STORMWATER REPORT

PREPARED FOR

A Proposed Self-Storage Facility

FOR

MA New Bedford & Washburn, LLC

Parcel I.D. 86-16

PREPARED BY

BRACKEN ENGINEERING, INC.
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Buzzards Bay, MA 02532

COMMONWEALTH OF MASSACHUSETTS
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REGISTERED PROFESSIONAL ENGINEER

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OBJECTIVE

To design stormwater management systems for a proposed self-storage facility in compliance with the Massachusetts Stormwater Management Standards and the City of New Bedford's Stormwater Management Rules and Regulations.

EXISTING CONDITIONS

The property is a developed 1.59+/- acre parcel located in the Eastern portion of the city, directly across from the Interstate 195 on ramp and West of the Acushnet River. The property is generally surrounded by a combination of commercial and residential properties to the East, West and South and a municipal park to the North. The property is improved by a vacant commercial building, paved parking area and public utilities. A large portion of the existing building has had the roof collapse and has been overgrown by vegetation; only the walls and concrete slab remain of that portion.

The closest water body to the property is the Acushnet River which is located 350' to 500' to the East. A portion of the site lies within LSCSF identified as FEMA Special Flood Hazard Zone AE (Elevation 6) as shown on FEMA Flood Insurance Rate Map No. 25005C-0393-G dated July 16, 2014. The remainder of the site is an area mapped as Flood Zone X that is "being protected from the 1-percent-annual-chance or greater flood hazard by a levee system. There are no other jurisdictional wetland resource areas located within 100 feet of the parcel.

Most of the stormwater runoff generated on site discharges to the City's stormwater management system, via roof leaders and a single catch basin in the parking area. Currently there is no treatment for stormwater discharge on site. Stormwater eventually reaches the Acushnet River.

The site is mapped as Urban Fill as depicted by the USDA Web Soil Survey Mapping Service. This was confirmed by a geotechnical report prepared by McArdle Gannon Associates, Inc., which indicates the urban fill to depths of 10 or 11 feet. The fill on site consists of loose to dense fine to coarse sand with about 20-40% silts.

Groundwater on site was determined by setting a Hobo Data Logger in a monitoring well from 4/16/19 thru 4/23/19. High groundwater was determined to be at el. 1.86, which is roughly 6 feet below grade and appears to be somewhat influenced by tide changes.

PROPOSED CONDITIONS

The project is the proposed rehabilitation of the existing building to create a self-storage facility. The rehabilitation will include enclosing the previously mentioned portion of the structure that is without a roof. Site improvements will also include the re-grading and paving of the parking area and upgrade of existing drainage and utilities.

All runoff from the parking lot will be treated, and pollution prevention measures shall be incorporated into the design in accordance with best management practices determined by the Department of Environmental Protection (DEP) in the Stormwater Management Handbook.

As a redevelopment project, the site will promote groundwater recharge in accordance with the appropriate DEP stormwater standards to the maximum extend feasible (see enclosed Stormwater Checklist and Report for additional details). Additionally, surface runoff from the parking area will be directed through Focal Point biofiltration systems (a proprietary treatment system) to treat the required water quality volume. Focal Point systems have been tested and verified to remove 91% TSS, 66% Phosphorus and 48% Nitrogen.

Roof runoff from the proposed addition will be conveyed to a subsurface infiltration system for recharge onsite prior to an overflow discharge to the municipal drainage system.

HYDROLOGIC MODELING

To estimate what runoff would be generated under proposed watershed conditions and to determine the capacity of the infiltration system, a mathematical model of the watersheds was prepared. The model utilized the standard engineering practices based on the National Engineering Handbook, Section 4, Hydrology (NEH-4), and the Soil Conservation Services (SCS) Technical Release 20 (TR-20), Urban Hydrology for Small Watersheds. The system was analyzed using the rainfall data for the two (2) year, ten (10) year and one hundred (100) year, 24-hour duration storm frequency in accordance with the City of New Bedford's Stormwater Management Rules and Regulations and the Mass DEP Stormwater Management Standards. The rainfall data was based on the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 - point precipitation frequency estimates.

The "TR-20" program calculates the runoff based on the rainfall and watershed characteristics, and produces a runoff hydrograph, (a runoff rate versus time curve). The stage-storage-discharge curves for a specific infiltration area are used to compute an outflow hydrograph by hydraulically routing an inflow hydrograph through the infiltration area. This procedure calculates the relationship of the inflow hydrograph with the characteristics of the infiltration area to determine the outflow, stage, and storage capacity of the infiltration area for a given time during the specified storm event.

To assist in the analysis, the Stormwater Modeling System utilized was Hydrocad®. This program is largely based on hydrologic techniques developed by the Natural Resource Conservation Service, combined with other hydrologic and hydraulic calculations.

CONCLUSION

The post development analysis demonstrates that there will be a decrease in flow rate and volume for the 2-, 10-, and 100-year storm events. This decrease is attributed to the reduction of impervious area and implementation of a subsurface infiltration system for the proposed roof runoff.

The following is a table of pre and post-development flows off site:

Design Point 1: Overflow to Municipal Drainage System

Strom Event	Rate (CFS)		Volume (CF)	
	Pre	Post	Pre	Post
2 Year	3.83	2.74	12,427	9,812
10 Year	5.70	5.14	18,689	15,836
100 Year	10.04	9.68	33,186	31,464

COMPLIANCE WITH MADEP STORMWATER STANDARDS

As required by the Stormwater Management Permit, issued by the City of New Bedford, this project shall comply to the Stormwater Management Standards to the maximum extent practicable for a redevelopment project.

The following is a list of Stormwater Management Standards and accompanying documentation describing compliance for each Standard:

Standard 1: No New Untreated Discharges

There are no new untreated discharges. The Water Quality Volume (WQV) required for this project is the first half inch (1/2") of runoff from impervious surfaces via Focal Point Biofiltration Systems.

Standard 2: Peak Rate Attenuation

As previously identified; post-development peak discharge rates and volumes do not exceed pre-development peak discharge rates and volumes for the 2-,10-, and 100-year storm.

Standard 3: Recharge

Recharge has been provided on site for the impervious parking area through the use of Focal Point Biofiltration Systems and the newly proposed roof area which directly discharges to a subsurface infiltration system. The infiltration systems have been designed to drain fully within 72 hours.

Standard 4: Total Suspended Solids Removal

Focal Point Biofiltration Systems have been designed to treat the required ½" water quality volume and to remove at least 80% of the Total Suspended Solids (TSS).

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

Project does not provide land uses with higher potential pollutant loads.

Standard 6: Critical Areas

The site does not discharge near or to any critical areas.

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

This project is considered a redevelopment project and has been designed to comply with the applicable standards to the maximum extent practicable.

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

A Construction Period Pollution Control Plan is included in the Stormwater Report.

Standard 9: Operation and Maintenance Plan

An Operations and Maintenance Plan is included in the Stormwater Report.

Standard 10: Prohibition of Illicit Discharges

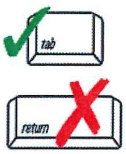
The proposed uses will not result in any illicit discharges.

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.

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[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.

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

COMMONWEALTH OF MASSACHUSETTS
DONALD F. BRACKEN, JR.
CIVIL
No. 37071
REGISTERED
PROFESSIONAL ENGINEER

[signature] 5-9-19

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): Focal Point Biofiltration System

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 for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist (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.

FOCAL POINT #1

FOCALPOINT

HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM

MASS DEP/CONSERVATION COMMISSION DESIGN WORKSHEET

1. FocalPoint Bed Area (min 174 square feet per acre of impervious area (e.g. 0.2 acres = 35 sf))

- Tributary Impervious area = 0.090 ac. (A)
- Tributary Pervious area = 0.028 ac. (B)
- Min FocalPoint bed area req'd = (((A) x 1.0) + ((B) x 0.4)) * 174 = 17.6 sf.
- FocalPoint Bed Area provided * = 20.0 sf.
- Dimensions of Proposed FocalPoint = 4 ft x 5 ft

* see criteria 2. to determine if minimum size is appropriate.

2. A Type III 24hr rainfall event that generates the WQ volume shall be modelled to demonstrate the entire storm volume is treated prior to activation of the overflow (typically set at 6-12" above the mulch) (Note: a 1.2 to 1.3" rainfall event usually generates 1 inch of runoff) contact ACF for a sample HydroCAD node.

- Water Quality Volume Goal (WQv) = 163 cubic feet
- Type III 24hr Rainfall Depth to generate WQv = 1.71 inches
- Temporary storage depth provided = 6.0 inches (typ 6" to 12")
- Temporary storage volume provided at above depth = 240 cubic feet.
- Peak ponding depth from Type III 24hr storm event = 4.0 inches (approx)

3. Size Harco Domed Overflow Riser

- Domed Overflow Riser Diameter: = 18 inches
- Rim Elev of Overflow Riser: = 6.83 (typ 6-12" above mulch surface)
- 6" invert in Elev from FocalPoint = 4.08 (typ 3 ft below mulch surface)
- 10" invert out Elev = 5.25

4. Flood Control – Peak flow attenuation of major storms

- The treated flow and bypass flow can be routed to a detention system either an open pond, or a subsurface system such as an expanded R-Tank system (contact ACF for additional information on designing expanded R-Tank systems)

5. The Design shall be reviewed by the manufacturer's representative prior to submission and installation will be overseen by the manufacturer's representative.

- The Design has been reviewed by ACF Environmental ☒
- Engineer will coordinate installation inspection with ACF ☒

FOCAL POINT #2

FOCALPOINT

HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM

MASS DEP/CONSERVATION COMMISSION DESIGN WORKSHEET

1. **FocalPoint Bed Area (min 174 square feet per acre of impervious area (e.g. 0.2 acres = 35 sf))**

- Tributary Impervious area = 0.165 ac. (A)
- Tributary Pervious area = 0.067 ac. (B)
- Min FocalPoint bed area req'd = (((A) x 1.0) + ((B) x 0.4)) * 174 = 33.4 sf.
- FocalPoint Bed Area provided * = 36.0 sf.
- Dimensions of Proposed FocalPoint = 6 ft x 6 ft

* see criteria 2. to determine if minimum size is appropriate.

2. **A Type III 24hr rainfall event that generates the WQ volume shall be modelled to demonstrate the entire storm volume is treated prior to activation of the overflow (typically set at 6-12" above the mulch) (Note: a 1.2 to 1.3" rainfall event usually generates 1 inch of runoff) contact ACF for a sample HydroCAD node.**

- Water Quality Volume Goal (WQv) = 299 cubic feet
- Type III 24hr Rainfall Depth to generate WQv = 1.91 inches
- Temporary storage depth provided = 6.0 inches (typ 6" to 12")
- Temporary storage volume provided at above depth = 378 cubic feet.
- Peak ponding depth from Type III 24hr storm event = 5 inches (approx)

3. **Size Harco Domed Overflow Riser**

- Domed Overflow Riser Diameter: = 18 inches
- Rim Elev of Overflow Riser: = 6.83 (typ 6-12" above mulch surface)
- 6" invert in Elev from FocalPoint = 4.08 (typ 3 ft below mulch surface)
- 10" invert out Elev = 4.70

4. **Flood Control – Peak flow attenuation of major storms**

- The treated flow and bypass flow can be routed to a detention system either an open pond, or a subsurface system such as an expanded R-Tank system (contact ACF for additional information on designing expanded R-Tank systems)

5. **The Design shall be reviewed by the manufacturer's representative prior to submission and installation will be overseen by the manufacturer's representative.**

- The Design has been reviewed by ACF Environmental ☒
- Engineer will coordinate installation inspection with ACF ☒

FOCALPOINT

HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM

MA DEP PROPRIETARY TECHNOLOGY COMPLIANCE

ACF Environmental has prepared this guidance document for engineers designing projects in Massachusetts with the FocalPoint high performance modular biofiltration system. This information is based on the guidance provide in Chapter 4 of the Massachusetts Stormwater Handbook titled "Process to Approve or Deny the Use of Proprietary Stormwater Technology". Each evaluation criteria is provided below followed by a response from ACF in **bold face blue** text to address the criteria. It is anticipated that this document would be provided as an attachment to a permit application with local MA conservation commission groups and local reviewing authorities.

Process To Approve or Deny the Use of Proprietary Stormwater Technology

There are only two ways to evaluate a proposed use of a proprietary BMP in Massachusetts:

1. The Commonwealth has evaluated the performance of the technology and assigned a TSS removal efficiency.

This does not apply to FocalPoint-HPMBS, please proceed to Item 2.

2. The issuing authority has evaluated the proposed use of a particular proprietary BMP at a specific site and assigned a TSS removal efficiency based upon its own case-by-case review of the effectiveness and intended use of the proprietary BMP.

MassDEP strongly recommends that the issuing authority evaluate proposed BMPs using studies reviewed by the University of Massachusetts and posted on its stormwater database website (www.mastep.net). That database includes information on the relative quality of the studies, and should be used as the basis for a local agency's evaluation of the effectiveness of a proprietary system. Based on this information, the issuing authority may decide to approve or deny the use of any proprietary technology. The issuing authority may not unreasonably deny the use of a proposed technology.

Per the MassDEP The Massachusetts Strategic Envirotechnology Partnership (MassSTEP) was defunded by the Commonwealth and thereafter sunset by the Massachusetts Executive Office of Energy and Environmental Affairs (MassEEA) on January 11, 2011. As such, it is not effective for regulatory purposes pursuant to the Massachusetts Wetlands Protection (310 CMR 10.00) or any other regulations of the Commonwealth. Similarly, the Massachusetts Stormwater Technology Evaluation Project (MASTEP) is no longer funded by the Massachusetts Department of Environmental Protection (MassDEP) and is not effective for regulatory purposes pursuant to the Massachusetts Wetlands Protection (310 CMR 10.00) or any other regulations of the Commonwealth.

In regards to the Technology and Reciprocity Partnership (TARP), MassDEP has not granted written reciprocity to any of the reviews conducted by the New Jersey Corporation for Advanced Technology (NJCAT) through the New Jersey DEP. As such, any documents represented as being TARP compliant verifications are not effective for regulatory purposes pursuant to the Massachusetts Wetlands Protection (310 CMR 10.00) or any other regulations of the Commonwealth.

If the operating parameters and performance claims of a proprietary technology have not been fully verified by STEP or TARP and a MassDEP removal efficiency rating has not been assigned, the technology vendor must submit evaluative information to the local agency regarding the technology's effectiveness.

On October 28, 2014, ACF Environmental of East Norriton, Pennsylvania authorized Civil & Environmental Consultants, Inc. (CEC) to perform a 3rd party, full-scale test to assess the water quality performance of the FocalPoint High Performance Modular Biofiltration System (HPMBS). The field-based assessment was performed in accordance with a protocol which produces the same quality and quantity of data as the protocols established by the University of New Hampshire Stormwater Center, the Technology Acceptance and Reciprocity Partnership, or the Washington State Department of Ecology Technology Assessment Protocol (TAPE). Specifically, TAPE protocols were followed for this study and are indicated in the Table 1. Table 2 provides a summary of removal efficiencies based on even mean concentrations. A full technical evaluation report that includes a complete breakdown of individual event data, statistical analysis, analytical sheets and conclusions is available upon request.

Table 1. TAPE versus TARP Protocols

STANDARD	TAPE	TARP
Number of test sites	1	None
Number of Storms	12-35	15-20
Storm Depth (inches)	≥ 0.15	≥ 0.10
Antecedent Dry Period (hrs)	6 with less than 0.04 inches	6
Storm Duration (hr)	1	None
Average Storm Intensity	None	None
Sampling Methods	Automated	Automated
Type of Samples	Flow weighted composite	Flow weighted composite
Minimum # of Aliquots	10	10

Volume Coverage (covering X% of each storms total runoff volume)	75	70
Pollutant Analyzed	TSS pH Metals (Zn, Cu, Cd) Oils and Grease TPH TP TKN (none) SSC (optional)	TSS
Performance Criteria for all three protocols	Influent Range 20-100 mg/L TSS, 100-200 mg/L TSS ≥ 200 mg/L TSS	Effluent Criteria ≤ 20 mg/L 80% removal 80% removal

Table 2. Summary of removal efficiencies for primary constituents of concern – Suspended Sediment (TSS), Total Phosphorus (TP), Total Nitrogen (TN)

Study Method	Constituents	% Removal Concentration Based, for the event mean [A]	% Removal Mass Based, for the event mean	Bootstrap 95% CI for mean [LCL, UCL], Concentration Based	Bootstrap 95% CI for mean [LCL, UCL] Mass Based	% Removal, Lab Based Column Study [B]
TAPE	Suspended Sediment (TSS)	84.4 (n=20)	91.4 (n=19)	[76.4, 91.4]	[87.5, 94.7]	91.2
TAPE	Total Phosphorus (TP)	52 (n=20)	72.5 (n=19)	[37.3, 67.6]	[63.9, 80.6]	66
TAPE	Total Nitrogen (TN) [C]	58.7 (n=16)	77.9 (n=15)	[45.4, 72]	[72.5, 83.2]	48.5

[A] Automated flow-weighted composites were collected and composite sample concentrations are defined as the volume weighted average of all the individual samples. Therefore, the event mean concentration (EMC) for the flow-weighted sample is the concentration of the composite.

[B] CEC Assessment of suspended solids and nutrient attenuation by the Virginia mixture of FocalPoint Biofiltration System via column testing, October 2014.

[C] For this study period there were no measureable removals of nitrates. The reduction in TN is derived from the attenuation of the Kjeldahl Nitrogen portion of the influent concentrations.

As indicated in the table above, the TAPE minimum 12 qualified rainfall\runoff events have been met. All 20 events are classified as qualifying storm events, as defined by TAPE for this research (i.e., qualifying storm event of 0.15-inch or greater rainfall total).

Relative to TSS, the influent concentrations measured from the test site range from 4.9 to 1,560 mg/L.

For the 20-100 mg/L influent range, the measured effluent TSS does meet the TAPE-required upper 95% confidence limit about the mean effluent concentration of less than or equal to 20 mg/L (data calculations from the study produced a 16.8 mg/L upper confidence limit concentration via bootstrapping; 14.5 mg/L upper confidence limit for the median from Q-Q plots).

For influent TSS in the range of 100-200 mg/L, the TAPE minimum 80% removal efficiency requirement is met.

For influent TSS greater than 200 mg/L, the TAPE minimum 80% removal efficiency requirement is met.

Please note that Proprietary BMPs are NOT required to be evaluated by MassDEP to be used in Massachusetts. Only a small number of proprietary BMPs have been evaluated by the Commonwealth, and those evaluations are limited to the specific conditions that were reviewed. In most case in Massachusetts, a proposed use of a particular proprietary BMP at a specific site will be reviewed by the local agency on a case–by-case basis.

FocalPoint HPMBS will be reviewed by the local agency on a case-by-case basis.

How to Evaluate the Effectiveness of Proprietary BMPs that Do Not Have a MassDEP TSS Removal Efficiency Rating: MassDEP recognizes that the process of reviewing a proposed use of a particular proprietary BMP at a specific site may be daunting. MassDEP has prepared guidance for conducting this review.

Step One: Information that should be submitted as part of the Wetlands NOI.

As more fully set out below, issuing authorities require sufficient information to evaluate proposed uses of proprietary BMPs. If sufficient information is not submitted with the NOI, the Conservation Commission should request additional information as part of the review process. Specific information that a Conservation Commission may want to request prior to a hearing include:

A complete description of the proprietary technology or product including a discussion of the advantages of the technology when compared to conventional stormwater treatment systems and LID practices, including:

FocalPoint HPMBS is a modular, high performance biofiltration system that often works in tandem with other integrated management practices (IMP). Contaminated stormwater runoff enters the biofiltration bed through a conveyance swale, planter box, or directly through a curb cut or false inlet. Energy is dissipated by a rock or vegetative dissipation device and is absorbed by a 3-inch layer of aged, double shredded hardwood mulch, with fines removed, on the surface of the biofiltration media.

