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SURVEYORS

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SUPPLEMENTAL STORMWATER REPORT

For

"Damien's Food Pantry"

242 Marion Road
Wareham, MA

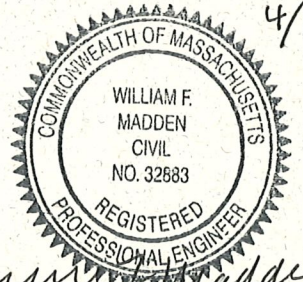
Prepared for

The Family Pantry – Damien's Place Corp.
P.O. Box 730
East Wareham, MA 02538

Prepared by

G.A.F. Engineering, Inc.
266 Main Street
Wareham, MA 02571

4/12/23



April 12, 2023

G.A.F. Job No.: 22-9838

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DRAINAGE NARRATIVE

Description of Site Drainage Revisions

This project consists of the construction of a 50'x 100' building with associated parking lot, access drives, utilities, and stormwater management system. The initial, approved site design had a two foot vertical separation from the finish floor elevation and pavement grade at the loading dock at the rear southeast corner of the building. This condition required the installation of a dock leveler or interior ramp to facilitate unloading trucks.

In order to eliminate the need for special accommodations within the building at the loading dock the finish floor of the building has been specified two feet higher so that there is a four foot height differential outside the building at the dock.

Proposed grading around the building has been adjusted accordingly. The bottom elevation of basin #1 has also been raised. It is also necessary to create a low point at the entrance driveway to Marion Road to prevent runoff from entering the state highway layout. A new watershed 4S is the pavement and small area of landscaping which is directed to a proprietary catch basin for pretreatment prior to discharge to an underground infiltration system consisting of two Cultec units installed in crushed stone. The chamber system is modeled as pond 3P in the HydroCAD calculations.

This supplemental report includes updated post-development calculations and all of the supporting documentation related to the proprietary catch basin and chamber system.

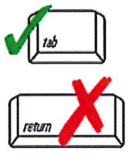
The revisions to the project do not result in any additional off-site runoff and the prior drainage summary and compliance with the stormwater management standards remains valid.

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

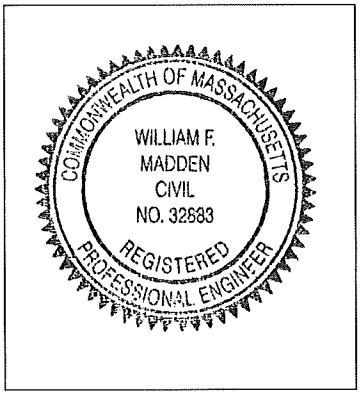
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



William F Madden 4/13/23

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 for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

☐ is within the Zone II or Interim Wellhead Protection Area

☐ is near or to other critical areas

☒ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)

☐ involves runoff from land uses with higher potential pollutant loads.

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

COMPLIANCE WITH THE STORMWATER MANAGEMENT STANDARDS

The Stormwater Management Standards

1. No new stormwater conveyances (e.g. outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

    - *This project does not include any new stormwater conveyances or outfalls.*

2. Stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

    - *The drainage calculations confirm that this standard has been met.*

3. Loss of annual recharge to groundwater shall be eliminated or minimized through the use of infiltration measures including environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post-development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

    - *Recharge volume calculations are included in the report and confirm that this standard is met.*

4. Stormwater management systems shall be designed to remove 80% of the average annual post-construction load of Total Suspended Solids (TSS). This Standard is met when:

    a. Suitable practices for source control and pollution prevention are identified in a long-term pollution prevention plan, and thereafter are implemented and maintained;
    b. Structural stormwater best management practices are sized to capture the required water quality volume determined in accordance with the Massachusetts Stormwater Handbook; and
    c. Pretreatment is provided in accordance with the Massachusetts Stormwater Handbook.

    - *This project has specified infiltration basins with sediment forebays as well as an underground storage and infiltration system which is preceeded*

by a proprietary catch basin unit. A TSS Calculation Sheet for the underground infiltration system is included in the supplemental report to document compliance.

