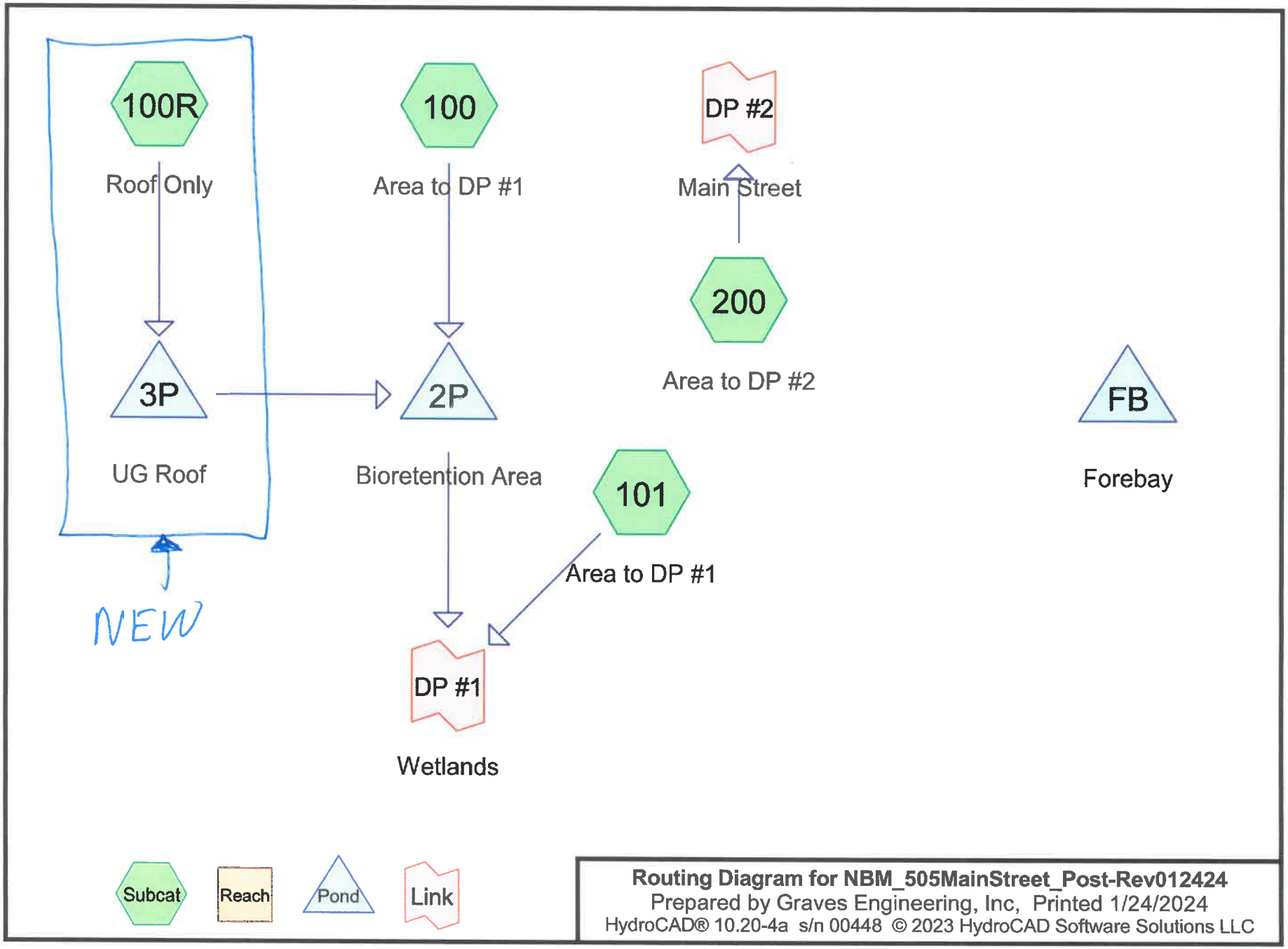
- *Snow removal and storage:*
  - Place snow in designated area where it can slowly infiltrate however it should not be placed over any component of the site's stormwater management system nor in the wetland buffer area.

Annual Budget

An annual budget for the operation and maintenance tasks describe above is estimated at $1,500.

Records

A copy of the O&M Plan will be kept by STL Group, LLC.