The FocalPoint HPMBS design describes a mostly permeable profile or boxless system that is identical to that of a traditional bioretention system (i.e., 2-3 inches of mulch layer, 18-24 inch media depth, ≥ 6" underdrain and 24 to 48 hr for complete drain down time) and substitutes high performance, high-flow rate engineered media for traditional slow-flow rate media and incorporates a matching high performance, highly permeable, modular underdrain for typical perforated pipe. The performance difference between these two systems is dramatic in terms of their ability to receive water. The modular underdrain also may be expanded to include integrated subsurface storage options for extended detention, infiltration, and/or reuse. These options are integral to the FocalPoint HPMBS design and they are almost infinitely scalable in length width and depth. Outfall from these underdrain structures may be restricted to meet any design need, either by pipe, pump (for harvesting) or subsurface infiltration.

As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the biofiltration media where the finer particles are removed and numerous chemical reactions take place to immobilize and capture pollutants in the soil media.

The cleansed water passes into the underdrain/storage system and remaining flows are directed to a stormwater conveyance system or other appropriate discharge point. Once the pollutants are in the media, bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the media where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a variety of very complex biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, media and biomass with some passing out of the system into the air or back into the water.

The System is comprised of the following elements and depicted in Figure 1.

Open Cell Underdrain: A modular, high infiltration rate 'flat pipe' underdrain/storage system which is designed to directly infiltrate or exfiltrate water through its surface. The modular underdrain overcomes the limited collection capacity of traditional stone and pipe underdrains. A 90% open surface area collects water significantly faster and can be extended below for additional volume.

Separation Layer: A wide aperture mesh layer is utilized to prevent bridging stone from entering the underdrain system. The separation layer utilizes the concept of 'bridging' to separate the biofiltration media from the underdrain without the use of geotextile fabrics. The use of geotextile fabrics within an infiltration device can lead to clogging; by eliminating the need for a geotextile fabric, the potential for clogging is greatly reduced.

High Flow Media: The advanced high flow rate engineered media utilizes physical, chemical and biological mechanisms of the soil, plant and microbe complex to remove pollutants found in stormwater runoff. Infiltration rates at 100 inches per hour overcome the challenges of clogging and flooding while minimizing space requirements.

Mulch: Shredded hardwood mulch acts as a pre-treatment mechanism by preventing trash, sediments and particles from entering the system. Removal and replacement of mulch is necessary only every 6-12 months and is the only maintenance requirement for the entire system. Maintenance cycles may be extended with the implementation of upstream pretreatment.

Plants: Native Plants are best suited as they adjust well to periodic droughts and temperature extremes. The media contains 10% by volume peat moss. Over the years the decaying mulch, roots, fungi, bacteria and organic inputs from stormwater runoff add to the organic mix as it evolves as more natural soil strata. Soil moisture is maintained through the use of peat moss and mulch.

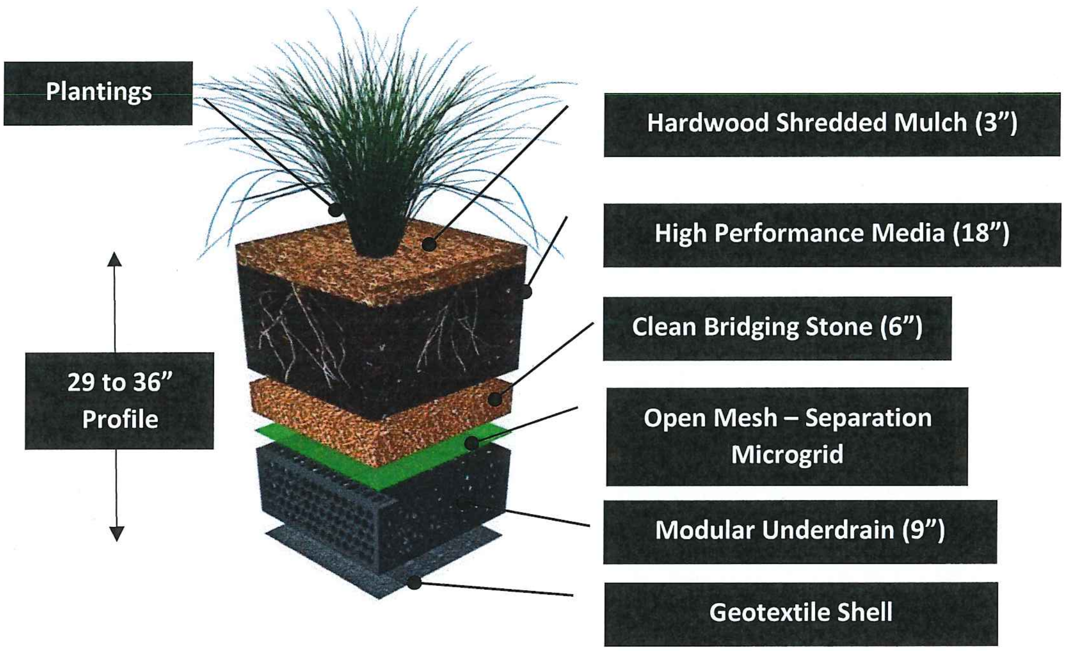


Figure 1. Cross section of a FocalPoint-HPMBS

While the most remarkable effect of the high-flow media in a FocalPoint HPMBS design is that it allows for a dramatically smaller footprint of the biofilter media bed, the surface storage option inherent in a conventional bioretention remains a design option. In this case the smaller biofilter bed is located within a simple, vegetated recession or swale without necessity for excavation, underdrain, special plantings or special maintenance beyond the small biofilter. Although the infiltration flow rate of the media bed is 100 inches per hour, the time frame associated with draining the surface pond, if this approach is utilized, is dependent not on the infiltration rate of subsurface soils as it would be with a conventional system, but on the size of the FocalPoint HPMBS biofilter, which can be adjusted according to allowable drain down time and factor of safety. These characteristics are the key to the economics,

maintainability and design flexibility of FocalPoint HPMBS and are not likely accomplished if the media is enclosed in a precast shell.

- Size: What volume is it designed to hold and/or treat? How is the system sized to meet the performance standards in order to handle the required water quality volume, rate of runoff, and types of storms? Standard 4 requires treatment for a required water quality volume, not for a specified design flow rate.
  - **The FocalPoint HPMBS is sized to treat the water quality volume (WQv) as determined by a qualified project engineer or local jurisdiction.**
  - **FocalPoint HPMBS sizing is iterative and site specific based on the available space above the unit for temporary storage of the water quality volume prior to overflow. For example, on a site with little available space for the water quality volume above the unit, the FocalPoint HPMBS may need to be increased in size to utilize the 100 inch/hr. infiltration rate to ensure the entire water quality volume passes through the unit. On the other hand, if a great wealth of space was available for the water quality volume to temporarily pond over the unit, the FocalPoint HPMBS could be incrementally reduced in size. A key design parameter is having the system draw down within 24-48 hours from the commencement of the storm.**
  - **ACF Environmental has developed a sizing calculator/tool (*ACF FP and RT Calculator)* to assist engineers and designers with the optimal sizing of the unit in all configurations and locations. The tool is a dynamic model that distributes the water quality volume and design storm with an SCS 24-hour rainfall event. The tool demonstrates how much volume is treated by the FocalPoint HPMBS and at what point in the storm the overflow device is activated. The system size can also be modeled and verified in a program such as HydroCAD or other model.**
  - **At a minimum, the filter bed area to impervious runoff area should be 0.40% (44 sq. ft of filter bed area to 10,890 s.q ft of impervious area) and the ponding volume above the practice equal to 20% of the WQV.**

- Technical description, schematic and process flow diagram: How does it work? What are the technical configurations of the unit? Are there any pretreatment requirements? How does it fit in combination with other treatment systems?
  - **Figure 1 below provides schematic and process flow diagram.**
  - **The system works according to the fundamentals of media bed\infitration bed design and is best described by the Darcy Equation which the area of the filter bed as a function of (WQv, filter bed depth, coefficient of permeability, average height of the water above the filter bed and drain down time of the filter bed).**
  - **The configuration is typically square or rectangular in shape. The minimum size FocalPoint HPMBS from a constructability standpoint is 20 SF and the minimum width should be 2 ft.**
  - **The system has a vertical profile of 3 ft (typical) from top of mulch to bottom of underdrain.**
  - **The ponding zone above the mulch can take on many different geometric shapes, the most common being trapezoidal bowl with a ponding depth of 6 to 18 inches.**

- Pretreatment of runoff entering a FocalPoint HPMBS is recommended to trap coarse sediment particles before they reach and prematurely close the filter bed. Pretreatment measures must be designed to dissipate velocities and spread water out over a 2 to 4 ft width. Many pretreatment options are available and include manufactured systems like the Rain Guardian or non-propriety systems like stone aprons\diaphragms, grass filter stripes and level lip spreaders.
- The system integrates into Low Impact Development objectives and seeks to decentralize the management of stormwater. Conversely, and may also be used in a more centralized or end of pipe application if site condition dictate.
- The system can be configured either off-line or on-line and be used in combination with other treatment systems if required to meet the project specific treatment goals.

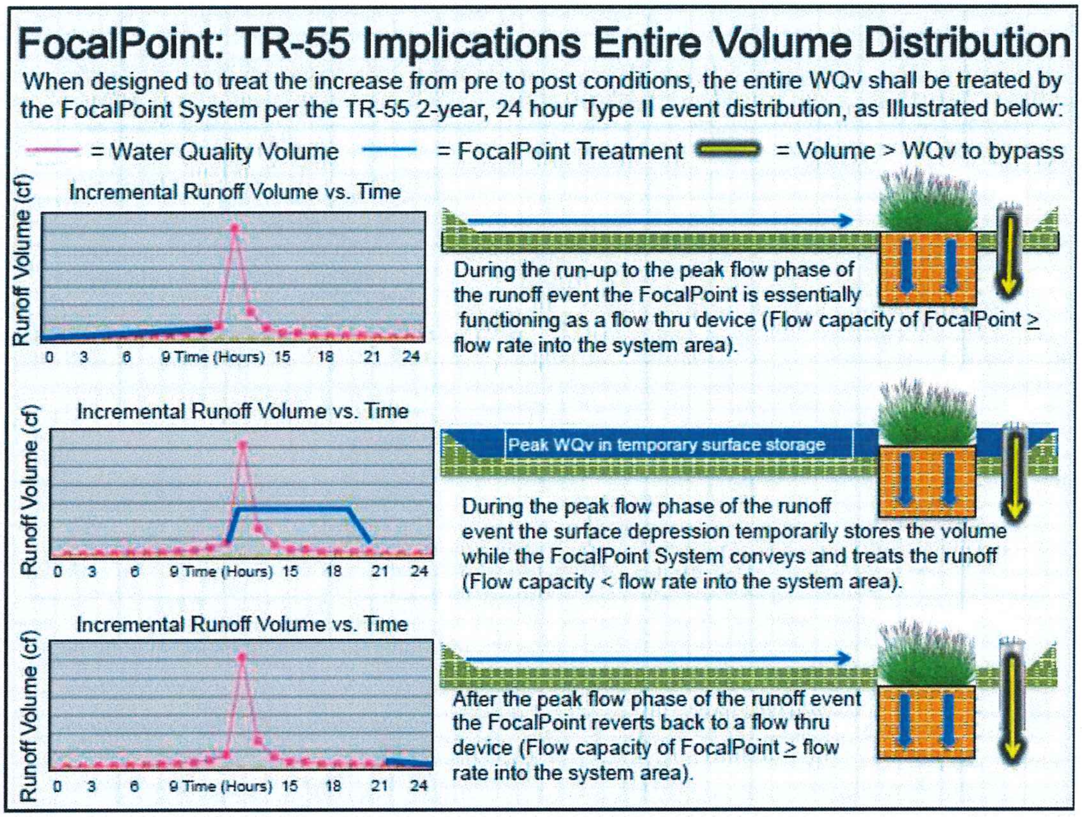


Figure 2. Cross section of a FocalPoint-HPMBS

- Capital costs and installation process and costs: What does this size system cost? Are there any consumable materials that need to be replaced and if so, how often and how much do they cost? How will the system be installed and who will supervise the installation to ensure that it is done properly? What mistakes can happen during installation? Is any special handling, installation techniques or equipment required?
  - Capital costs are market driven and typically range from $125 to $185/SF of filter bed area. Installation cost range from $30 to $60/SF of filter bed area.
  - The system is installed with common utility\landscape equipment and labor.

- A jobsite superintendent or foreman is qualified to supervise installation as this is not different than a planter bed, bioretention or landscape feature.
- ACF Environmental has certified installers and is qualified to site supervise. We offer these services as part of our contract with the customer.
- No special handling is required.
- No special equipment is required

- Potential disadvantages at this site: Any physical constraints? Weight or buoyancy issues? Durability issues? Energy requirements?
  - **The system should be separated from the water table to ensure that groundwater does not inundate the filter bed. A separation distance of 2 feet is recommended between bottom of excavated FocalPoint HPMBS area and the seasonally high ground water table.**

- Operation and maintenance (O&M) requirements and costs: New technologies will not have long-term data on O&M requirements, so it is particularly important that an applicant provide all available information for evaluation.
  - **We have installed over 1,000 systems across the United States and sufficient experience with O&M to feel confident our recommendation on maintenance frequency are sound.**
  - **All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding operation and maintenance agreement. Other reasons for maintenance include:**
    - **Avoid legal challenges from your jurisdiction's maintenance enforcement program.**
    - **Prolong the lifespan of your FocalPoint HPMBS.**
    - **Avoid costly repairs.**
    - **Help reduce pollutant loads leaving your property.**
  - **Simple maintenance of the FocalPoint HPMBS is required to continue effective pollutant removal from stormwater runoff before any discharge into downstream waters. This procedure will also extend the longevity of the living biofiltration system. The unit will recycle and accumulate pollutants within the biomass, but may also be subjected to other materials entering the surface of the system. This may include trash, silt and leaves etc. which will be contained above the mulch and/or biofiltration media layer. Too much silt may inhibit the FocalPoint's HPMBS flowrate, which is a primary reason for system maintenance. Removal of accumulated silt/sediment and/or replacement of the mulch layer (when specified), is an important activity that prevents over accumulation of such silt/sediment.**
  - **Convergent Water Technologies and/or its Value-Added Reseller (VAR) include a 1-year maintenance plan with each system purchased. Annual included maintenance consists of two (2) scheduled maintenance visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as when the**

site is appropriately stabilized, the unit is installed and activated (by VAR), i.e., when mulch (if specified) and plantings are added.

- **Activation should be avoided until the site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands. The fall visit helps the system by removing excessive leaf litter.**
- **It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required. Regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency.**
- **Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the VAR/Maintenance contractor and Owner predict future maintenance frequencies, reflecting individual site conditions. Owners must promptly notify the VAR/Maintenance contractor of any damage to the plant(s), which constitute(s) an integral part of the biofiltration technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance of the FocalPoint HPMBS to the VAR/Maintenance contractor (i.e. no pruning or fertilizing).**

B. Data on how well the alternative technology works:

- Flow proportional sampling from laboratory testing and full-scale operations that is representative of the potential range of rainfall events (for example, a sufficient number of storms is generally at least 15) and located at sites similar to the conditions of the installation under review.
    - **A full scale FocalPoint HPMBS has been field monitoring to TAPE protocols as described Table 1 above and include flow weighted composite sample.**
    - **The system was installed in July of 2015 and has experienced 57 days with measurable precipitation. The total rainfall depth for the study period to date is 18.24 inches. Of the 57 wet weather events, there have been 12 qualified events as defined by TAPE.**

- Calculation of TSS removal rate should be presented. If there is a removal rating for a similar technology and use posted at http://www.mass.gov/dep/, and the proponent makes a claim for a higher TSS removal rate than for the similar system posted, the applicant must provide sufficient data to support the claim. Removal rates should show removal of various particle sizes across the full range of operating conditions including maximum, minimum and optimal conditions for reliable performance.
    - **Removal rates from the TAPE level field study are based in event mean concentrations, which characterize the operating rate conditions, influent\effluent TSS concentrations and particle sizes from the start to the end of the rainfall event.**
    - **Total Suspended Solids (TSS) removal of 86% as defined as the change in average event mean concentration (EMC) between the influent runoff and effluent runoff was observed. TSS influent EMCs ranges from 4.9 to 238 mg/L from the field test site. Hydraulic operating conditions for each storm event**

ranged from 7 to 157% of design capacity; thereby demonstrating performance across the full range of operating conditions.

- **Per TAPE protocol, particle size distribution (PSD) shall be determined by Method ASTM D3977. We have run this method for two events and determined the majority of material in the runoff are clays and silts (Method B) with the remainder being fine to coarse sand (below 250 microns). The corresponding influent TSS concentration for the 9/30/15 event was 26.6 mg/L and the portion associated with silts and clays (Method B) measured at 16 mg/L or mg/kg, for a percentage of 60%. The influent TSS concentration for the 10/9/15 event was 197 mg/L and the portion associated with silts and clays (Method B) was 161 mg/L or mg/kg, for a percentage of 82%.**

- **The MassSDEP requires 80% TSS removal for most permitted projects and the results from the TAPE field study confirm the we are able to meet and exceed this removal rate.**

- A copy of the site's operation and maintenance plan including operational details on any full-scale installations: e.g., locations, length of time in operation, maintenance logs (logs should record the dates of inspections and cleaning, actions performed, quantities of solids removed, and time required for work).
    - **Not applicable at this time.**

- Information on any system failures, what those failures were, and how were they corrected.
    - **The mechanisms of failure inherent with bioswales, bioretention, rain gardens are the same for FocalPoint.**
    - **The system includes a 1-yr guarantee on media infiltration rate along with the first year of maintenance as part of the upfront capital cost.**

- Copies of any articles from peer-reviewed, scientific or engineering journals.
    - ***Land and Water Magazine, Jan\Feb 2016 Issue, Lessons Learned from LID Based Roadway, Anthony Kendrick, Env SP.***

- Any approvals or permits from other authorities. **(See below)**

RECENT REGULATORY APPROVALS:

New Hampshire Department of Environmental Protection (NHDES) Alteration of Terrain Bureau (AOT) has approved the FocalPoint\HPMBS system for stand-alone 80% treatment on the basis of our TAPE field testing data.

Maine Department of Environmental Protection (MEDEP) has approved the FocalPoint\HPMBS system for stand-alone treatment of TSS and Phosphorus.

VA DEQ – BMP Clearinghouse Approval for 50% Phosphorus (maximum allowable removal)

Virginia Department of Transportation (VDOT) Tree Box Filter Specification

- **The filtration media shall achieve a flow rate equal to a minimum of 100 inches per hour and verified via a third part report**

- **The unit shall remove 80% TSS using Sil-Co-Sill 106 typical particle size distribution in the laboratory. Field results should show at least 80% TSS removal following either TAPE or TARP testing protocols.**
- **The unit shall belocated to esnnure that high flow events shall bypass the filter media preventing erosion and resuspension of pollutants.**

Florida Department of Environmental Protection (FLDEP) included on the Accepted Technology List

Pennsylvania Department of Environmental Protection – approved as a stand alone treatment BMP for TP, TSS and TN.

District of Columbia – Department of Energy and Enviroment (DDOEE) - approved as a stand-alone bioretention practice consistent with Chapter 3.5 BMP Manual.