5. For land uses with higher potential pollutant loads, source control and pollution prevention shall be implemented in accordance with the Massachusetts Stormwater Handbook to eliminate or reduce the discharge of stormwater runoff from such land uses to the maximum extent practicable. If through source control and/or pollution prevention all land uses with higher potential pollutant loads cannot be completely protected from exposure to rain, snow, snow melt, and stormwater runoff, the proponent shall use the specific structural stormwater BMPs determined by the Department to be suitable for such uses as provided in the Massachusetts Stormwater Handbook. Stormwater discharges from land uses with higher potential pollutant loads shall also comply with the requirements of the Massachusetts Clean Waters Act, M.G.L. c. 21, §§ 26-53 and the regulations promulgated thereunder at 314 CMR 3.00, 314 CMR 4.00 and 314 CMR 5.00.

    - *This project is not considered a land use with higher potential pollutant load.*

6. Stormwater discharges within the Zone II or Interim Wellhead Protection Area of a public water supply, and stormwater discharges near or to any other critical area, require the use of the specific source control and pollution prevention measures and the specific structural stormwater best management practices determined by the Department to be suitable for managing discharges to such areas, as provided in the Massachusetts Stormwater Handbook. A discharge is near a critical area if there is a strong likelihood of a significant impact occurring to said area, taking into account site-specific factors. Stormwater discharges to Outstanding Resource Waters and Special Resource Waters shall be removed and set back from the receiving water or wetland and receive the highest and best practical method of treatment. A "storm water discharge" as defined in 314 CMR 3.04(2)(a)1 or (b) to an Outstanding Resource Water or Special Resource Water shall comply with 314 CMR 3.00 and 314 CMR 4.00. Stormwater discharges to a Zone I or Zone A are prohibited unless essential to the operation of a public water supply.

    - *This project is not located within a Zone II of a public water supply and there are no critical areas downstream from the property.*

7. A redevelopment project is required to meet the following Stormwater Management Standards only to the maximum extent practicable: Standard 2, Standard 3, and the pretreatment and structural best management practice requirements of Standards 4, 5, and 6. Existing stormwater discharges shall comply with Standard 1 only to the maximum extent practicable. A redevelopment project shall also comply with all other requirements of the Stormwater Management Standards and improve existing conditions.

- *This project is considered new development.*

8. A plan to control construction-related impacts including erosion, sedimentation and other pollutant sources during construction and land disturbance activities (construction period erosion, sedimentation, and pollution prevention plan) shall be developed and implemented.

    - *Construction period erosion and sedimentation control measures are included on the design plans and in this report.*

9. A post-construction operation and maintenance plan shall be developed and implemented to ensure that stormwater management systems function as designed.

    - *The post-construction operation and maintenance plan has been listed on the design plans and in this report.*