100R
Roof Only
100
Area to DP #1
DP #2
Main Street
200
Area to DP #2
FB
Forebay
3P
UG Roof
2P
Bioretention Area
101
Area to DP #1
NEW
DP #1
Wetlands
Subcat
Reach
Pond
Link
Routing Diagram for NBM_505MainStreet_Post-Rev012424
Prepared by Graves Engineering, Inc, Printed 1/24/2024
HydroCAD® 10.20-4a s/n 00448 © 2023 HydroCAD Software Solutions LLC

Summary for Subcatchment 100R: Roof Only

Runoff = 0.01 cfs @ 12.13 hrs, Volume= 35 cf, Depth> 0.16"
Routed to Pond 3P : UG Roof

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 Rv Rainfall=0.32"

Area (sf)	CN	Description
2,632	98	Unconnected roofs, HSG B
2,632		100.00% Impervious Area
2,632		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0	175		0.49		**Direct Entry, TC**

STORM EVENT OF 0.32" (24-HR) GENERATES 35 cf OF RUNOFF VOLUME FROM ROOF AREA ALONE (EQUAL TO REQUIRED RETENTION VOLUME)

Summary for Pond 3P: UG Roof

[93] Warning: Storage range exceeded by 0.04'
[58] Hint: Peaked 0.04' above defined flood level

Inflow Area = 2,632 sf,100.00% Impervious, Inflow Depth > 7.93" for 100 year event
Inflow = 0.43 cfs @ 12.13 hrs, Volume= 1,740 cf
Outflow = 0.39 cfs @ 12.16 hrs, Volume= 1,647 cf, Atten= 10%, Lag= 1.9 min
Primary = 0.39 cfs @ 12.16 hrs, Volume= 1,647 cf
Routed to Pond 2P : Bioretention Area

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs / 2
Peak Elev= 586.67' @ 12.16 hrs Surf.Area= 126 sf Storage= 144 cf
Flood Elev= 586.63' Surf.Area= 126 sf Storage= 144 cf

Plug-Flow detention time= 67.3 min calculated for 1,647 cf (95% of inflow)
Center-of-Mass det. time= 33.8 min (775.4 - 741.7)

Volume	Invert	Avail.Storage	Storage Description
#1A	584.30'	99 cf	**12.17'W x 10.32'L x 2.33'H Field A** 293 cf Overall - 44 cf Embedded = 249 cf x 40.0% Voids
#2A	584.80'	44 cf	**ADS_StormTech SC-310 +Cap** x 3 Inside #1 Effective Size= 28.9"W x 16.0"H => 2.07 sf x 7.12'L = 14.7 cf Overall Size= 34.0"W x 16.0"H x 7.56'L with 0.44' Overlap 3 Chambers in 3 Rows
		144 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	585.65'	**4.0" Vert. Outlet Pipe** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.38 cfs @ 12.16 hrs HW=586.65' (Free Discharge)
↑**1=Outlet Pipe** (Orifice Controls 0.38 cfs @ 4.39 fps)