Missouri Department of Transportation – approved as an acceptable bioretention practice

Harris County, TX - Office of Public Infrastructure – approved as a stand alone BMP and is acceptabke fir LID method for green roadway, green street and green infrastructure. Generic FocalPoint-HPMBS details and specicaitons are available for download at the Harris County

- References along with contact information from other installations.

Town of Falmouth
Department of Public Works
271 Falmouth Rd
Falmouth, ME 04105
Mr. Jay Reynolds
207-699-5374

Harris County Government
Engineering Department
1001 Preston, 7th Floor
Houston, TX 77002
Mr. John Blount, P.E.
713-755-6888

City of Houston
Engineering Services Section
611 Walker St
Houston, TX 77002
Ms. Kathlie Jeng-Bullock, P.E.
832-395-2511

Sebago Technics
City of South Portland Engineer
75 John Roberts Rd, Suite 1A
South Portland, ME 04106
Mr. Dan Riley, P.E.
207-200-2100

Town of Kittery
Code Enforcement
200 Rogers Road
Kittery, ME 03904
Jessa Kellogg
207-475-1321

C. Operation and Maintenance (O&M) Plan:

- To ensure that the system will function as designed, all stormwater management systems must have a written operation and maintenance plan in accordance with Stormwater

Management Standard 9. MassDEP stresses the importance of routine maintenance for all stormwater control technologies. A number of alternative technologies perform very well, but only if they are installed and maintained as specified by the manufacturer. For example, some alternative wet vaults may be able to achieve a high TSS removal rate, but only if they are cleaned often enough to prevent re-entrainment of previously trapped sediment.

The O & M Plan shall **(see attached)**

1. Identify access points to all components of the stormwater system;

2. Specify equipment, personnel, and training needed to inspect and maintain system;

3. Include a list of any safety equipment and safety training required for personnel;

4. Set forth a suggested frequency of inspection and cleaning; and

5. Provide a sample inspection checklist and maintenance log.

Please refer to Standard 9 in the Stormwater Technical Handbook (Volume 1, Chapter 1 and Volume 2, Chapter 1) for further guidance about O&M.

RECHARGE CALCULATIONS

SWMA #	Impervious Area (s.f.) Proposed Roof	Required Recharge Volume (c.f.)	Volume Provided (c.f.)	Bottom Area	Draw-down time (hrs.)
Subsurface Infiltration	16,917	846	2,055	1,993	0.62

Recharge Volume (Rv)=F x impervious area
F= 0.6" for HSG "A"
Rv=(.6"/1/12)(impervious area)

Draw down time = Rv/(k)(bot. area)
K=8.27 in/hr, 0.69 ft/hr

SWMA #	Impervious Area (s.f.) Existing Roof	Recharge Volume (c.f.)	Volume Provided (c.f.)	Bottom Area	Draw-down time (hrs.)
None	36,848	1842	-	-	N/A

Recharge Volume (Rv)=F x impervious area
F= 0.6" for HSG "A"
Rv=(.6"/1/12)(impervious area)

Draw down time = Rv/(k)(bot. area)
K=8.27 in/hr, 0.69 ft/hr

SWMA #	Impervious Area (s.f.) Pavement	Recharge Volume (c.f.)	Volume Provided (c.f.)	Bottom Area	Draw-down time (hrs.)
Focal Point #1	3,918	196	250	20	14.20

Recharge Volume (Rv)=F x impervious area
F= 0.6" for HSG "A"
Rv=(.6"/1/12)(impervious area)

Draw down time = Rv/(k)(bot. area)
K=8.27 in/hr, 0.69 ft/hr

SWMA #	Impervious Area (s.f.) Pavement	Recharge Volume (c.f.)	Volume Provided (c.f.)	Bottom Area	Draw-down time (hrs.)
Focal Point #2	7,170	359	397	36	14.43

Recharge Volume (Rv)=F x impervious area
F= 0.6" for HSG "A"
Rv=(.6"/1/12)(impervious area)

Draw down time = Rv/(k)(bot. area)
K=8.27 in/hr, 0.69 ft/hr

Total		3243	2702	80% recharged

BRACKEN ENGINEERING, INC.

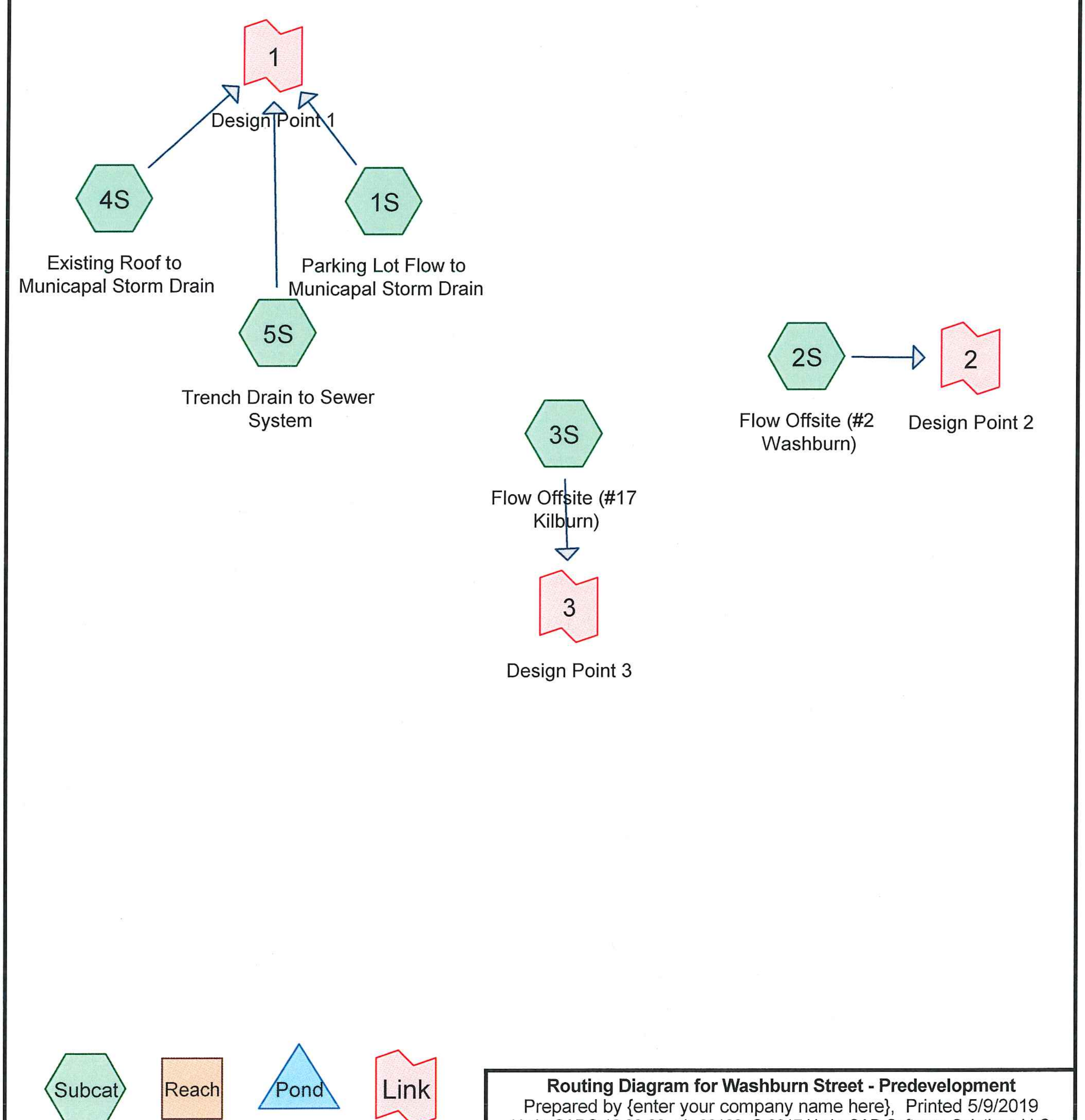
Project: Self-Storage Facility – 8 Washburn Street – New Bedford, MA
Prepared By: RMM
Date: May 9, 2019

TSS Removal Calculation Worksheet

A	B	C	D	E
BMP	TSS Removal Rate	Starting TSS Load	Amount Removed (BxC)	Remaining Load (C-D)
STREET SWEEPING	5%	1.00	0.05	0.95
FOCAL POINT SYSTEM	91%	0.95	0.86	0.09

Total TSS Removal = 91%

49 Herring Pond Road
Buzzards Bay, MA 02532
ph: 508-833-0070
fx: 505-833-2282



Routing Diagram for Washburn Street - Predevelopment
Prepared by {enter your company name here}, Printed 5/9/2019

Summary for Subcatchment 1S: Parking Lot Flow to Municapal Storm Drain

Runoff = 1.01 cfs @ 12.07 hrs, Volume= 3,255 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	13,633	98	Paved parking
	13,633		100.00% Impervious Area

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

Summary for Subcatchment 2S: Flow Offsite (#2 Washburn)

Runoff = 0.00 cfs @ 12.43 hrs, Volume= 35 cf, Depth> 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	3,323	48	Brush, Poor
*	135	98	Impervious
	3,458	50	Weighted Average
	3,323		96.10% Pervious Area
	135		3.90% Impervious Area

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

Summary for Subcatchment 3S: Flow Offsite (#17 Kilburn)

Runoff = 0.01 cfs @ 12.47 hrs, Volume= 113 cf, Depth> 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	13,226	48	Brush, Poor
*	241	98	Impervious
	13,467	49	Weighted Average
	13,226		98.21% Pervious Area
	241		1.79% Impervious Area

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

Summary for Subcatchment 4S: Existing Roof to Municapal Storm Drain

Runoff = 2.74 cfs @ 12.07 hrs, Volume= 8,844 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	37,038	98	Roofs
	37,038		100.00% Impervious Area

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

Summary for Subcatchment 5S: Trench Drain to Sewer System

Runoff = 0.12 cfs @ 12.00 hrs, Volume= 327 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	1,369	98	Paved parking
	1,369		100.00% Impervious Area

Summary for Link 1: Design Point 1

Inflow Area = 52,040 sf,100.00% Impervious, Inflow Depth > 2.87" for 2-Year event
Inflow = 3.83 cfs @ 12.07 hrs, Volume= 12,427 cf
Primary = 3.83 cfs @ 12.07 hrs, Volume= 12,427 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 2: Design Point 2

Inflow Area = 3,458 sf, 3.90% Impervious, Inflow Depth > 0.12" for 2-Year event
Inflow = 0.00 cfs @ 12.43 hrs, Volume= 35 cf
Primary = 0.00 cfs @ 12.43 hrs, Volume= 35 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3: Design Point 3

Inflow Area =	13,467 sf,	1.79% Impervious,	Inflow Depth > 0.10"	for 2-Year event
Inflow =	0.01 cfs @	12.47 hrs, Volume=	113 cf	
Primary =	0.01 cfs @	12.47 hrs, Volume=	113 cf, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment 1S: Parking Lot Flow to Municapal Storm Drain

Runoff = 1.50 cfs @ 12.07 hrs, Volume= 4,896 cf, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	13,633	98	Paved parking
	13,633		100.00% Impervious Area

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

Summary for Subcatchment 2S: Flow Offsite (#2 Washburn)

Runoff = 0.04 cfs @ 12.12 hrs, Volume= 162 cf, Depth> 0.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	3,323	48	Brush, Poor
*	135	98	Impervious
	3,458	50	Weighted Average
	3,323		96.10% Pervious Area
	135		3.90% Impervious Area

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

Summary for Subcatchment 3S: Flow Offsite (#17 Kilburn)

Runoff = 0.12 cfs @ 12.12 hrs, Volume= 577 cf, Depth> 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	13,226	48	Brush, Poor
*	241	98	Impervious
	13,467	49	Weighted Average
	13,226		98.21% Pervious Area
	241		1.79% Impervious Area

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

Summary for Subcatchment 4S: Existing Roof to Municapal Storm Drain

Runoff = 4.08 cfs @ 12.07 hrs, Volume= 13,301 cf, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	37,038	98	Roofs
	37,038		100.00% Impervious Area

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

Summary for Subcatchment 5S: Trench Drain to Sewer System

Runoff = 0.17 cfs @ 12.00 hrs, Volume= 492 cf, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	1,369	98	Paved parking
	1,369		100.00% Impervious Area

Summary for Link 1: Design Point 1

Inflow Area = 52,040 sf,100.00% Impervious, Inflow Depth > 4.31" for 10-Year event
Inflow = 5.70 cfs @ 12.07 hrs, Volume= 18,689 cf
Primary = 5.70 cfs @ 12.07 hrs, Volume= 18,689 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 2: Design Point 2

Inflow Area = 3,458 sf, 3.90% Impervious, Inflow Depth > 0.56" for 10-Year event
Inflow = 0.04 cfs @ 12.12 hrs, Volume= 162 cf
Primary = 0.04 cfs @ 12.12 hrs, Volume= 162 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3: Design Point 3

Inflow Area =	13,467 sf, 1.79% Impervious, Inflow Depth > 0.51" for 10-Year event	
Inflow =	0.12 cfs @ 12.12 hrs, Volume=	577 cf
Primary =	0.12 cfs @ 12.12 hrs, Volume=	577 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment 1S: Parking Lot Flow to Municapal Storm Drain

Runoff = 2.65 cfs @ 12.07 hrs, Volume= 8,694 cf, Depth> 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	13,633	98	Paved parking
	13,633		100.00% Impervious Area

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

Summary for Subcatchment 2S: Flow Offsite (#2 Washburn)

Runoff = 0.23 cfs @ 12.09 hrs, Volume= 681 cf, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	3,323	48	Brush, Poor
*	135	98	Impervious
	3,458	50	Weighted Average
	3,323		96.10% Pervious Area
	135		3.90% Impervious Area

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

Summary for Subcatchment 3S: Flow Offsite (#17 Kilburn)

Runoff = 0.84 cfs @ 12.09 hrs, Volume= 2,533 cf, Depth> 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	13,226	48	Brush, Poor
*	241	98	Impervious
	13,467	49	Weighted Average
	13,226		98.21% Pervious Area
	241		1.79% Impervious Area

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

Summary for Subcatchment 4S: Existing Roof to Municapal Storm Drain

Runoff = 7.19 cfs @ 12.07 hrs, Volume= 23,619 cf, Depth> 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	37,038	98	Roofs
	37,038		100.00% Impervious Area

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

Summary for Subcatchment 5S: Trench Drain to Sewer System

Runoff = 0.30 cfs @ 12.00 hrs, Volume= 873 cf, Depth> 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	1,369	98	Paved parking
	1,369		100.00% Impervious Area

Summary for Link 1: Design Point 1

Inflow Area = 52,040 sf,100.00% Impervious, Inflow Depth > 7.65" for 100-Year event
Inflow = 10.04 cfs @ 12.07 hrs, Volume= 33,186 cf
Primary = 10.04 cfs @ 12.07 hrs, Volume= 33,186 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 2: Design Point 2

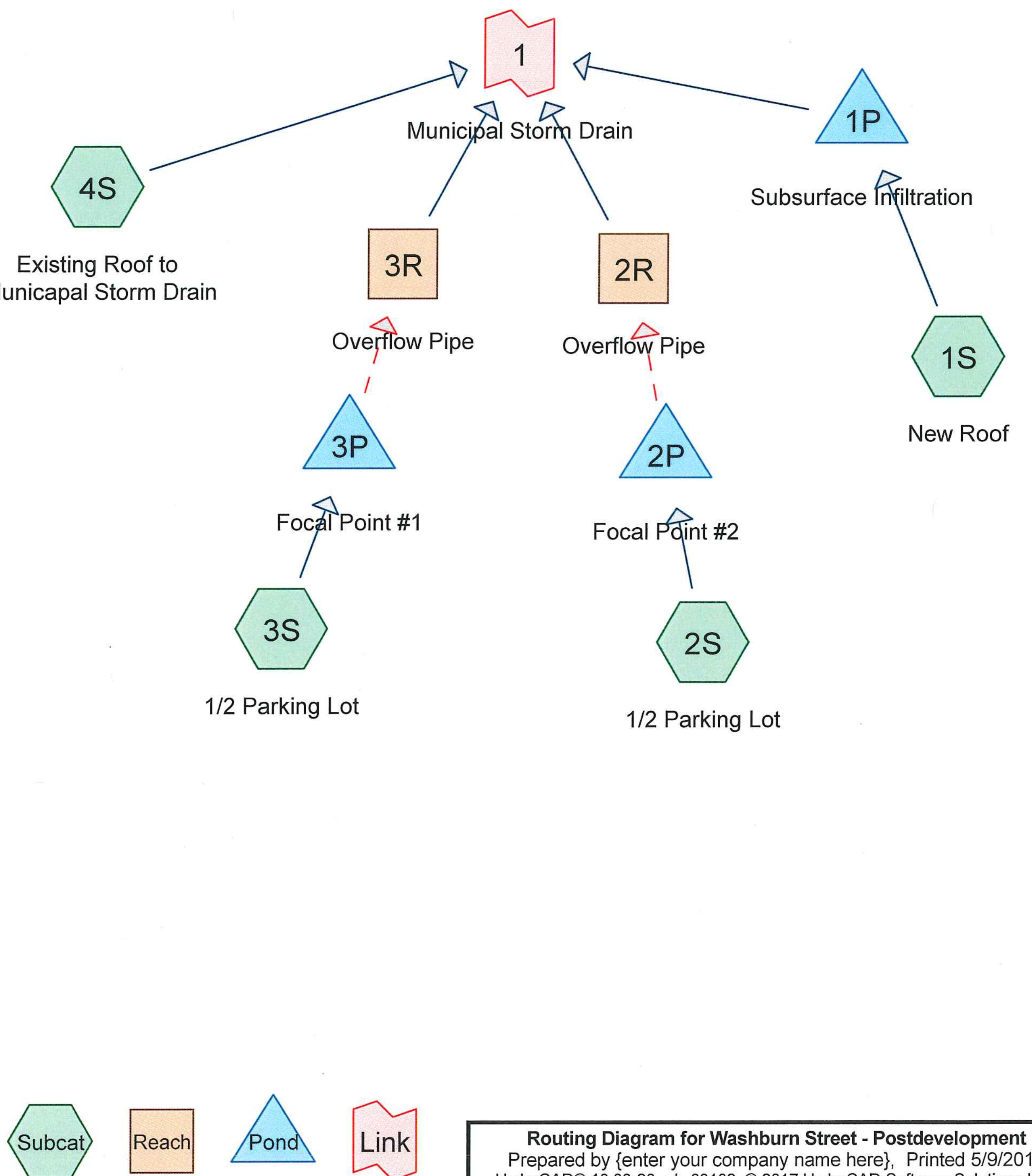
Inflow Area = 3,458 sf, 3.90% Impervious, Inflow Depth > 2.36" for 100-Year event
Inflow = 0.23 cfs @ 12.09 hrs, Volume= 681 cf
Primary = 0.23 cfs @ 12.09 hrs, Volume= 681 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Link 3: Design Point 3

Inflow Area =	13,467 sf,	1.79% Impervious,	Inflow Depth > 2.26"	for 100-Year event
Inflow =	0.84 cfs @	12.09 hrs, Volume=	2,533 cf	
Primary =	0.84 cfs @	12.09 hrs, Volume=	2,533 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



Routing Diagram for Washburn Street - Postdevelopment
Prepared by {enter your company name here}, Printed 5/9/2019

Summary for Subcatchment 1S: New Roof

Runoff = 1.25 cfs @ 12.07 hrs, Volume= 4,040 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	16,917	98	Roofs
	16,917		100.00% Impervious Area