10. All illicit discharges to the stormwater management system are prohibited.

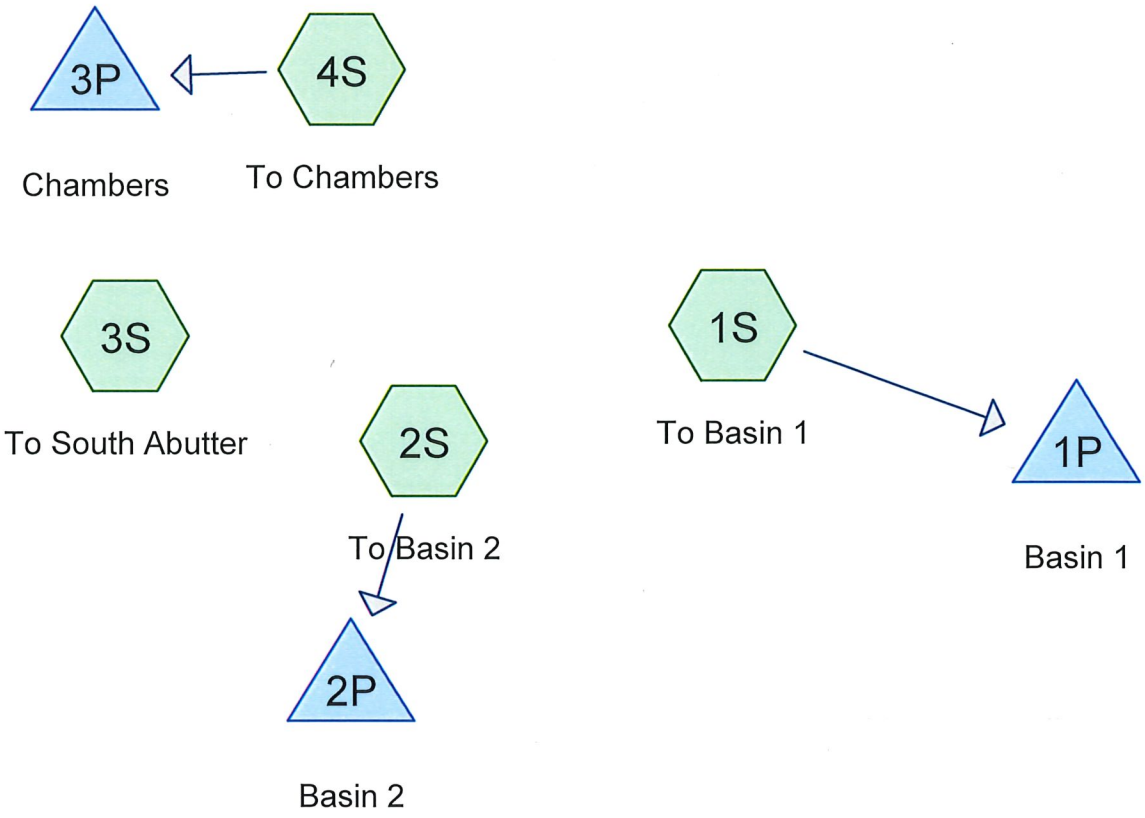
    - *An illicit discharge statement was provided with the initial report.*

Date: 8/3/2022

To whom it may concern:

I hereby certify that no illicit discharge connections presently exist nor will any be permitted in the future at the property located at 242 Marion Road, Wareham, Mass., the future home of Damien's Food Pantry.

The Family Pantry – Damien's Place, Corp.



Subcat Reach Pond Link

Routing Diagram for 9838POST Rev1
Prepared by GAF Engineering, Inc, Printed 4/12/2023

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2 Year Storm	Type III 24-hr		Default	24.00	1	3.44	2
2	10 Year Storm	Type III 24-hr		Default	24.00	1	5.05	2
3	25 Year Storm	Type III 24-hr		Default	24.00	1	6.05	2
4	100 Year Storm	Type III 24-hr		Default	24.00	1	7.60	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.729	39	>75% Grass cover, Good, HSG A (1S, 2S, 3S, 4S)
0.336	98	Parking Lot, Walks, Roof Area (1S)
0.036	98	Pavement (4S)
0.496	98	Pavement, Walks, Pads, Roof (2S)
0.281	30	Raised Bed Garden (3S)
0.602	30	Woods, Good, HSG A (1S, 2S, 3S)
2.480	**56**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.331	HSG A	1S, 2S, 3S, 4S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
1.149	Other	1S, 2S, 3S, 4S
2.480		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchmen Numbers
0.729	0.000	0.000	0.000	0.000	0.729	>75% Grass cover, Good	1S, 2S, 3S, 4S
0.000	0.000	0.000	0.000	0.336	0.336	Parking Lot, Walks, Roof Area	1S
0.000	0.000	0.000	0.000	0.036	0.036	Pavement	4S
0.000	0.000	0.000	0.000	0.496	0.496	Pavement, Walks, Pads, Roof	2S
0.000	0.000	0.000	0.000	0.281	0.281	Raised Bed Garden	3S
0.602	0.000	0.000	0.000	0.000	0.602	Woods, Good	1S, 2S, 3S
1.331	**0.000**	**0.000**	**0.000**	**1.149**	**2.480**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: To Basin 1 Runoff Area=31,145 sf 46.96% Impervious Runoff Depth=0.72"
Flow Length=70' Tc=17.3 min CN=65 Runoff=0.35 cfs 0.043 af