* NEW SUBSURFACE (ROOF) INFILTRATION SYSTEM

Stage-Area-Storage for Pond 3P: UG Roof

Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)	Elevation (feet)	Storage (cubic-feet)
584.30	0	584.96	38	585.62	88	586.28	126
584.31	1	584.97	39	585.63	89	586.29	126
584.32	1	584.98	40	585.64	89	586.30	127
584.33	2	584.99	40	585.65	90	586.31	127
584.34	2	585.00	41	585.66	91	586.32	128
584.35	3	585.01	42	585.67	91	586.33	128
584.36	3	585.02	43	585.68	92	586.34	129
584.37	4	585.03	44	585.69	93	586.35	129
584.38	4	585.04	44	585.70	93	586.36	130
584.39	5	585.05	45	585.71	94	586.37	130
584.40	5	585.06	46	585.72	95	586.38	131
584.41	6	585.07	47	585.73	95	586.39	132
584.42	6	585.08	48	585.74	96	586.40	132
584.43	7	585.09	48	585.75	97	586.41	133
584.44	7	585.10	49	585.76	97	586.42	133
584.45	8	585.11	50	585.77	98	586.43	134
584.46	8	585.12	51	585.78	99	586.44	134
584.47	9	585.13	52	585.79	99	586.45	135
584.48	9	585.14	52	585.80	100	586.46	135
584.49	10	585.15	53	585.81	101	586.47	136
584.50	10	585.16	54	585.82	101	586.48	136
584.51	11	585.17	55	585.83	102	586.49	137
584.52	11	585.18	55	585.84	103	586.50	137
584.53	12	585.19	56	585.85	103	586.51	138
584.54	12	585.20	57	585.86	104	586.52	138
584.55	13	585.21	58	585.87	104	586.53	139
584.56	13	585.22	59	585.88	105	586.54	139
584.57	14	585.23	59	585.89	106	586.55	140
584.58	14	585.24	60	585.90	106	586.56	140
584.59	15	585.25	61	585.91	107	586.57	141
584.60	15	585.26	62	585.92	107	586.58	141
584.61	16	585.27	62	585.93	108	586.59	142
584.62	16	585.28	63	585.94	108	586.60	142
584.63	17	585.29	64	585.95	109	586.61	143
584.64	17	585.30	65	585.96	109	586.62	143
584.65	18	585.31	65	585.97	110	586.63	144
584.66	18	585.32	66	585.98	111	586.64	**144**
584.67	19	585.33	67	585.99	111	586.65	144
584.68	19	585.34	68	586.00	112	586.66	144
584.69	20	585.35	68	586.01	112	586.67	144
584.70	20	585.36	69	586.02	113	586.68	144
584.71	21	585.37	70	586.03	113		
584.72	21	585.38	71	586.04	114		
584.73	22	585.39	71	586.05	114		
584.74	22	585.40	72	586.06	115		
584.75	23	585.41	73	586.07	115		
584.76	23	585.42	74	586.08	116		
584.77	24	585.43	74	586.09	116		
584.78	24	585.44	75	586.10	117		
584.79	25	585.45	76	586.11	117		
584.80	25	585.46	77	586.12	118		
584.81	26	585.47	77	586.13	118		
584.82	27	585.48	78	586.14	119		
584.83	28	585.49	79	586.15	119		
584.84	28	585.50	79	586.16	120		
584.85	29	585.51	80	586.17	120		
584.86	30	585.52	81	586.18	121		
584.87	31	585.53	82	586.19	121		
584.88	32	585.54	82	586.20	122		
584.89	32	585.55	83	586.21	122		
584.90	33	585.56	84	586.22	123		
584.91	34	585.57	84	586.23	123		
584.92	35	585.58	85	586.24	124		
584.93	36	585.59	86	586.25	124		
584.94	36	585.60	87	586.26	125		
584.95	37	585.61	87	586.27	125		

90 cubic feet STORAGE VOLUME BELOW LOWEST OUTLET

Summary for Pond 2P: Bioretention Area

Inflow Area = 14,234 sf, 75.02% Impervious, Inflow Depth > 6.78" for 100 year event
Inflow = 2.15 cfs @ 12.13 hrs, Volume= 8,045 cf
Outflow = 2.06 cfs @ 12.16 hrs, Volume= 7,764 cf, Atten= 4%, Lag= 1.5 min
Primary = 2.06 cfs @ 12.16 hrs, Volume= 7,764 cf
Routed to Link DP #1 : Wetlands

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Peak Elev= 584.91' @ 12.16 hrs Surf.Area= 1,043 sf Storage= 766 cf
Flood Elev= 585.50' Surf.Area= 1,087 sf Storage= 865 cf

Plug-Flow detention time= 43.3 min calculated for 7,748 cf (96% of inflow)
Center-of-Mass det. time= 22.4 min (812.8 - 790.4)

Volume	Invert	Avail.Storage	Storage Description
#1	584.00'	865 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
584.00	660	86.0	0	0	660
585.00	1,087	125.0	865	865	1,323

Device	Routing	Invert	Outlet Devices
#1	Primary	584.80'	**8.0' long x 5.0' breadth Emergency Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88
#2	Primary	584.30'	**8.0" Round Outlet Pipe X 2.00** L= 15.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 584.30' / 584.00' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.35 sf

Primary OutFlow Max=2.01 cfs @ 12.16 hrs HW=584.90' (Free Discharge)
1=Emergency Spillway (Weir Controls 0.63 cfs @ 0.75 fps)
2=Outlet Pipe (Inlet Controls 1.39 cfs @ 2.09 fps)

* NO CHANGES TO VOLUME,
REMOVED INFILTRATION (OUTLET)
+ REVISED OUTLET PIPE FROM
10" ⟶ 8" DIAMETER