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

Summary for Subcatchment 2S: 1/2 Parking Lot

Runoff = 0.42 cfs @ 12.08 hrs, Volume= 1,205 cf, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	7,170	98	Paved parking
*	2,907	39	Grass/Landscape
	10,077	81	Weighted Average
	2,907		28.85% Pervious Area
	7,170		71.15% Impervious Area

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

Summary for Subcatchment 3S: 1/2 Parking Lot

Runoff = 0.25 cfs @ 12.08 hrs, Volume= 706 cf, Depth> 1.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	3,918	98	Paved parking
*	1,231	39	Grass/Landscape
	5,149	84	Weighted Average
	1,231		23.91% Pervious Area
	3,918		76.09% Impervious Area

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

Summary for Subcatchment 4S: Existing Roof to Municapal Storm Drain

Runoff = 2.73 cfs @ 12.07 hrs, Volume= 8,799 cf, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.30"

	Area (sf)	CN	Description
*	36,848	98	Roofs
	36,848		100.00% Impervious Area

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

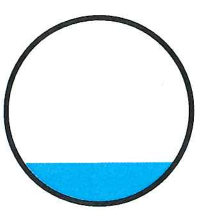
Summary for Reach 2R: Overflow Pipe

Inflow = 0.33 cfs @ 12.17 hrs, Volume= 646 cf
Outflow = 0.32 cfs @ 12.17 hrs, Volume= 646 cf, Atten= 2%, Lag= 0.2 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.61 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.59 fps, Avg. Travel Time= 0.2 min

Peak Storage= 2 cf @ 12.17 hrs
Average Depth at Peak Storage= 0.19'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.09 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 17.0' Slope= 0.0118 '/'
Inlet Invert= 4.70', Outlet Invert= 4.50'



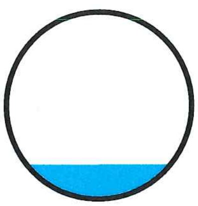
Summary for Reach 3R: Overflow Pipe

Inflow	=	0.21 cfs @	12.16 hrs,	Volume=	367 cf
Outflow	=	0.19 cfs @	12.17 hrs,	Volume=	367 cf, Atten= 7%, Lag= 0.7 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.02 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.29 fps, Avg. Travel Time= 1.0 min

Peak Storage= 5 cf @ 12.16 hrs
Average Depth at Peak Storage= 0.15'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.85 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 75.0' Slope= 0.0100 '/'
Inlet Invert= 5.25', Outlet Invert= 4.50'



Summary for Pond 1P: Subsurface Infiltration

Inflow Area =		16,917 sf,100.00% Impervious,	Inflow Depth > 2.87"	for 2-Year event	
Inflow	=	1.25 cfs @	12.07 hrs,	Volume=	4,040 cf
Outflow	=	0.38 cfs @	11.80 hrs,	Volume=	4,039 cf, Atten= 70%, Lag= 0.0 min
Discarded	=	0.38 cfs @	11.80 hrs,	Volume=	4,039 cf
Primary	=	0.00 cfs @	5.00 hrs,	Volume=	0 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.57' @ 12.37 hrs Surf.Area= 1,993 sf Storage= 660 cf

Plug-Flow detention time= 8.2 min calculated for 4,038 cf (100% of inflow)
Center-of-Mass det. time= 8.0 min (745.5 - 737.5)

Volume	Invert	Avail.Storage	Storage Description
#1	3.90'	1,403 cf	**24.81'W x 80.32'L x 2.33'H Prismatoid** 4,643 cf Overall - 1,135 cf Embedded = 3,508 cf x 40.0% Voids
#2	4.40'	1,135 cf	**ADS_StormTech SC-310 +Cap** x 77 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 7 Rows of 11 Chambers
		2,538 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.90'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	5.63'	**8.0" Round Culvert** L= 45.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 5.63' / 4.50' S= 0.0251 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.38 cfs @ 11.80 hrs HW=3.92' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=3.90' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 2P: Focal Point #2

Inflow Area = 10,077 sf, 71.15% Impervious, Inflow Depth > 1.43" for 2-Year event
Inflow = 0.42 cfs @ 12.08 hrs, Volume= 1,205 cf
Outflow = 0.33 cfs @ 12.17 hrs, Volume= 916 cf, Atten= 20%, Lag= 5.3 min
Discarded = 0.01 cfs @ 17.82 hrs, Volume= 270 cf
Secondary = 0.33 cfs @ 12.17 hrs, Volume= 646 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.91' @ 12.17 hrs Surf.Area= 36 sf Storage= 337 cf

Plug-Flow detention time= 90.1 min calculated for 913 cf (76% of inflow)
Center-of-Mass det. time= 30.6 min (829.8 - 799.2)

Volume	Invert	Avail.Storage	Storage Description
#1	6.33'	378 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
#2	4.08'	16 cf	**6.00'W x 6.00'L x 2.25'H Prismatoid** 81 cf Overall x 20.0% Voids
#3	3.92'	3 cf	**ACF R-Tank XD 1** x 6 Inside= 19.7"W x 2.0"H => 0.24 sf x 1.97'L = 0.5 cf Outside= 19.7"W x 2.0"H => 0.27 sf x 1.97'L = 0.5 cf 3 Rows of 2 Chambers
		397 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	466	0	0
6.50	514	83	83
7.00	664	295	378

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.92'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	6.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.01 cfs @ 17.82 hrs HW=6.83' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

Secondary OutFlow Max=0.29 cfs @ 12.17 hrs HW=6.90' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.29 cfs @ 0.87 fps)

Summary for Pond 3P: Focal Point #1

Inflow Area =	5,149 sf, 76.09% Impervious,	Inflow Depth > 1.65"	for 2-Year event	
Inflow =	0.25 cfs @	12.08 hrs, Volume=	706 cf	
Outflow =	0.21 cfs @	12.16 hrs, Volume=	527 cf,	Atten= 13%, Lag= 4.8 min
Discarded =	0.01 cfs @	17.47 hrs, Volume=	161 cf	
Secondary =	0.21 cfs @	12.16 hrs, Volume=	367 cf	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.89' @ 12.16 hrs Surf.Area= 20 sf Storage= 202 cf

Plug-Flow detention time= 92.2 min calculated for 527 cf (75% of inflow)
Center-of-Mass det. time= 30.5 min (821.9 - 791.4)

Volume	Invert	Avail.Storage	Storage Description
#1	6.33'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
#2	4.08'	9 cf	**4.00'W x 5.00'L x 2.25'H Prismatoid** 45 cf Overall x 20.0% Voids
#3	3.92'	2 cf	**ACF R-Tank XD 1** x 4 Inside= 19.7"W x 2.0"H => 0.24 sf x 1.97'L = 0.5 cf Outside= 19.7"W x 2.0"H => 0.27 sf x 1.97'L = 0.5 cf 2 Rows of 2 Chambers
		250 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	275	0	0
6.50	314	50	50
7.00	444	190	240

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.92'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	6.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 17.47 hrs HW=6.83' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Secondary OutFlow Max=0.19 cfs @ 12.16 hrs HW=6.88' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.19 cfs @ 0.76 fps)

Summary for Link 1: Municipal Storm Drain

Inflow Area =	53,765 sf,100.00% Impervious,	Inflow Depth > 2.19"	for 2-Year event	
Inflow =	2.74 cfs @ 12.08 hrs,	Volume=	9,812 cf	
Primary =	2.74 cfs @ 12.08 hrs,	Volume=	9,812 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment 1S: New Roof

Runoff = 1.87 cfs @ 12.07 hrs, Volume= 6,075 cf, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	16,917	98	Roofs
	16,917		100.00% Impervious Area

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

Summary for Subcatchment 2S: 1/2 Parking Lot

Runoff = 0.78 cfs @ 12.08 hrs, Volume= 2,261 cf, Depth> 2.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	7,170	98	Paved parking
*	2,907	39	Grass/Landscape
	10,077	81	Weighted Average
	2,907		28.85% Pervious Area
	7,170		71.15% Impervious Area

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

Summary for Subcatchment 3S: 1/2 Parking Lot

Runoff = 0.44 cfs @ 12.07 hrs, Volume= 1,273 cf, Depth> 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	3,918	98	Paved parking
*	1,231	39	Grass/Landscape
	5,149	84	Weighted Average
	1,231		23.91% Pervious Area
	3,918		76.09% Impervious Area

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

Summary for Subcatchment 4S: Existing Roof to Municapal Storm Drain

Runoff = 4.06 cfs @ 12.07 hrs, Volume= 13,233 cf, Depth> 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.88"

	Area (sf)	CN	Description
*	36,848	98	Roofs
	36,848		100.00% Impervious Area

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

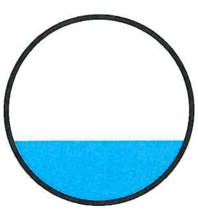
Summary for Reach 2R: Overflow Pipe

Inflow = 0.76 cfs @ 12.10 hrs, Volume= 1,680 cf
Outflow = 0.75 cfs @ 12.10 hrs, Volume= 1,680 cf, Atten= 0%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.68 fps, Min. Travel Time= 0.1 min
Avg. Velocity = 1.82 fps, Avg. Travel Time= 0.2 min

Peak Storage= 3 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.09 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 17.0' Slope= 0.0118 '/'
Inlet Invert= 4.70', Outlet Invert= 4.50'



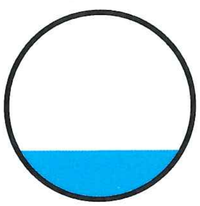
Summary for Reach 3R: Overflow Pipe

Inflow = 0.43 cfs @ 12.10 hrs, Volume= 923 cf
Outflow = 0.42 cfs @ 12.11 hrs, Volume= 923 cf, Atten= 2%, Lag= 0.5 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.76 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.42 fps, Avg. Travel Time= 0.9 min

Peak Storage= 9 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.22'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.85 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 75.0' Slope= 0.0100 '/'
Inlet Invert= 5.25', Outlet Invert= 4.50'



Summary for Pond 1P: Subsurface Infiltration

Inflow Area = 16,917 sf,100.00% Impervious, Inflow Depth > 4.31" for 10-Year event
Inflow = 1.87 cfs @ 12.07 hrs, Volume= 6,075 cf
Outflow = 0.38 cfs @ 11.70 hrs, Volume= 6,074 cf, Atten= 80%, Lag= 0.0 min
Discarded = 0.38 cfs @ 11.70 hrs, Volume= 6,074 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.10' @ 12.49 hrs Surf.Area= 1,993 sf Storage= 1,447 cf

Plug-Flow detention time= 19.9 min calculated for 6,073 cf (100% of inflow)
Center-of-Mass det. time= 19.7 min (754.3 - 734.5)

Volume	Invert	Avail.Storage	Storage Description
#1	3.90'	1,403 cf	**24.81'W x 80.32'L x 2.33'H Prismatoid** 4,643 cf Overall - 1,135 cf Embedded = 3,508 cf x 40.0% Voids
#2	4.40'	1,135 cf	**ADS_StormTech SC-310 +Cap** x 77 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 7 Rows of 11 Chambers
		2,538 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.90'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	5.63'	**8.0" Round Culvert** L= 45.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 5.63' / 4.50' S= 0.0251 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.38 cfs @ 11.70 hrs HW=3.93' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=3.90' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Summary for Pond 2P: Focal Point #2

Inflow Area = 10,077 sf, 71.15% Impervious, Inflow Depth > 2.69" for 10-Year event
Inflow = 0.78 cfs @ 12.08 hrs, Volume= 2,261 cf
Outflow = 0.76 cfs @ 12.10 hrs, Volume= 1,971 cf, Atten= 2%, Lag= 1.5 min
Discarded = 0.01 cfs @ 9.43 hrs, Volume= 291 cf
Secondary = 0.76 cfs @ 12.10 hrs, Volume= 1,680 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.96' @ 12.10 hrs Surf.Area= 36 sf Storage= 373 cf

Plug-Flow detention time= 57.8 min calculated for 1,971 cf (87% of inflow)
Center-of-Mass det. time= 18.4 min (803.2 - 784.8)

Volume	Invert	Avail.Storage	Storage Description
#1	6.33'	378 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
#2	4.08'	16 cf	**6.00'W x 6.00'L x 2.25'H Prismatoid** 81 cf Overall x 20.0% Voids
#3	3.92'	3 cf	**ACF R-Tank XD 1** x 6 Inside= 19.7"W x 2.0"H => 0.24 sf x 1.97'L = 0.5 cf Outside= 19.7"W x 2.0"H => 0.27 sf x 1.97'L = 0.5 cf 3 Rows of 2 Chambers
		397 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	466	0	0
6.50	514	83	83
7.00	664	295	378

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.92'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	6.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 9.43 hrs HW=4.08' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Secondary OutFlow Max=0.75 cfs @ 12.10 hrs HW=6.96' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.75 cfs @ 1.19 fps)

Summary for Pond 3P: Focal Point #1

Inflow Area =	5,149 sf,	76.09% Impervious,	Inflow Depth > 2.97"	for 10-Year event	
Inflow =	0.44 cfs @	12.07 hrs,	Volume=	1,273 cf	
Outflow =	0.43 cfs @	12.10 hrs,	Volume=	1,094 cf,	Atten= 1%, Lag= 1.3 min
Discarded =	0.01 cfs @	9.13 hrs,	Volume=	171 cf	
Secondary =	0.43 cfs @	12.10 hrs,	Volume=	923 cf	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.92' @ 12.10 hrs Surf.Area= 20 sf Storage= 216 cf

Plug-Flow detention time= 61.9 min calculated for 1,094 cf (86% of inflow)
Center-of-Mass det. time= 19.7 min (797.4 - 777.7)

Volume	Invert	Avail.Storage	Storage Description
#1	6.33'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
#2	4.08'	9 cf	**4.00'W x 5.00'L x 2.25'H Prismatoid** 45 cf Overall x 20.0% Voids
#3	3.92'	2 cf	**ACF R-Tank XD 1** x 4 Inside= 19.7"W x 2.0"H => 0.24 sf x 1.97'L = 0.5 cf Outside= 19.7"W x 2.0"H => 0.27 sf x 1.97'L = 0.5 cf 2 Rows of 2 Chambers
		250 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	275	0	0
6.50	314	50	50
7.00	444	190	240

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.92'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	6.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 9.13 hrs HW=4.08' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Secondary OutFlow Max=0.42 cfs @ 12.10 hrs HW=6.92' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.42 cfs @ 0.98 fps)

Summary for Link 1: Municipal Storm Drain

Inflow Area =	53,765 sf,100.00% Impervious,	Inflow Depth > 3.53"	for 10-Year event	
Inflow =	5.14 cfs @ 12.08 hrs,	Volume=	15,836 cf	
Primary =	5.14 cfs @ 12.08 hrs,	Volume=	15,836 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Subcatchment 1S: New Roof

Runoff = 3.29 cfs @ 12.07 hrs, Volume= 10,788 cf, Depth> 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	16,917	98	Roofs
	16,917		100.00% Impervious Area

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

Summary for Subcatchment 2S: 1/2 Parking Lot

Runoff = 1.67 cfs @ 12.07 hrs, Volume= 4,970 cf, Depth> 5.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	7,170	98	Paved parking
*	2,907	39	Grass/Landscape
	10,077	81	Weighted Average
	2,907		28.85% Pervious Area
	7,170		71.15% Impervious Area

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

Summary for Subcatchment 3S: 1/2 Parking Lot

Runoff = 0.89 cfs @ 12.07 hrs, Volume= 2,690 cf, Depth> 6.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	3,918	98	Paved parking
*	1,231	39	Grass/Landscape
	5,149	84	Weighted Average
	1,231		23.91% Pervious Area
	3,918		76.09% Impervious Area

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

Summary for Subcatchment 4S: Existing Roof to Municapal Storm Drain

Runoff = 7.16 cfs @ 12.07 hrs, Volume= 23,498 cf, Depth> 7.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
*	36,848	98	Roofs
	36,848		100.00% Impervious Area

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

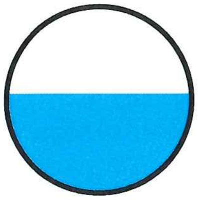
Summary for Reach 2R: Overflow Pipe

Inflow = 1.73 cfs @ 12.07 hrs, Volume= 4,326 cf
Outflow = 1.71 cfs @ 12.07 hrs, Volume= 4,325 cf, Atten= 1%, Lag= 0.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 5.77 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 2.37 fps, Avg. Travel Time= 0.1 min

Peak Storage= 5 cf @ 12.07 hrs
Average Depth at Peak Storage= 0.44'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 3.09 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 17.0' Slope= 0.0118 '/'
Inlet Invert= 4.70', Outlet Invert= 4.50'



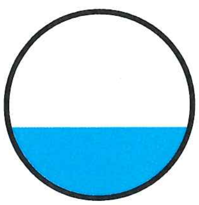
Summary for Reach 3R: Overflow Pipe

Inflow = 0.88 cfs @ 12.09 hrs, Volume= 2,307 cf
Outflow = 0.87 cfs @ 12.10 hrs, Volume= 2,306 cf, Atten= 1%, Lag= 0.4 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.60 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 1.85 fps, Avg. Travel Time= 0.7 min

Peak Storage= 14 cf @ 12.10 hrs
Average Depth at Peak Storage= 0.32'
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.85 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 75.0' Slope= 0.0100 '/'
Inlet Invert= 5.25', Outlet Invert= 4.50'



Summary for Pond 1P: Subsurface Infiltration

Inflow Area = 16,917 sf,100.00% Impervious, Inflow Depth > 7.65" for 100-Year event
Inflow = 3.29 cfs @ 12.07 hrs, Volume= 10,788 cf
Outflow = 1.72 cfs @ 12.24 hrs, Volume= 10,786 cf, Atten= 48%, Lag= 10.4 min
Discarded = 0.38 cfs @ 11.55 hrs, Volume= 9,452 cf
Primary = 1.34 cfs @ 12.24 hrs, Volume= 1,334 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.78' @ 12.25 hrs Surf.Area= 1,993 sf Storage= 2,538 cf

Plug-Flow detention time= 31.3 min calculated for 10,749 cf (100% of inflow)
Center-of-Mass det. time= 31.0 min (763.1 - 732.1)

Volume	Invert	Avail.Storage	Storage Description
#1	3.90'	1,403 cf	**24.81'W x 80.32'L x 2.33'H Prismatoid** 4,643 cf Overall - 1,135 cf Embedded = 3,508 cf x 40.0% Voids
#2	4.40'	1,135 cf	**ADS_StormTech SC-310 +Cap** x 77 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 7 Rows of 11 Chambers
		2,538 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.90'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	5.63'	**8.0" Round Culvert** L= 45.0' CMP, mitered to conform to fill, Ke= 0.700 Inlet / Outlet Invert= 5.63' / 4.50' S= 0.0251 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.35 sf

Discarded OutFlow Max=0.38 cfs @ 11.55 hrs HW=3.93' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.38 cfs)

Primary OutFlow Max=1.29 cfs @ 12.24 hrs HW=6.72' (Free Discharge)
↑—**2=Culvert** (Inlet Controls 1.29 cfs @ 3.71 fps)

Summary for Pond 2P: Focal Point #2

Inflow Area = 10,077 sf, 71.15% Impervious, Inflow Depth > 5.92" for 100-Year event
Inflow = 1.67 cfs @ 12.07 hrs, Volume= 4,970 cf
Outflow = 1.73 cfs @ 12.07 hrs, Volume= 4,676 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.01 cfs @ 7.23 hrs, Volume= 350 cf
Secondary = 1.73 cfs @ 12.07 hrs, Volume= 4,326 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 7.06' @ 12.07 hrs Surf.Area= 36 sf Storage= 397 cf