Subcatchment 2S: To Basin 2 Runoff Area=42,825 sf 50.50% Impervious Runoff Depth=0.87"
Flow Length=135' Tc=16.8 min CN=68 Runoff=0.63 cfs 0.071 af

Subcatchment 3S: To South Abutter Runoff Area=32,070 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=180' Tc=12.3 min CN=31 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: To Chambers Runoff Area=2,000 sf 77.50% Impervious Runoff Depth=1.96"
Tc=6.0 min CN=85 Runoff=0.11 cfs 0.008 af

Pond 1P: Basin 1 Peak Elev=16.67' Storage=370 cf Inflow=0.35 cfs 0.043 af
Outflow=0.12 cfs 0.043 af

Pond 2P: Basin 2 Peak Elev=15.33' Storage=257 cf Inflow=0.63 cfs 0.071 af
Outflow=0.42 cfs 0.071 af

Pond 3P: Chambers Peak Elev=15.59' Storage=30 cf Inflow=0.11 cfs 0.008 af
Outflow=0.05 cfs 0.008 af

Total Runoff Area = 2.480 ac Runoff Volume = 0.121 af Average Runoff Depth = 0.59"
65.01% Pervious = 1.612 ac 34.99% Impervious = 0.868 ac

Summary for Subcatchment 1S: To Basin 1

Runoff = 0.35 cfs @ 12.28 hrs, Volume= 0.043 af, Depth= 0.72"
Routed to Pond 1P : Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	14,625	98	Parking Lot, Walks, Roof Area
	9,470	39	>75% Grass cover, Good, HSG A
	7,050	30	Woods, Good, HSG A
	31,145	65	Weighted Average
	16,520		53.04% Pervious Area
	14,625		46.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	50	0.0080	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.1	20	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	70	Total			

Summary for Subcatchment 2S: To Basin 2

Runoff = 0.63 cfs @ 12.26 hrs, Volume= 0.071 af, Depth= 0.87"
Routed to Pond 2P : Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	21,625	98	Pavement, Walks, Pads, Roof
	17,900	39	>75% Grass cover, Good, HSG A
	3,300	30	Woods, Good, HSG A
	42,825	68	Weighted Average
	21,200		49.50% Pervious Area
	21,625		50.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.6	30	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	55	0.0070	1.70		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
16.8	135	Total			

Summary for Subcatchment 3S: To South Abutter

[45] Hint: Runoff=Zero

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
	3,950	39	>75% Grass cover, Good, HSG A
*	12,250	30	Raised Bed Garden
	15,870	30	Woods, Good, HSG A
	32,070	31	Weighted Average
	32,070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.44"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	180	Total			

Summary for Subcatchment 4S: To Chambers

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af, Depth= 1.96"
Routed to Pond 3P : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Storm Rainfall=3.44"

	Area (sf)	CN	Description
*	1,550	98	Pavement
	450	39	>75% Grass cover, Good, HSG A
	2,000	85	Weighted Average
	450		22.50% Pervious Area
	1,550		77.50% Impervious Area

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

Summary for Pond 1P: Basin 1

Inflow Area = 0.715 ac, 46.96% Impervious, Inflow Depth = 0.72" for 2 Year Storm event
Inflow = 0.35 cfs @ 12.28 hrs, Volume= 0.043 af
Outflow = 0.12 cfs @ 12.82 hrs, Volume= 0.043 af, Atten= 66%, Lag= 32.3 min
Discarded = 0.12 cfs @ 12.82 hrs, Volume= 0.043 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 16.67' @ 12.82 hrs Surf.Area= 2,169 sf Storage= 370 cf

Plug-Flow detention time= 21.2 min calculated for 0.043 af (100% of inflow)
Center-of-Mass det. time= 21.2 min (920.2 - 899.0)

Volume	Invert	Avail.Storage	Storage Description
#1	16.50'	5,768 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.50	2,100	0	0
17.00	2,300	1,100	1,100
17.50	2,912	1,303	2,403
18.00	3,328	1,560	3,963
18.50	3,892	1,805	5,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	16.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.12 cfs @ 12.82 hrs HW=16.67' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.12 cfs)