Plug-Flow detention time= 36.1 min calculated for 4,676 cf (94% of inflow)
Center-of-Mass det. time= 14.3 min (780.5 - 766.1)

Volume	Invert	Avail.Storage	Storage Description
#1	6.33'	378 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
#2	4.08'	16 cf	**6.00'W x 6.00'L x 2.25'H Prismatoid** 81 cf Overall x 20.0% Voids
#3	3.92'	3 cf	**ACF R-Tank XD 1** x 6 Inside= 19.7"W x 2.0"H => 0.24 sf x 1.97'L = 0.5 cf Outside= 19.7"W x 2.0"H => 0.27 sf x 1.97'L = 0.5 cf 3 Rows of 2 Chambers
		397 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	466	0	0
6.50	514	83	83
7.00	664	295	378

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.92'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	6.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 7.23 hrs HW=4.08' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Secondary OutFlow Max=1.63 cfs @ 12.07 hrs HW=7.05' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 1.63 cfs @ 1.55 fps)

Summary for Pond 3P: Focal Point #1

Inflow Area = 5,149 sf, 76.09% Impervious, Inflow Depth > 6.27" for 100-Year event
Inflow = 0.89 cfs @ 12.07 hrs, Volume= 2,690 cf
Outflow = 0.88 cfs @ 12.09 hrs, Volume= 2,510 cf, Atten= 1%, Lag= 1.2 min
Discarded = 0.01 cfs @ 6.93 hrs, Volume= 203 cf
Secondary = 0.88 cfs @ 12.09 hrs, Volume= 2,307 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.98' @ 12.09 hrs Surf.Area= 20 sf Storage= 241 cf

Plug-Flow detention time= 40.1 min calculated for 2,501 cf (93% of inflow)
Center-of-Mass det. time= 16.1 min (776.2 - 760.0)

Volume	Invert	Avail.Storage	Storage Description
#1	6.33'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) -Impervious
#2	4.08'	9 cf	**4.00'W x 5.00'L x 2.25'H Prismatoid** 45 cf Overall x 20.0% Voids
#3	3.92'	2 cf	**ACF R-Tank XD 1** x 4 Inside= 19.7"W x 2.0"H => 0.24 sf x 1.97'L = 0.5 cf Outside= 19.7"W x 2.0"H => 0.27 sf x 1.97'L = 0.5 cf 2 Rows of 2 Chambers
		250 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
6.33	275	0	0
6.50	314	50	50
7.00	444	190	240

Device	Routing	Invert	Outlet Devices
#1	Discarded	3.92'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.10'
#2	Secondary	6.83'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.00 cfs @ 6.93 hrs HW=4.08' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.00 cfs)

Secondary OutFlow Max=0.86 cfs @ 12.09 hrs HW=6.98' (Free Discharge)
↑—**2=Orifice/Grate** (Weir Controls 0.86 cfs @ 1.25 fps)

Summary for Link 1: Municipal Storm Drain

Inflow Area =	53,765 sf,100.00% Impervious,	Inflow Depth > 7.02"	for 100-Year event	
Inflow =	9.68 cfs @	12.07 hrs, Volume=	31,464 cf	
Primary =	9.68 cfs @	12.07 hrs, Volume=	31,464 cf,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

CONSTRUCTION POLLUTION PREVENTION PLAN

&

OPERATION AND MAINTENANCE PLAN

PREPARED FOR

"Self-Storage Facility"
#8 Washburn Street
New Bedford, MA 02740

OWNER AND OPERATOR:

MA NEW BEDFORD & WASHBURN, LLC
101 SOUTH 200 EAST, SUITE 200
SALT LAKE CITY, UT 84111

PREPARED BY

BRACKEN ENGINEERING, INC.
49 HERRING POND ROAD
BUZZARDS BAY, MA 02532

MAY 9, 2019

CONSTRUCTION POLLUTION PREVENTION PLAN

SITE EVALUATION AND DESIGN DEVELOPMENT

EXISTING CONDITIONS

The property is a developed 1.59+/- acre parcel located in the Eastern portion of the city, directly across from the Interstate 195 on ramp and West of the Acushnet River. The property is generally surrounded by a combination of commercial and residential properties to the East, West and South and a municipal park to the North. The property is improved by a vacant commercial building, paved parking area and public utilities. A large portion of the existing building has had the roof collapse and has been overgrown by vegetation; only the walls and concrete slab remain of that portion.

The closest water body to the property is the Acushnet River which is located 350' to 500' to the East. A portion of the site lies within LSCSF identified as FEMA Special Flood Hazard Zone AE (Elevation 6) as shown on FEMA Flood Insurance Rate Map No. 25005C-0393-G dated July 16, 2014. The remainder of the site is an area mapped as Flood Zone X that is "being protected from the 1-percent-annual-chance or greater flood hazard by a levee system. There are no other jurisdictional wetland resource areas located within 100 feet of the parcel. Groundwater on site is roughly 6 feet below grade and appears to be somewhat influenced by tide changes. Most of the stormwater runoff generated on site discharges to the City's stormwater management system, via roof leaders and a single catch basin in the parking area.

SOILS INFORMATION

The site is mapped as Urban Fill as depicted by the USDA Web Soil Survey Mapping Service. This was confirmed by a geotechnical report prepared by McArdle Gannon Associates, Inc., which indicates the urban fill to depths of 10 or 11 feet.

RUNOFF WATER QUALITY

Currently there is no available information regarding the quality of runoff from the site.

NAME OF RECEIVING WATER

Site drains into the municipal system in Washburn Street the eventually discharges into the Acushnet River.

RAINFALL DATA

To estimate what runoff would be generated under proposed watershed conditions and to determine the capacity of the infiltration system, a mathematical model of the watersheds was prepared. The model utilized the standard engineering practices based on the

National Engineering Handbook, Section 4, Hydrology (NEH-4), and the Soil Conservation Services (SCS) Technical Release 20 (TR-20), Urban Hydrology for Small Watersheds. The system was analyzed using the rainfall data for the two (2) year, ten (10) year and one hundred (100) year, 24-hour duration storm frequency in accordance with the City of New Bedford's Stormwater Management Rules and Regulations and the Mass DEP Stormwater Management Standards. The rainfall data was based on the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 - point precipitation frequency estimates.

SITE PLAN DEVELOPMENT

The project is the proposed rehabilitation of the existing building to create a self-storage facility. The rehabilitation will include enclosing the previously mentioned portion of the structure that is without a roof. Site improvements will also include the re-grading and paving of the parking area and upgrade of existing drainage and utilities.

SITE MAP

Refer to the grading, drainage and utilities sheet as part of the development plan set. These plans indicate areas of disturbance, grading, stormwater controls, erosion control measures, etc.

Existing and proposed drainage patterns are indicated on the Pre- and Post- development Watershed Maps as well as the Grading and Drainage plan. These plans show the location of proposed subsurface infiltration systems to control runoff.

ASSESSMENT

MEASURE SITE AREA

The total project area is 1.59 acres.

DRAINAGE AREAS AND HYDROLOGICAL ANALYSIS

Refer to the Pre- and Post-Development Watershed Maps for drainage areas. Runoff quantities and drainage system designs were completed. Refer to the hydrology report additional information.

EROSION AND SEDIMENT CONTROLS

Staked hay bales, wattles, construction fencing and/or silt fence shall be located at all downgradient areas of construction activity and/or along the limit of work. Erosion control shall be inspected weekly and after significant rainfalls and replaced where necessary.

Silt Sacks are to be installed according to the Demolition and Erosion Control Plan and are to be inspected and cleaned as necessary.

CONSTRUCTION ENTRANCE

A stabilized construction entrance shall be maintained throughout the project. Temporary paved driveway entrances are to be utilized with silt fence during site development in conjunction with stone tracking pads are to be installed. Contractor is to maintain a clean entrance at all times and prevent any tracking of material out onto Washburn Street.

STORMWATER MANAGEMENT CONTROLS

The collection systems are comprised of a combination of Focal Point Biofiltration Systems, manholes, and subsurface infiltration systems. Refer to hydrology report for detailed analysis along with Total Suspended Solids (TSS) removal rates. See site plans for design and details.

CONSTRUCTION OPERATION AND MAINTENANCE PLAN

The following is an Operations and Maintenance Plan during construction activities:

FACILITY DESCRIPTION:

The drainage system components consist of the following:

- Two (2) Focal Point Biofiltration Systems
- One (1) subsurface leaching system

MAINTENANCE DURING SITE CONSTRUCTION:

Stockpile areas shall be located in an area away from the driveway/parking areas to avoid entering proposed stormwater management systems and/or the abutting properties. The perimeter of any stockpile area is to be staked with silt fence and/or haybales, if required. Any stockpile to be left in place for greater than 30 days is to be stabilized with an approved means.

The Focal Points shall be protected during construction with haybales and silt fence. Avoid excessive soil compaction around the Focal Points. The Focal Point areas shall be used as a temporary catchment area until site is stabilized. Runoff is to be directed to the planned Focal Points only after the contributing drainage area is fully stabilized (Refer to manufacturer's O&M attached for more information).

Subsurface infiltration units shall be protected during construction with haybales and/or silt fence. Avoid excessive soil compaction around the infiltration areas. Roof runoff is to be directed to the planned infiltration areas only after the pavement area above has been installed.

A stone construction pad shall be installed at each entrance and maintained until the surrounding areas are stabilized and the entrance permanently paved.

All erosion control measures shall be inspected and repaired or replaced following every rainfall event of 0.5" or greater.

MAINTENANCE DURING BUILDING CONSTRUCTION:

Areas that drain to the driveway/parking areas, such as landscape/lawn areas, shall be permanently stabilized prior to final driveway/parking surfacing.

The site contractor shall be responsible for maintaining all erosion control measures.

The site contractor shall inspect all of the erosion control measures on a weekly basis and repair/replace as required. The site contractor shall also inspect all erosion control measures after each significant rainstorm. Additional erosion control measures are to be maintained onsite for emergency use.

Focal Point Systems shall be cleaned at least once every six (6) months during construction. Additional cleaning may be required following significant rainstorms (Refer to manufacturer's O&M attached for more information).

FINAL CONSTRUCTION MAINTENANCE:

The permanent operation and maintenance plan shall begin only after the following:

- Driveway/parking area construction and slope stabilization is complete;
- Building construction is complete;
- All disturbed areas are adequately vegetated and stabilized;
- All Focal Point Systems, manholes, and subsurface systems have been pumped and completely cleaned, and;
- The systems have been completely inspected by the design engineer and the city's representative and found to be functioning as designed in that no clogging of the leaching system has occurred during construction.

PERMANENT OPERATION AND MAINTENANCE PLAN

RESPONSIBLE PARTY: MA New Bedford & Washburn, LLC

Non-Structural BMP's

Implementing source controls can aid in reducing the types and concentrations of contaminants in stormwater runoff, which in turn can result in improved water quality. This principle for pollution prevention and non-structural controls, or Best Management Practices (BMP's), is to minimize the volume of runoff and to minimize contact of storm water with potential pollutants. Measures such as managing snow removal and educating the owner/operator of good maintenance practices are examples of non-structural BMP's.

PUBLIC AWARENESS

Periodically, the facility owner or property management shall issue reminder to its guests to prevent dumping or releasing pollutants to the storm drain, the ground, and the parking areas.

SNOW AND SNOWMELT MANAGEMENT

It is suggested that during minor snowfall events the snow be stockpiled along the edge of landscaping areas up gradient of a proposed Focal Point Systems. It is the responsibility of the owner to make sure the snow removal contractor does not pile the snow on top of the proposed Focal Point Systems. The owner is to remove sediment from snow storage areas every spring.

It is suggested that no de-icing compounds, such as CaCL2, calcium magnesium acetate (CMA) be used on the site. The snow removal contractor shall store all sand off-site. No quantities of sand compounds shall be stored or disposed of on-site.

STRUCTURAL BMP'S

Structural BMP's are those physical facilities that are designed to manage both stormwater quantity and quality. Proper maintenance of the proposed structural BMP's will ensure design performance and promote longevity of the structure and may decrease operator maintenance costs. The structural BMP's selected for the proposed site development include: Focal Point Biofiltration Systems and subsurface infiltration systems.

SUBSURFACE INFILTRATION SYSTEMS

The subsurface infiltration systems shall be used to retain, mitigate and recharge proposed runoff back into the aquifer. Infiltration systems shall be inspected four times a year to ensure that the systems are clean of debris and sediment. Access is available via the manhole covers to grade. Remove accumulated sediment and debris from the chambers and dispose at an approved off-site location.

If a system is found to be clogged, it first shall be cleaned with a vacuum truck. If it is still found not to be operational then the system shall be replaced and or enlarged.

STANDARD 10

Illicit Discharge Pollution Prevention Statement
For
Self-Storage Facility - 8 Washburn Street New Bedford, MA

May 9, 2019

There is to be no dumping of toxins, pollutants, or illicit materials into the storm drainage systems on-site as it is strictly prohibited by law.

Toxins, pollutants, or illicit materials consist of, but are not limited to: paint, bleach, antifreeze, motor oil, raw sewage, hydrocarbons, kitchen grease, lubricating grease, etc.

The on-site storm drainage systems are to be inspected periodically in accordance with the Operations and Maintenance plan. At the time of inspection, an inspection for illicit discharges shall be conducted. If illicit discharges are found during inspection, then immediate action should be taken to remediate and clean up the illicit discharge.

The remediation and/or clean-up is to be performed by a qualified company, such as Clean Harbors, 42 Longwater Dr., Norwell, MA 02061, Phone 1-800-645-8265 or equivalent.

Acknowledgement:

____

MA New Bedford & Washburn, LLC
101 South 200 East Suite 200
Salt Lake City, UT 84111

FocalPoint

BIOFILTRATION SYSTEMS

HIGH PERFORMANCE MODULAR BIOFILTRATION SYSTEM (HPMBS)

Operations & Maintenance

ACF ENVIRONMENTAL
Customer Focused, Environmentally Committed

GENERAL DESCRIPTION

The following general specifications describe the general operations and maintenance requirements for the FocalPoint® High Performance Modular Biofiltration System (HPMBS). The system utilizes physical, chemical and biological mechanisms of a soil, plant and microbe complex to remove pollutants typically found in urban stormwater runoff. The treatment system is a fully equipped, modular, constructed in place system designed to treat contaminated runoff.

Stormwater enters the FocalPoint® HPMBS, is filtered by the High Flow Biofiltration Media and passes through to the underdrain/storage system where the treated water is detained, retained or infiltrated to sub-soils, prior to discharge to the storm sewer system of any remaining flow.

Higher flows bypass the FocalPoint® HPMBS via a downstream inlet or other overflow conveyance. Maintenance is a simple, inexpensive and safe operation that does not require confined space entry, pumping or vacuum equipment, or specialized tools. Properly trained landscape personnel can effectively maintain FocalPoint® HPMBS by following instructions in this manual.

BASIC OPERATIONS

FocalPoint® is a modular, high performance biofiltration system that often works in tandem with other integrated management practices (IMP). Contaminated stormwater runoff enters the biofiltration bed through a conveyance swale, planter box, or directly through a curb cut or false inlet. Energy is dissipated by a rock or vegetative dissipation device and is absorbed by a 3-inch layer of aged, double shredded hardwood mulch, with fines removed, (when specified) on the surface of the biofiltration media.

As the water passes through the mulch layer, most of the larger sediment particles and heavy metals are removed through sedimentation and chemical reactions with the organic material in the mulch. Water passes through the biofiltration media where the finer particles are removed and numerous chemical reactions take place to immobilize and capture pollutants in the soil media.

The cleansed water passes into the underdrain/storage system and remaining flows are directed to a storm sewer system or other appropriate discharge point. Once the pollutants are in the soil, bacteria begin to break down and metabolize the materials and the plants begin to uptake and metabolize the pollutants. Some pollutants such as heavy metals, which are chemically bound to organic particles in the mulch, are released over time as the organic matter decomposes to release the metals to the feeder roots of the plants and the cells of the bacteria in the soil where they remain and are recycled. Other pollutants such as phosphorus are chemically bound to the soil particles and released slowly back to the plants and bacteria and used in their metabolic processes. Nitrogen goes through a variety of very complex biochemical processes where it can ultimately end up in the plant/bacteria biomass, turned to nitrogen gas or dissolves back into the water column as nitrates depending on soil temperature, pH and the availability of oxygen. The pollutants ultimately are retained in the mulch, soil and biomass with some passing out of the system into the air or back into the water.

DESIGN AND INSTALLATION

Each project presents different scopes for the use of FocalPoint® HPMBS. To ensure the safe and specified function of this stormwater BMP, Convergent Water Technologies and/or its Value Added Resellers (VAR) review each application before supply. Information and design assistance is available to the design engineer during the planning process. Correct FocalPoint® sizing is essential to optimum performance. The engineer shall submit calculations for approval by the local jurisdiction when required. The contractor and/or VAR is responsible for the correct installation of FocalPoint® HPMBS units as described in approved plans. A comprehensive installation manual is available at www.convergentwater.com.

MAINTENANCE

Why Maintain?

All stormwater treatment systems require maintenance for effective operation. This necessity is often incorporated in your property's permitting process as a legally binding BMP maintenance agreement. Other reasons for maintenance include:

- Avoid legal challenges from your jurisdiction's maintenance enforcement program.
- Prolong the lifespan of your FocalPoint® HPMBS.
- Avoid costly repairs.
- Help reduce pollutant loads leaving your property.

Simple maintenance of the FocalPoint® HPMBS is required to continue effective pollutant removal from stormwater runoff before any discharge into downstream waters. This procedure will also extend the longevity of the living biofiltration system. The unit will recycle and accumulate pollutants within the biomass, but may also subjected to other materials entering the surface of the system. This may include trash, silt and leaves etc. which will be contained above the mulch and/or biofiltration media layer. Too much silt may inhibit the FocalPoint's® HPMBS flow rate, which is a primary reason for system maintenance. Removal of accumulated silt/sediment and/or replacement of the mulch layer (when specified), is an important activity that prevents over accumulation of such silt/sediment.

When to Maintain?

Convergent Water Technologies and/or its VAR includes a 1-year maintenance plan with each system purchased. Annual included maintenance consists of two (2) scheduled maintenance visits. Additional maintenance may be necessary depending on sediment and trash loading (by Owner or at additional cost). The start of the maintenance plan begins when the system is activated for full operation. Full operation is defined as when the site is appropriately stabilized, the unit is installed and activated (by VAR), i.e., when mulch (if specified) and plantings are added.

Activation should be avoided until the site is fully stabilized (full landscaping, grass cover, final paving and street sweeping completed). Maintenance visits are scheduled seasonally; the spring visit aims to clean up after winter loads including salts and sands. The fall visit helps the system by removing excessive leaf litter.

A first inspection to determine if maintenance is necessary should be performed at least twice annually after storm events of greater than (1) one inch total depth (subject to regional climate). Please refer to the maintenance checklist for specific conditions that indicate if maintenance is necessary.

It has been found that in regions which receive between 30-50 inches of annual rainfall, (2) two visits are generally required. Regions with less rainfall often only require (1) one visit per annum. Varying land uses can affect maintenance frequency.

Some sites may be subjected to extreme sediment or trash loads, requiring more frequent maintenance visits. This is the reason for detailed notes of maintenance actions per unit, helping the VAR/Maintenance contractor and Owner predict future maintenance frequencies, reflecting individual site conditions.

Owners must promptly notify the VAR/Maintenance contractor of any damage to the plant(s), which constitute(s) an integral part of the biofiltration technology. Owners should also advise other landscape or maintenance contractors to leave all maintenance of the FocalPoint® HPMBS to the VAR/Maintenance contractor (i.e. no pruning or fertilizing).

EXCLUSION OF SERVICES

It is the responsibility of the owner to provide adequate irrigation when necessary to the plant(s) in the FocalPoint® HPMBS.

Clean up due to major contamination such as oils, chemicals, toxic spills, etc. will result in additional costs and are not covered under the VAR/Maintenance contractor maintenance contract. Should a major contamination event occur, the Owner must block off the outlet pipe of the FocalPoint® (where the cleaned runoff drains to, such as drop-inlet) and block off the point where water enters of the FocalPoint® HPMBS. The VAR/Maintenance contractor should be informed immediately.

MAINTENANCE VISIT SUMMARY

Each maintenance visit consists of the following simple tasks (detailed instructions below).

1. Inspection of FocalPoint® HPMBS and surrounding area
2. Removal of debris, trash and mulch
3. Mulch replacement
4. Plant health evaluation (including measurements) and pruning or replacement as necessary
5. Clean area around FocalPoint® HPMBS
6. Complete paperwork, including date stamped photos of the tasks listed above.

MAINTENANCE TOOLS, SAFETY EQUIPMENT AND SUPPLIES

Ideal tools include: camera, bucket, shovel, broom, pruners, hoe/rake, and tape measure. Appropriate Personal Protective Equipment (PPE) should be used in accordance with local or company procedures. This may include impervious gloves where the type of trash is unknown, high visibility clothing and barricades when working in close proximity to traffic and also safety hats and shoes.

MAINTENANCE VISIT PROCEDURE

Inspection of FocalPoint® HPMBS and surrounding area

Record individual unit before maintenance with photograph (numbered). Record on Maintenance Report (see example in this document) the following:

- ____ Standing Water yes | no
- ____ Is Bypass Inlet Clear? yes | no
- ____ Damage to HPMBS System yes | no
- ____ to Overflow conveyance yes | no

Removal of Silt / Sediment / Clay

Dig out silt (if any) and mulch and remove trash & foreign items.

- ____ Silt / Clay Found? yes | no
- ____ Cups / Bags Found? yes | no
- ____ Leaves? yes | no
- ____ Volume of material removed _______ (volume or weight)

Removal of debris, trash and mulch

After removal of mulch and debris, measure distance from the top of the FocalPoint® HPMBS engineered media soil to the flow line elevation of the adjacent overflow conveyance. If this distance is greater than that specified on the plans (typ. 6" - 12"), add media (not top soil or other) to recharge to the distance specified.

- ____ Distance to media surface to flow line of overflow conveyance (inches) ___________
- ____ # of Buckets of Media Added ________

Mulch Replacement

Most maintenance visits require only replacement mulch (if utilized) which must be, aged, double shredded hardwood mulch with fines removed. For smaller projects, one cubic foot of mulch will cover four square feet of biofiltration bed, and for larger projects, one cubic yard of mulch will cover 108 square feet of biofiltration bed. Some visits may require additional FocalPoint® HPMBS engineered soil media available from the VAR/Contractor.

- ____ Add double shredded, aged hardwood mulch which has been screened to remove fines, evenly across the entire biofiltration media bed to a depth of 3".
- ____ Clean accumulated sediment from energy dissipation system at the inlet to the FocalPoint® HPMBS to allow for entry of trash during a storm event.

Plant health evaluation and pruning or replacement as necessary

Examine the plant's health and replace if dead or dying.
Prune as necessary to encourage growth in the correct directions

- ____ Height above Grate (feet) _______
- ____ Width at Widest point (feet) ______
- ____ Health alive | dead
- ____ Damage to Plant yes | no

Clean area around FocalPoint® HPMBS

- ____ Clean area around unit and remove all refuse to be disposed of appropriately.

Complete paperwork

- ____ Deliver Maintenance Report and photographs as appropriate.
- ____ Some jurisdictions may require submission of maintenance reports in accordance with approvals.
- ____ It is the responsibility of the Owner to comply with local regulations.

FocalPoint

BIOFILTRATION SYSTEM

FocalPoint Warranty

Seller warrants goods sold hereunder against defects in materials and workmanship only, for a period of (1) year from date the Seller activates the system into service. Seller makes no other warranties, express or implied.

Seller's liability hereunder shall be conditioned upon the Buyer's installation, maintenance, and service of the goods in strict compliance with the written instructions and specifications provided by the Seller. Any deviation from Seller's instructions and specifications or any abuse or neglect shall void warranties.

In the event of any claim upon Seller's warranty, the burden shall be upon the Buyer to prove strict compliance with all instructions and specifications provided by the Seller.

Seller's liability hereunder shall be limited only to the cost or replacement of the goods. Buyer agrees that Seller shall not be liable for any consequential losses arising from the purchase, installation, and/or use of the goods.

Maintenance Checklist

Element	Problem	What To Check	Should Exist	Action
Inlet	Excessive sediment or trash accumulation	Accumulation of sediment or trash impair free flow of water into FocalPoint	Inlet free of obstructions allowing free flow into FocalPoint System	Sediments or trash should be removed
Mulch Cover	Trash and floatable debris accumulation	Excessive trash or debris accumulation.	Minimal trash or other debris on mulch cover	Trash and debris should be removed and mulch cover raked level. Ensure that bark nugget
Mulch Cover	Ponding of water on mulch cover	Ponding in unit could be indicative of clogging due to excessive fine sediment accumulation or spill of petroleum oils	Stormwater should drain freely and evenly over mulch cover.	Contact VAR for advice.
Plants	Plants not growing, or in poor condition	Soil/mulch too wet, evidence of spill. Pest infestation. Vandalism to plants.	Plants should be healthy and pest free.	Contact VAR for advice.
Plants	Plant growth excessive	Plants should be appropriate to the species and location of FocalPoint		Trim/prune plants in accordance with typical landscaping and

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

PROPOSED SELF STORAGE FACILITY
8 WASHBURN STREET
NEW BEDFORD, MASSACHUSETTS

PREPARED FOR:
PATAGON
786 EAST REDFORD ROAD
PROVO, UT 84604

PREPARED BY:
MCARDLE GANNON ASSOCIATES, INC.
300 OAK STREET, SUITE 460
PEMBROKE, MA 02359

MGA FILE NO:
W0729

DATE:
SEPTEMBER 2018

McArdle Gannon Associates, Inc.
Engineers & Consultants

September 27, 2018
MGA File No. W0729

Benjamin Q. Bradley, MRED
Co-Founder & Principal
Patagon
786 East Redford Road
Provo, Utah 84604

RE: Preliminary Geotechnical Engineering Report – Proposed Self Storage Facility – 8 Washburn Street New Bedford, Massachusetts.

Dear Benjamin:

McArdle Gannon Associates, Inc. (MGA) is pleased to present this letter summarizing our preliminary geotechnical studies for the subject project. This report presents the results of our initial subsurface investigations, and provides preliminary geotechnical considerations for the proposed new self storage facility building addition at the subject site in New Bedford, Massachusetts.

The purpose of our preliminary geotechnical study was to assess subsurface soil and groundwater conditions at the site in order to assist you in your land acquisition evaluation and due-diligence review. The scope of our work for this investigation was to focus primarily on the geotechnical issues that we expect could have significant fiscal impacts on future site development. These considerations and recommendations are considered preliminary and additional studies including additional borings performed within the proposed building addition footprint should be performed when the building addition location and site grading have been finalized.

Our studies have been performed in accordance with our proposal to Patagon dated August 27, 2018 and are subject to the Statement of Limitations attached as Appendix A.

BACKGROUND

Our understanding of the site and current project design is based on our discussions with you, our site visits, and a review of the following documents:

- A plan entitled "Subdivision of Land," by Tibbets Engineering Corp., dated April 29, 1974,
- New Bedford Assessor's on-line database information,
- A document entitled "Certified Sanborn Map Report," provided by Sitec Environmental, dated August 7, 2018, and
- A plan entitled "Bedrock Map of Massachusetts," by the United States Geological Survey (USGS), dated 1983.

The site comprises approximately 1.59± acres at 8 Washburn Street in New Bedford, Massachusetts. A Site Locus is attached as Figure 1. The site is bounded by Washburn Street to the north, Belleville Avenue to the west, and is generally surrounded by commercial and residential properties. The Acushnet River is located nearby to the east.

The site is currently developed with an existing 38,000± square foot, 1-story manufacturing building in the western and central portions of the site. An existing paved parking area and an undeveloped area are located in the eastern portion of the site. A concrete wall surrounds the majority of the perimeter of the site. The existing building was reportedly constructed around 1940.

Based on our review of the referenced Sanborn Maps, it appears that the Acushnet River previously occupied the eastern portion of the site until the early 1900's. By 1924, the eastern portion of the site had been filled and the site was formerly developed by the New England Oil Refining Company. Three large steel oil tanks and the perimeter concrete wall are shown on the 1924 Sanborn Map.

The proposed re-development is conceptual in design at this time. We understand that the existing building may be renovated into self-storage space and a building addition may be constructed in the eastern portion of the site.

Existing and proposed site grades were not provided for our review however, the site appears to be relatively flat.

SUBSURFACE EXPLORATIONS

Geosearch, Inc. of Fitchburg, Massachusetts performed two borings (MGA-1 and MGA-2) at the site on September 17 and 18, 2018 using an all-terrain vehicle (ATV) mounted drill rig. The borings were advanced using flush jointed casing and were advanced to depths of between 26.5± to 32.5± feet below existing ground surface terminating at refusal on probable bedrock.

Standard penetration testing (SPT) and split spoon samples were generally obtained continuously in the upper 13± to 20± feet and at 5-foot intervals during advancement of the borings. The testing was performed by driving a standard 2 inch outside diameter split spoon sampler up to 24 inches using a standard 140 pound automatic trip hammer falling 30 inches. The number of hammer blows required to drive the sampler in 6 inch increments (or to refusal) are recorded on the boring logs attached in Appendix B.

The soil samples retrieved in the split spoon sampler during each SPT were visually described in the field by MGA using Burmister soil descriptions. It should be recognized that the inside diameter of the split spoon sampler is 1.4± inches. Therefore, soil samples obtained via Standard Penetration Testing do not account for soil fractions in excess of about 1.4± inches in diameter, which may be present in any given strata.

A monitoring well was installed in the completed borehole at boring location MGA-1 to measure stabilized groundwater levels.

In addition, Geosearch performed 8 probes (P-1 through P-8) with hollow stem augers across the site to assess for the presence of a concrete slab that was encountered within the fill layer during advancement of boring MGA-1. No sampling was performed during advancement of the probes. Refusal was encountered at each probe location at about 2± feet below existing grades.

MGA personnel observed the explorations, visually described the conditions encountered, prepared the logs, and located the explorations in the field by pacing and/or taping from the existing site features. Ground surface elevations were not available. The boring and probe locations are approximately shown on Figure 2.

LABORATORY SOIL TESTING

A laboratory soil testing program consisting of 3 wash sieve and moisture content analyses was performed on selected samples of the existing fill and natural sand and silt soils collected during MGA's preliminary exploration phase from borings MGA-1 and MGA-2. The testing was performed to aid in classifying the soil and assess the grain size distribution of the soil which is useful in assessing engineering design parameters and predicting soil behavior. The results of these tests are provided in Appendix C.

SUBSURFACE CONDITIONS

Based on the subsurface conditions observed in the recent borings, the site is underlain by the following geologic units, listed in order of occurrence below existing ground surface:

Fill: Fill was encountered at each boring location. The fill encountered ranges from about 10± to 11± feet in thickness and generally consists of granular fill over urban fill. The granular fill generally consists of a loose to medium dense, brown to gray to black, fine to coarse sand with about 10 to 25 percent silt and about 10 to 35 percent fine to coarse gravel.

About 4± to 8± feet of urban fill was encountered at about 2± to 7± feet below existing grades. The urban fill generally consists of very loose to dense, black to dark brown to gray, fine to coarse sand with about 20 to 40 percent silt, about 0 to 20 percent fine to coarse gravel, and up to about 40 percent organic matter and debris (brick, concrete, ash, and wood).

An approximately 2.4± feet thick concrete slab was encountered within the fill layer at about 1.6± feet below existing grade in boring MGA-1. In addition, 8 probes (P-1 through P-8) were performed across the site (between the two borings) and refusal was encountered at each probe location at about 2± feet below existing grades. Refusal was likely due to the concrete slabs.

Refer to Appendix C for gradation curves of the 1-3/8 inch minus fraction of the fill collected from borings MGA-1 and MGA-2.

Organics: Organic silt was encountered below the fill at each boring location. The organic silt layer was about 5.5± to 6± feet thick and generally consists of very soft to medium stiff, dark gray to black, organic silt with up to about 5 percent organic fibers. This organic layer is very soft and considered highly compressible.

Natural Granular Soils: Natural granular soils (sand and silt over sand and gravel) were encountered below the fill at about 16± to 16.5± feet below existing ground surface.

The sand and silt was about 2± to 6.5± feet thick and generally consists of dense, tan to brown, fine sand with about 20 to 45 percent silt and up to 5 percent fine gravel.

The sand and gravel soils generally consist of dense to very dense, tan to gray, fine to coarse sand and fine to coarse gravel with about 10 to 20 percent silt.

Refer to Appendix C for a gradation curve of the 1-3/8 inch minus fraction of the natural granular soils (sand and silt) collected from boring MGA-1.

Probable Bedrock: Both borings terminated with casing and rollerbit refusal at 26.5± to 32.5± feet below the existing ground surface on probable bedrock or possibly large boulders.

The rock shown at the site on the referenced "Bedrock Map of Massachusetts" is described as: *Zagr: Alaskite (Proterozoic Z) – Light-gray, pinkish-gray to tan, mafic-poor granite commonly containing muscovite.*

Groundwater: Groundwater levels for our study were recorded in the completed test borings at the times and under the conditions noted on the logs. A stabilized groundwater level reading was obtained in the monitoring well installed in boring MGA-1 at 6.8± feet below existing grade on September 18, 2018. Groundwater was measured during drilling in boring MGA-2 at a depth of about 6± feet below existing site grade.

It should be expected that groundwater levels will fluctuate due to variations in temperature, rainfall and other factors. Therefore, groundwater levels during construction and thereafter may be different than those reported herein.

PRELIMINARY GEOTECHNICAL CONSIDERATIONS

The existing fill and organic soils are not considered suitable for the support of a shallow spread footing foundation system. Supporting the new building addition loads above the existing fill and organic soils would likely result in unacceptable foundation and slab settlement from consolidation of these unsuitable materials. Because of the depth of unsuitable soils (16± to 16.5± feet below current site grades) and relatively shallow groundwater levels at the site (6.8± feet below existing grade in the monitoring well), we do not feel removal and replacement of these unsuitable materials with compacted structural fill is economical or in some areas technically feasible.

For these reasons, we feel a deep foundation system consisting of driven or drilled piles is appropriate for support of the proposed building addition. An "intermediate" foundation system, such as ground improvement (aggregate piers or rigid inclusions) with shallow foundations may also be suitable for support of the proposed addition. However, where the organic soils are thicker or if significant raises in grade are planned, ground improvement may not be suitable due to long term settlement concerns of the organic soils. The naturally deposited granular soil deposits below the fill and organic soils are considered competent bearing material for the support of pile foundations or ground improvement elements. Each is discussed further below.

The technical and economic feasibility of each option should be further explored during the design phase once the building addition location and finished floor elevations have been finalized. The actual depth and thicknesses of the existing fill and organic soils within the building addition footprint and the environmental impacts of excavated soil management/disposal at the site will also impact the feasibility and practicality of each option.

Pile Supported Foundations

A deep foundation system consisting of driven or drilled piles is appropriate for support of the proposed building addition. The type of pile suitable for a particular project depends on the local subsurface soil conditions, the anticipated loading, the amount of allowable settlement, and the compatibility of the chosen pile with site constraints and other construction requirements.

Driven piles could consist of concrete filled steel pipe piles, H-piles, pre-stressed concrete piles, or timber piles, depending on the proposed structural loads. The installation of driven piles will generate significant vibrations that will be annoying to abutters and may not be feasible adjacent to sensitive structures. If construction related vibrations are a concern, drilled mini-piles are another foundation option to minimize vibrations on and off site. MGA can provide additional recommendations for pile options during the final design phase.

Ground Improvement

Alternatively, ground improvement techniques and a shallow foundation system could be considered for support of the proposed building addition loads. Due to the thickness of the organic soils at the site (5.5± to 6± feet at the boring locations), we anticipate that the ground improvement system would consist of grouted aggregate piers or rigid inclusions/concrete columns. Aggregate piers can be installed across an otherwise poor site to reinforce the existing soil, making it suitable for support of shallow foundations. Rigid inclusions/concrete columns are a ground improvement technique that use high modulus concrete columns below a load transfer layer to transmit structural loads through weak soils into a firm underlying stratum. Dewatering is generally not required for installation of these ground improvement elements.

However, where the organic soils are thicker or if significant raises in grade are planned, ground improvement may not be suitable due to long term settlement concerns of the organic soils. The risk of post construction total and differential settlement is greater for ground improvement than a deep foundation system. The Owner must understand and be willing to accept the risk when considering this option.

Building Addition Slab

If the building addition is supported by a deep foundation system, the existing fill and organic soils will likely compress under new load and settlement of a slab on grade would likely result. Therefore, a pile-supported structural slab is recommended for the ground floor slab if the pile supported foundation option is utilized.

If ground improvement is performed, it may be possible to construct a slab-on-grade, provided that arching through the existing fill above the organic soils is enough to transfer the slab loads to the underlying piers, pending analysis by the contractor's design representative. A structural slab may be necessary if significant raises in site grading are anticipated.

We anticipate that utilities below the building slab will need to be hung from a structural slab to mitigate possible settlement issues. At points where the utilities enter the building, over-sized openings and or couplings/joints should be provided to allow for differential movements (for either a structural slab or slab-on-grade).

Seismic Design

For preliminary design, the site of the proposed building addition may be considered a Site Class D soil site in accordance with Section 1613 of the Ninth Edition of The Massachusetts State Building Code (MSBC).

Site Grading

We recommend that raises in grade at the site be kept to a minimum in order to reduce potential settlement from consolidation of the underlying organic soils. If possible, proposed grading should be kept at or below existing grades.

If significant raises in grade are planned, ground improvement may not be a viable option for foundation and slab support. Deep foundations and a structural slab would likely be required if site grading is raised significantly particularly in those areas of the site underlain by organic soils. In addition, a surcharge program may be required within proposed pavement areas to limit post-construction settlement to tolerable limits.

Post-construction settlement due to on-going consolidation of the existing fill and organic soils within proposed pavement areas should be anticipated. Differential settlement may also occur at pavement/building interfaces and some future maintenance of pavement areas should be anticipated. Flexible connections at utility interfaces may also be necessary depending upon the final grading and anticipated post construction settlement.

Obstructions

Obstructions will be encountered within the existing fill soils during installation of a deep foundation system or ground improvement elements. Some excavation will be required to remove obstructions during construction.

In particular, there appears to be one large or several smaller concrete slabs located about 1.6± to 2± feet below existing grades across the site based on boring MGA-1 and probes P-1 through P-8. We anticipate that these slabs may have previously supported the former oil tank(s) at the site. These slabs will likely have to be removed and disposed of off-site due to conflicts with foundation elements (deep foundations and grade beams or ground improvement elements and shallow foundations) and site utilities.

In addition, the concrete slabs and the existing building may be pile supported. It may be necessary to cut-off or remove existing piles within proposed building addition and pavement areas. If the piles are to remain in place, it will be necessary to design the proposed piles or ground improvement elements around the existing piles.

DESIGN PHASE GEOTECHNICAL STUDIES

It should be noted that these conclusions have been made for the purpose of preliminary design, and should be verified and expanded prior to final design and construction. To this end, we recommend that prior to final design of the proposed building addition, design phase geotechnical studies be completed, the scope of which should include additional subsurface explorations, laboratory testing and engineering analyses. We anticipate that additional test borings will be performed to further define the depth and composition of existing fills and organic soils within the proposed building area.

We look forward to our continued assistance as the project moves forward. Please feel free to contact us should you have any questions regarding this report or require additional information.

Very truly yours,

MCARDLE GANNON ASSOCIATES, INC.

Wayne A. McArdle, P.E.
Principal

Sherry L. Holmes, P.E.
Geotechnical Engineer

WAM/slh

cc: Daniel Lyman, Patagon

Attachments: Figure 1 – Site Locus
Figure 2 – Site and Exploration Location Plan
Appendix A – Statement of Limitations
Appendix B – Test Boring Logs
Appendix C – Geotechnical Laboratory Test Results

FIGURES

SCALE: 1"=1500'

0 750 1500 3000 FEET

McArdle Gannon Associates, Inc.
Engineers & Consultants
300 Oak Street, Suite 460
Pembroke, MA 02359
781.826.0040 phone
781.735.0418 fax

LOCUS PLAN
PROPOSED SELF STORAGE FACILITY
8 WASHBURN STREET
NEW BEDFORD, MASSACHUSETTS

PROJECT: W0729 | DATE: 9/2018 | SCALE: AS NOTED

SKETCH NO.: FIG. No. 1

DRAWN: SLH
CHECKED: WAM

NOTES:

NGS PERFORMED BY GEOSEARCH INC OF STERLING, MA ON
17 AND 18, 2018.

OBES PERFORMED BY GEOSEARCH INC OF STERLING, MA
IBER 18, 2018.

APPROXIMATE DEPTH (FEET) TO BOTTOM OF EXISTING

1. BASE PLAN DEVELOPED FROM GOOGLE MAPS SATELLITE IMAGERY.
2. THE EXPLORATION LOCATIONS SHOWN WERE DETERMINED BY TAPE MEASUREMENT, PACING AND LINE OF SITE FROM EXISTING FEATURES. THEIR LOCATIONS SHOULD BE CONSIDERED APPROXIMATE.
3. MGA OBSERVED AND LOGGED THE EXPLORATIONS SHOWN

SCALE: 1"=4

0 20 4

APPENDIX A: STATEMENT OF LIMITATIONS

STATEMENT OF LIMITATIONS

Explorations

The analysis and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

The stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

Water level readings have been made in the explorations at the time and under the conditions stated on the logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors that are different from the time the measurements were made.

Review

In the event that any change in the nature, design or location of the proposed structure are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

It is recommended that this firm be provided the opportunity for a general review of final design and specifications in order that earthwork recommendations may be properly interpreted and implemented in the design and specifications.

Construction

It is recommended that this firm be retained to provide soil engineering services during the construction phase of the work. This is to observe compliance with design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

Use of Report

This report has been prepared for the exclusive use of Patagon for specific application to the Proposed Self Storage Facility at 8 Washburn Street in New Bedford, Massachusetts, in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made.

APPENDIX B: TEST BORING LOGS

McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING MGA-1 (MW)

PROJECT: Self Storage Facility - 8 Washburn Street New Bedford, MA
CLIENT: Patagon
CONTRACTOR: Geosearch, Inc.

MGA NO. : W0729
SHEET NO. : 1 of 2
LOCATION N : See Plan
E :
ELEVATION :
DATE START : 09/17/2018
END : 09/17/2018
DRILLER : Kenny Bylund
ENGINEER : Robert Drown

GROUNDWATER		DEPTH (ft) OF:		
Date	Time	Water	Casing	Hole
09/18/18	1:00	6.8	MW	

EQUIPMENT	CASING	SAMPLER	CORE
Type	HW	Split Spoon	---
Size I.D.	4"	1-3/8"	---
Hammer Wt.	140#	140#	----
Hammer Fall	30"	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS	Well Schematic
0			7 10 16 50/1"	S-1	0.0 1.6	8	0.0 0.0 -1.6 1.6	Medium dense, brown, fine to coarse SAND, some fine to coarse Gravel, little (-) Silt, trace (-) Roots. -FILL-	
							-4.0 4.0	-CONCRETE SLAB-	
4			5 3 3 2	S-2	5.0 7.0	11	-7.0 7.0	Loose, gray to black, fine to coarse SAND, some fine to coarse Gravel, some (-) Silt. -FILL-	
8			5 5 3 7	S-3	7.0 9.0	1		Gray to red, BRICK and CONCRETE FRAGMENTS. -URBAN FILL-	
			WOH WOH WOH WOH	S-4	9.0 11.0	8	-11.0 11.0	Very loose, black, fine to coarse SAND and SILT, some Brick fragments, trace (-) Leaves.	
12			1 1 1 1	S-5	11.0 13.0	6		Very soft to soft, dark gray, ORGANIC SILT, trace (-) Organic Fibers. [Casing was pushed ahead of rollerbit while drilling through organic layer, drove casing ahead to 18 feet] -ORGANIC SILT-	
16							-16.5 16.5	[Change in strata at 16.5± feet based on increase in driving resistance of casing]	
20			28 18 19 24	S-6	18.0 20.0	12		Dense, tan, fine SAND and SILT. -SAND AND SILT-	

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY
0 - 4	Very Loose	0 - 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
50 +	Very Dense	15 - 30	Very Stiff
		30+	Hard

SAMPLE IDENTIFICATION
- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- W - Wash Sample

SUMMARY
Overburden:
Rock:
Samples:

BORING MGA-1 (MW)

McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING MGA-1 (MW)

PROJECT: Self Storage Facility - 8 Washburn Street New Bedford, MA
CLIENT: Patagon

MGA NO. : W0729

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS	Well Schematic
							-23.0		
24			57 27 21 17	S-7	23.0 25.0	9	23.0	Dense, tan, fine to coarse GRAVEL and fine to coarse SAND, little Silt.	
28			29 19 41 22	S-8	28.0 30.0	7		Very dense, tan, fine to coarse SAND and fine to coarse GRAVEL, little (-) Silt. -SAND AND GRAVEL-	
32							-32.5		
							32.5	CASING AND ROLLERBIT REFUSAL AT 32.5 FEET ON PROBABLE BEDROCK.	
36									
40									
44									
48									

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION
0 - 4	Very Loose	0 - 2	Very Soft	- S - Split Spoon
4 - 10	Loose	2 - 4	Soft	- T - Thin Wall Tube
10 - 30	Medium Dense	4 - 8	Medium Stiff	- U - Undisturbed Piston
30 - 50	Dense	8 - 15	Stiff	- C - Diamond Core
50 +	Very Dense	15 - 30	Very Stiff	- W - Wash Sample
		30+	Hard	

SUMMARY

Overburden:
Rock:
Samples:

BORING MGA-1 (MW)

McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING MGA-2

PROJECT: Self Storage Facility - 8 Washburn Street New Bedford, MA
CLIENT: Patagon
CONTRACTOR: Geosearch, Inc.

MGA NO.: W0729
SHEET NO.: 1 of 2
LOCATION N: See Plan
E:
ELEVATION:
DATE START: 09/18/18
END: 09/18/18
DRILLER: Kenny Bylund
ENGINEER: Robert Drown

GROUNDWATER		DEPTH (ft) OF:		
Date	Time	Water	Casing	Hole
09/18/18	9:00	6	0	8

EQUIPMENT	CASING	SAMPLER	CORE
Type	HW	Split Spoon	---
Size I.D.	4"	1-3/8"	---
Hammer Wt.	140#	140#	----
Hammer Fall	30"	30"	----

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
0			15 15 12 18	S-1	0.0 2.0	14	-2.0	Medium dense, brown, fine to coarse SAND and fine to coarse GRAVEL, little (-) Silt. -FILL-
			18 18 20 20	S-2	2.0 4.0	16	2.0	Dense, dark brown to black, fine to coarse SAND, little fine to coarse Gravel, trace (+) Brick. [Strong petroleum-like odor]
4			15 10 13 10	S-3	4.0 6.0	14		Medium dense, dark brown to black to gray, fine to coarse SAND, some (-) Silt, little fine to coarse Gravel, little Brick/Ash/Wood. [Strong petroleum-like odor]
			7 5 5 3	S-4	6.0 8.0	14		Loose to medium dense, fine to coarse SAND, some (-) Silt, little (+) fine to coarse Gravel. [Strong petroleum-like odor]
8			7 3 3 3	S-5	8.0 10.0	0	-10.0	[No Recovery, rock fragments in split spoon] -URBAN FILL-
			2 2 2 2	S-6	10.0 12.0	10	10.0	Soft to medium stiff, black to dark gray, ORGANIC SILT, trace (-) Organic Fibers. -ORGANIC SILT-
12								
			WOH WOH WOH WOH	S-7	13.0 15.0	24		Very soft, dark gray, ORGANIC SILT, trace (-) fine gravel, trace (-) Organic Fibers.
			3 4	S-8	15.0 16.0	12	-16.0	Dark gray, ORGANIC SILT.
16			8 22	S-8A	16.0 17.0	12	16.0 -18.0	Brown, fine SAND, some Silt, trace (-) fine Gravel. -SAND AND SILT-
			26 29 36 35	S-9	18.0 20.0	13	18.0	Very dense, gray, fine to coarse SAND and fine to coarse GRAVEL, little (-) Silt. -SAND AND GRAVEL-
20								

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY	SAMPLE IDENTIFICATION
0 - 4	Very Loose	0 - 2	Very Soft	- S - Split Spoon
4 - 10	Loose	2 - 4	Soft	- T - Thin Wall Tube
10 - 30	Medium Dense	4 - 8	Medium Stiff	- U - Undisturbed Piston
30 - 50	Dense	8 - 15	Stiff	- C - Diamond Core
50 +	Very Dense	15 - 30	Very Stiff	- B - Bulk/Grab Sample
		30+	Hard	

SUMMARY
Station:
Rock:
Samples:

BORING MGA-2

McArdle Gannon Associates, Inc.
Engineers & Consultants

TEST BORING LOG

BORING MGA-2

PROJECT: Self Storage Facility - 8 Washburn Street New Bedford, MA
CLIENT: Patagon

MGA NO. : W0729
SHEET NO. : 2 of 2

Depth in Feet	Strata Change	Case BPF (Drill) (min/ft)	Sampler Blows Per 6" (RQD%)	Sample Number/ Type	Sample Depth Range (ft)	Sample Recovery (in)	Elevation/ Depth (ft)	FIELD CLASSIFICATION AND REMARKS
24			17 17 19 24	S-10	23.0 25.0	16		Dense, tan, fine to coarse SAND and fine to coarse GRAVEL, little (-) Silt. -SAND AND GRAVEL-
							-26.5 26.5	CASING AND ROLLERBIT REFUSAL AT 26.5 FEET ON PROBABLE BEDROCK.
28								
32								
36								
40								
44								
48								

BLOWS/FT.	DENSITY	BLOWS/FT.	CONSISTENCY
0 - 4	Very Loose	0 - 2	Very Soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium Dense	4 - 8	Medium Stiff
30 - 50	Dense	8 - 15	Stiff
50 +	Very Dense	15 - 30	Very Stiff
		30+	Hard

SAMPLE IDENTIFICATION
- S - Split Spoon
- T - Thin Wall Tube
- U - Undisturbed Piston
- C - Diamond Core
- B - Bulk/Grab Sample

SUMMARY
Station:
Rock:
Samples:

BORING MGA-2

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Fill
	Concrete
	Urban Fill
	Organic Silt
	Sand & Silt
	Sand and Gravel
Soil Samplers	
	Split Spoon
Monitor Well Details	
	pipe riser
	assorted cuttings
	bentonite pellets
	silica sand, blank PVC
	slotted pipe w/ sand
	end of well installation

Notes:

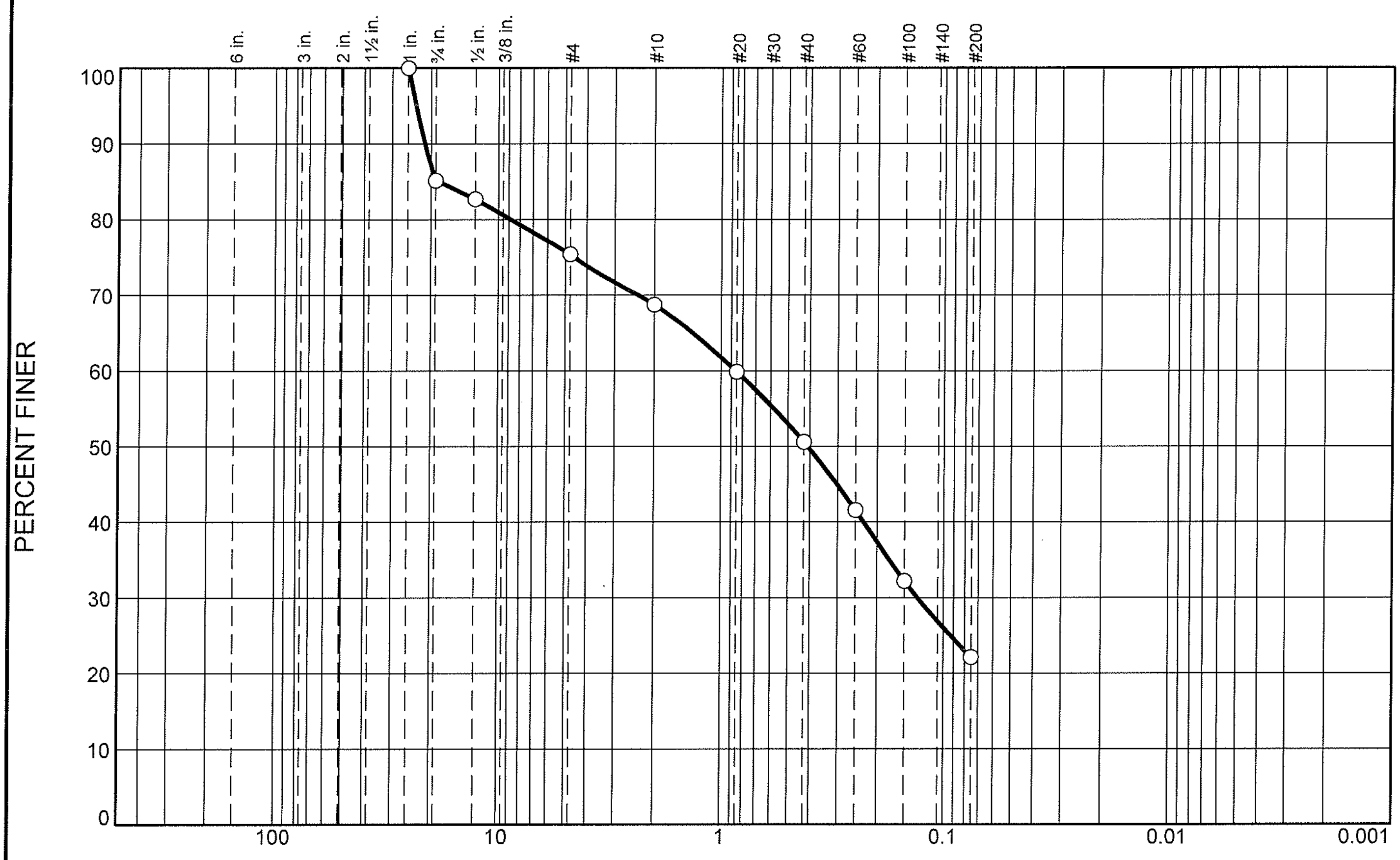
1. Test borings performed by Geosearch, Inc. on September 17 and 18, 2018 using an all terrain vehicle (ATV) mounted drill rig equipped with a 140 pound automatic trip hammer.

2. Test boring elevations were not available.

3. Test borings observed and logged by MGA.

APPENDIX C: GEOTECHNICAL LABORATORY TEST RESULTS

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.8	9.8	6.7	18.1	28.5	22.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	85.2		
1/2	82.7		
#4	75.4		
#10	68.7		
#20	59.8		
#40	50.6		
#60	41.6		
#100	32.2		
#200	22.1		

* (no specification provided)

Soil Description

Gray to black, fine to coarse SAND, some fine to coarse Gravel, some (-) Silt.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 21.3776 D_{85}= 18.5591 D_{60}= 0.8617
D_{50}= 0.4091 D_{30}= 0.1312 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Existing Fill
Water Content: 18.4%

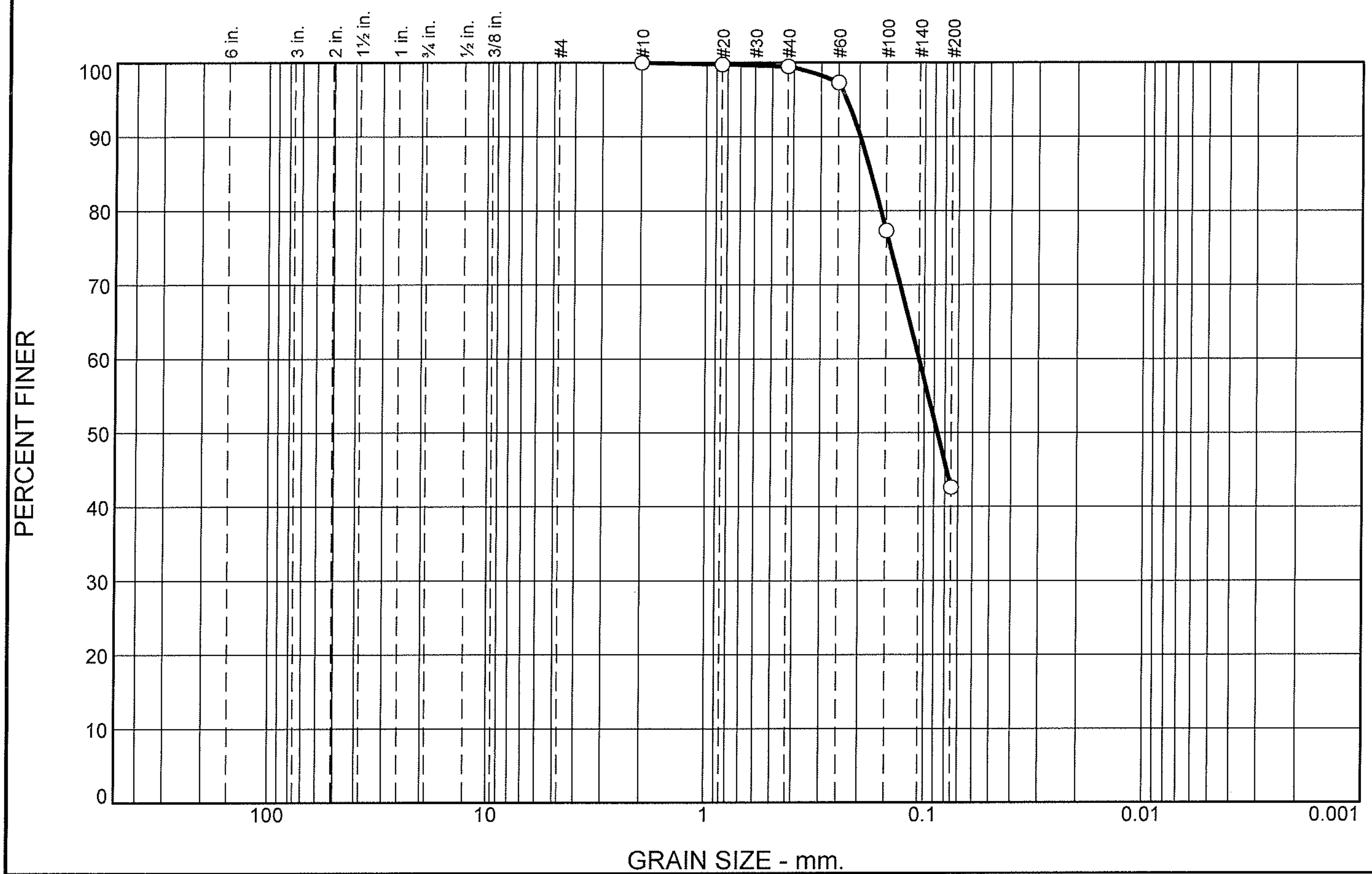
Source of Sample: MGA-1 **Depth:** 5 - 7'
Sample Number: S-2

Date: 09-26-2018

MGA McArdle Gannon Associates, Inc.
Engineers & Consultants

Client: Patagon
Project: Proposed Self Storage Facility
8 Washburn Street, New Bedford, MA
Project No: W0729 **Figure**

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	56.9	42.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	99.8		
#40	99.5		
#60	97.3		
#100	77.3		
#200	42.6		

* (no specification provided)

Soil Description

Tan, fine SAND and SILT.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.1980 D_{85}= 0.1763 D_{60}= 0.1058
D_{50}= 0.0868 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Natural Sand & Silt
Water Content: 22.2%

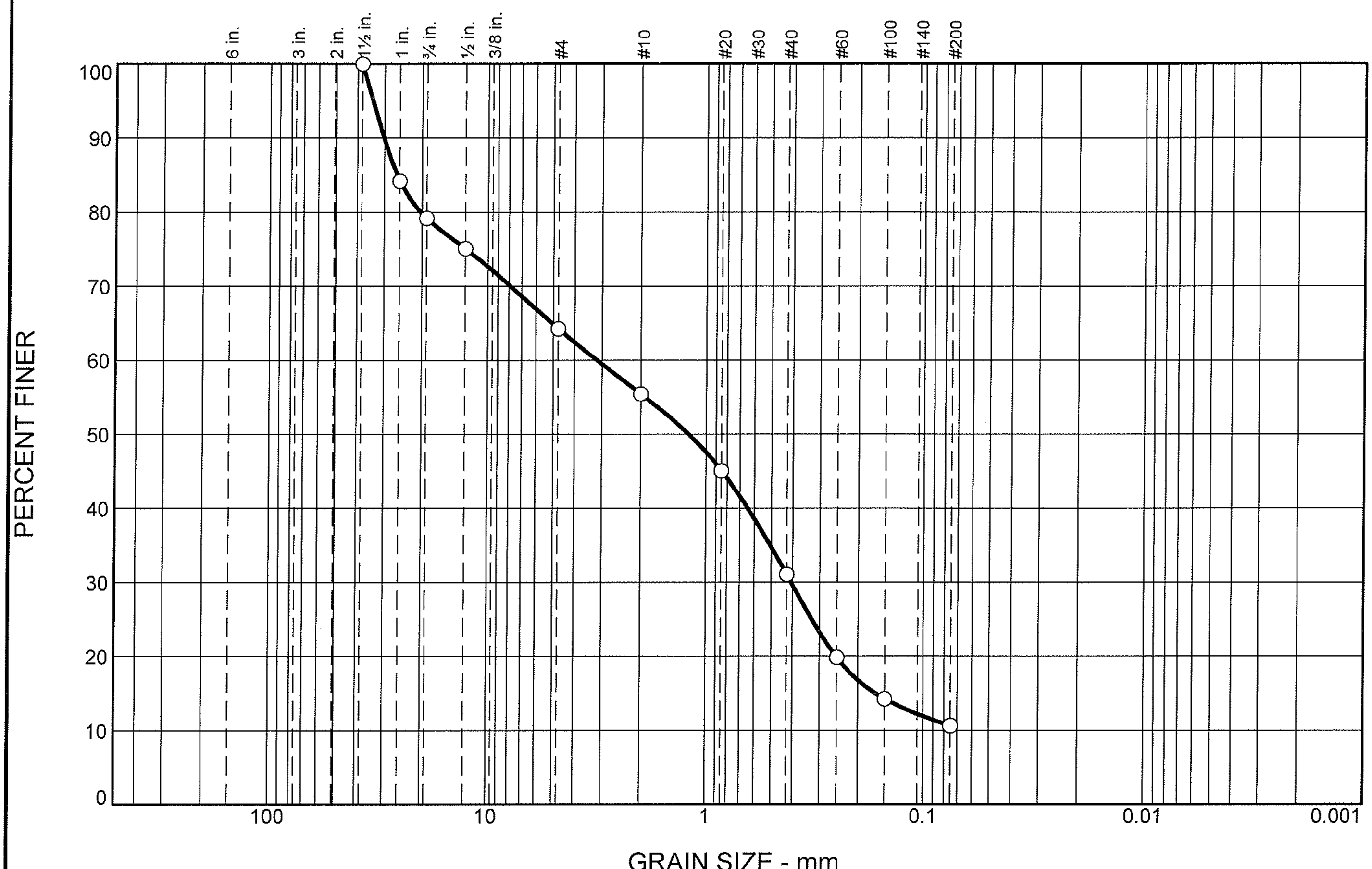
Source of Sample: MGA-1 **Depth:** 18 - 20'
Sample Number: S-6

Date: 09-26-2018

McArdle Gannon Associates, Inc.
Engineers & Consultants

Client: Patagon
Project: Proposed Self Storage Facility
8 Washburn Street, New Bedford, MA
Project No: W0729 **Figure**

PARTICLE SIZE DISTRIBUTION REPORT



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	20.8	15.0	8.8	24.3	20.5	10.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	84.2		
3/4	79.2		
1/2	75.1		
#4	64.2		
#10	55.4		
#20	45.1		
#40	31.1		
#60	19.8		
#100	14.2		
#200	10.6		

* (no specification provided)

Soil Description

Brown, fine to coarse SAND and fine to coarse GRAVEL, little (-) Silt.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 30.1928 D_{85}= 26.1217 D_{60}= 3.1683
D_{50}= 1.2050 D_{30}= 0.4059 D_{15}= 0.1657
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Existing Fill
Water Content: 4.8%

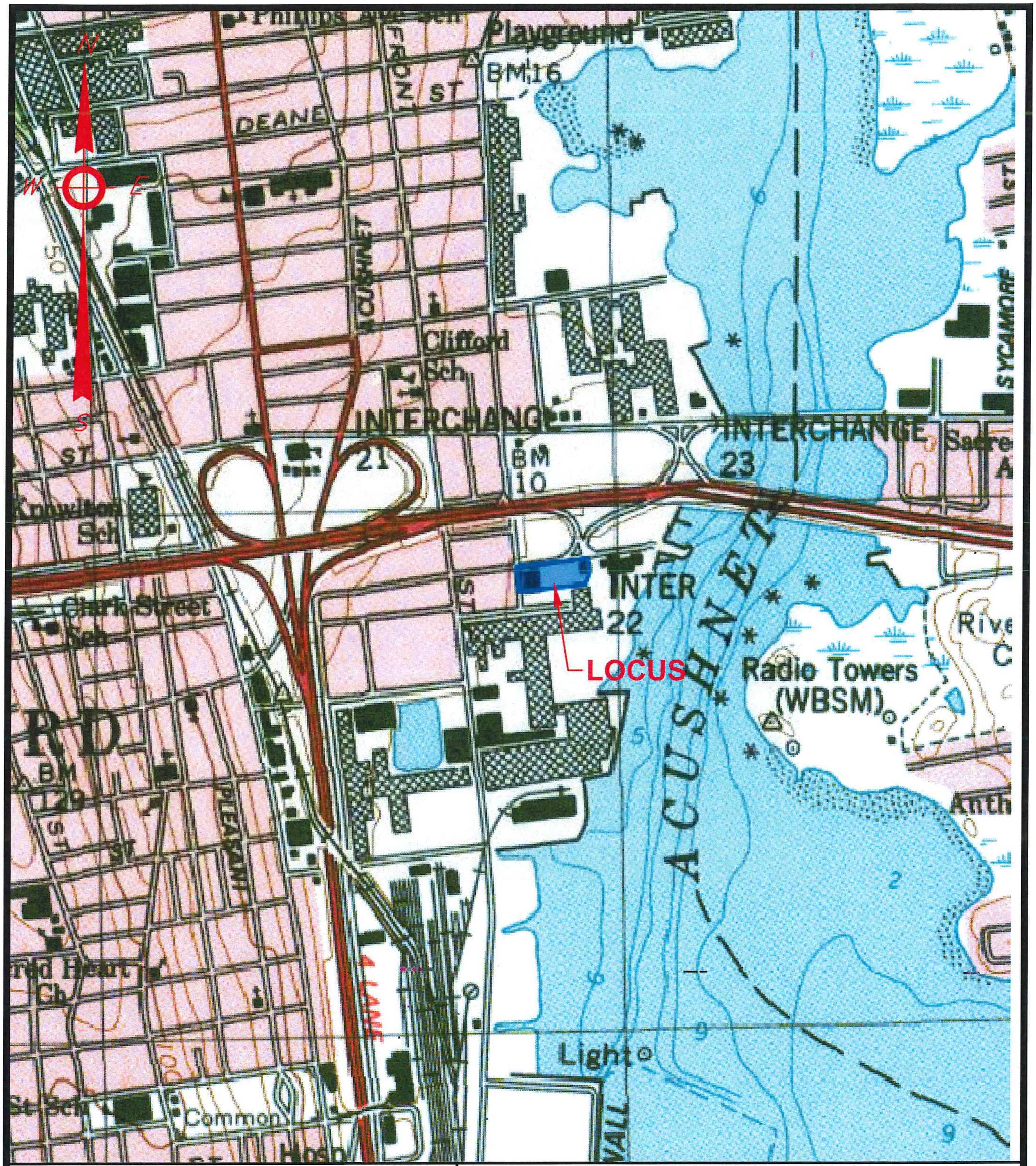
Source of Sample: MGA-2 **Depth:** 0 - 2'
Sample Number: S-1

Date: 09-26-2018

MGA McArdle Gannon Associates, Inc.
Engineers & Consultants

Client: Patagon
Project: Proposed Self Storage Facility
8 Washburn Street, New Bedford, MA
Project No: W0729

Figure



BRACKEN ENGINEERING, INC.

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(fax) 508-833-2282

19 OLD SOUTH ROAD
NANTUCKET, MA 02554
(tel) 508-325-0044
www.brackeneng.com

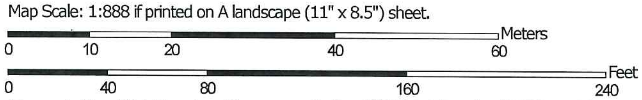
USGS TOPOGRAPHIC MAP

8 WASHBURN STREET
NEW BEDFORD, MASSACHUSETTS
MAP 86, PARCEL 16

Soil Map—Bristol County, Massachusetts, Southern Part

Map Scale: 1:888 if printed on A landscape (11" x 8.5") sheet.

N



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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 12, Sep 7, 2018

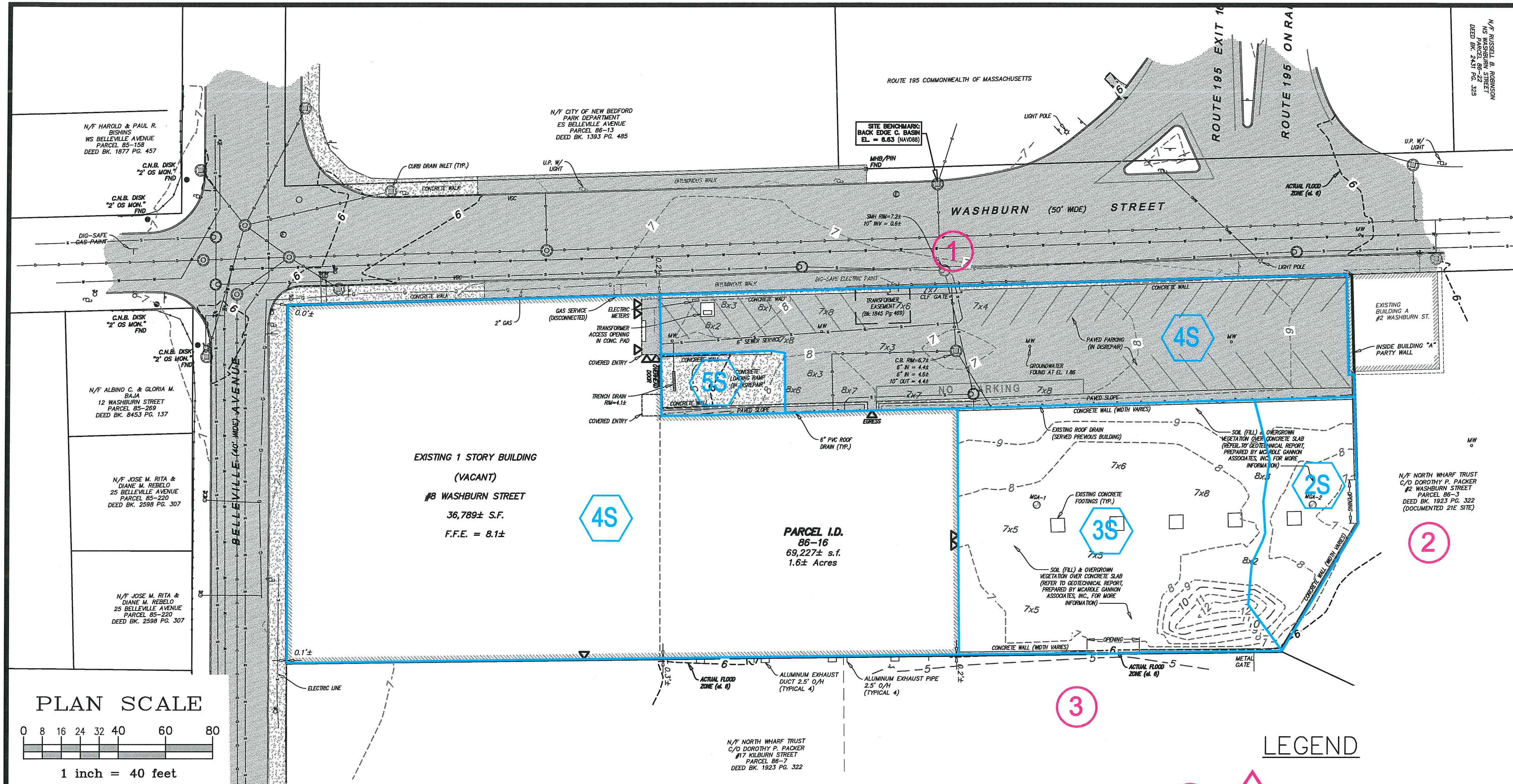
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Dec 31, 2009—Jul 3, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
602	Urban land	3.6	100.0%
Totals for Area of Interest		**3.6**	**100.0%**



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PRE-DEVELOPMENT WATERSHED PLAN

Prepared for:

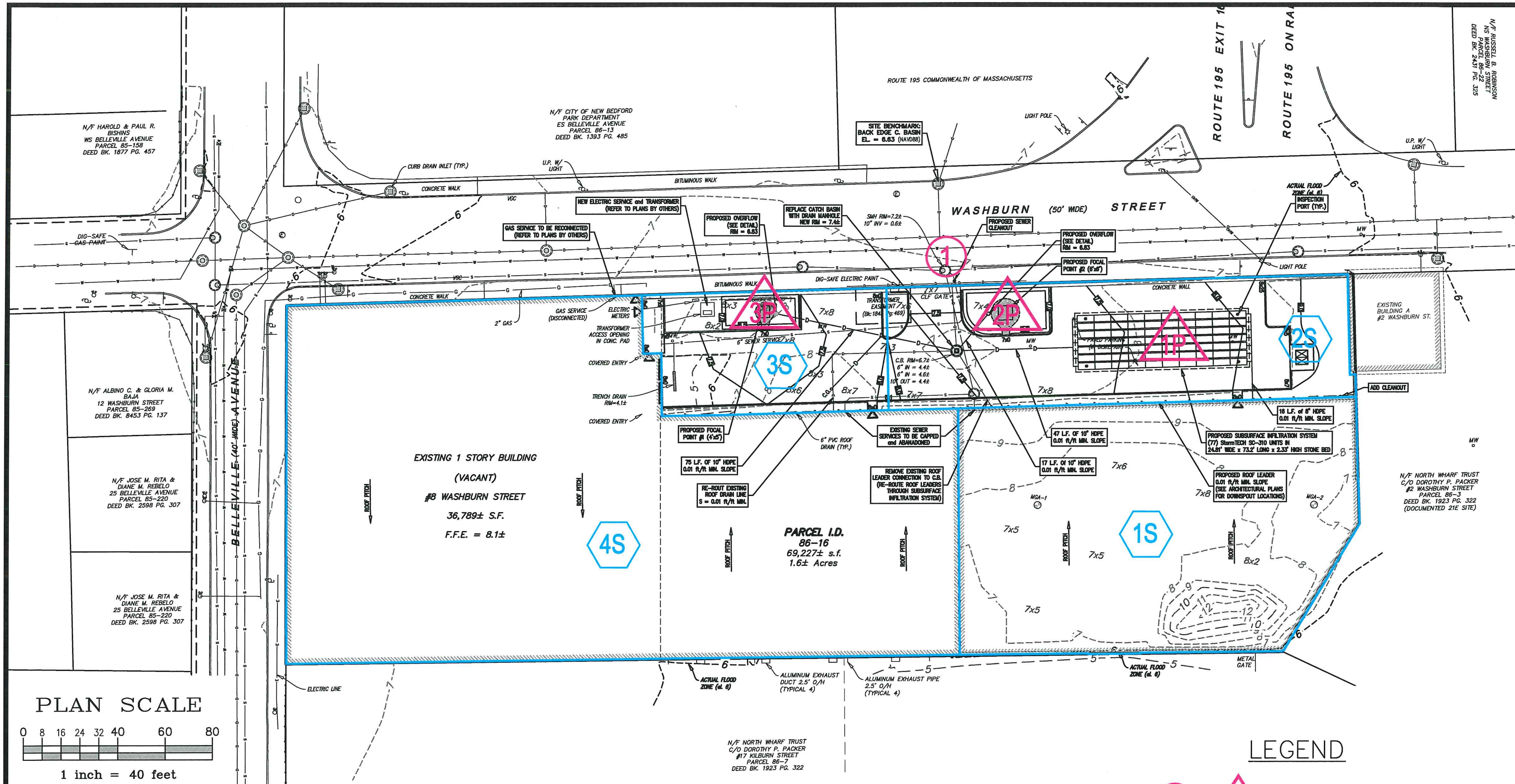
MA NEW BEDFORD & WASHBURN, LLC

#8 WASHBURN STREET

PARCEL I.D.: 86-16

Date:	Drawn:	Checked:
MAY 9, 2019	RMM/ERC/BEI	DFB/AMG

S:\Autocad Drawings\New Bedford\Washburn Street\8 Washburn Street\Hydrology\8 Washburn Street – Pre Development.dwg



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POST-DEVELOPMENT WATERSHED PLAN

Prepared for:
MA NEW BEDFORD & WASHBURN, LLC
#8 WASHBURN STREET
PARCEL I.D.: 86–16

Date:	Drawn:	Checked:
MAY 9, 2019	RMM/ERC/BEI	DFB/AMG

LEGEND

1 / 1P = DESIGN POINT/POND

1S = SUBCATCHMENT AREA

(line) = SUBCATCHMENT BOUNDARY

S:\Autocad Drawings\New Bedford\Washburn Street\8 Washburn Street\Hydrology\8 Washburn Street – Post Development.dwg