Summary for Pond 2P: Basin 2

Inflow Area = 0.983 ac, 50.50% Impervious, Inflow Depth = 0.87" for 2 Year Storm event
Inflow = 0.63 cfs @ 12.26 hrs, Volume= 0.071 af
Outflow = 0.42 cfs @ 12.53 hrs, Volume= 0.071 af, Atten= 34%, Lag= 15.9 min
Discarded = 0.42 cfs @ 12.53 hrs, Volume= 0.071 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.33' @ 12.53 hrs Surf.Area= 7,515 sf Storage= 257 cf

Plug-Flow detention time= 5.0 min calculated for 0.071 af (100% of inflow)
Center-of-Mass det. time= 5.0 min (892.3 - 887.4)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	10,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	7,460	0	0
16.00	8,573	5,612	5,612
16.50	9,151	4,431	10,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.42 cfs @ 12.53 hrs HW=15.33' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.42 cfs)

Summary for Pond 3P: Chambers

Inflow Area = 0.046 ac, 77.50% Impervious, Inflow Depth = 1.96" for 2 Year Storm event
Inflow = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af
Outflow = 0.05 cfs @ 12.25 hrs, Volume= 0.008 af, Atten= 50%, Lag= 9.4 min
Discarded = 0.05 cfs @ 12.25 hrs, Volume= 0.008 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.59' @ 12.25 hrs Surf.Area= 252 sf Storage= 30 cf

Plug-Flow detention time= 2.8 min calculated for 0.008 af (100% of inflow)
Center-of-Mass det. time= 2.8 min (825.7 - 822.9)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	219 cf	**7.00'W x 36.00'L x 2.50'H Crushed Stone** 630 cf Overall - 83 cf Embedded = 547 cf x 40.0% Voids
#2	15.80'	83 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.05 cfs @ 12.25 hrs HW=15.59' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: To Basin 1 Runoff Area=31,145 sf 46.96% Impervious Runoff Depth=1.69"
Flow Length=70' Tc=17.3 min CN=65 Runoff=0.96 cfs 0.101 af

Subcatchment 2S: To Basin 2 Runoff Area=42,825 sf 50.50% Impervious Runoff Depth=1.92"
Flow Length=135' Tc=16.8 min CN=68 Runoff=1.54 cfs 0.157 af

Subcatchment 3S: To South Abutter Runoff Area=32,070 sf 0.00% Impervious Runoff Depth=0.02"
Flow Length=180' Tc=12.3 min CN=31 Runoff=0.00 cfs 0.001 af

Subcatchment 4S: To Chambers Runoff Area=2,000 sf 77.50% Impervious Runoff Depth=3.41"
Tc=6.0 min CN=85 Runoff=0.18 cfs 0.013 af

Pond 1P: Basin 1 Peak Elev=17.21' Storage=1,598 cf Inflow=0.96 cfs 0.101 af
Outflow=0.14 cfs 0.101 af

Pond 2P: Basin 2 Peak Elev=15.52' Storage=1,681 cf Inflow=1.54 cfs 0.157 af
Outflow=0.44 cfs 0.157 af

Pond 3P: Chambers Peak Elev=16.11' Storage=95 cf Inflow=0.18 cfs 0.013 af
Outflow=0.06 cfs 0.013 af

Total Runoff Area = 2.480 ac Runoff Volume = 0.271 af Average Runoff Depth = 1.31"
65.01% Pervious = 1.612 ac 34.99% Impervious = 0.868 ac

Summary for Subcatchment 1S: To Basin 1

Runoff = 0.96 cfs @ 12.25 hrs, Volume= 0.101 af, Depth= 1.69"
Routed to Pond 1P : Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.05"

	Area (sf)	CN	Description
*	14,625	98	Parking Lot, Walks, Roof Area
	9,470	39	>75% Grass cover, Good, HSG A
	7,050	30	Woods, Good, HSG A
	31,145	65	Weighted Average
	16,520		53.04% Pervious Area
	14,625		46.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	50	0.0080	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.1	20	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	70	Total			

Summary for Subcatchment 2S: To Basin 2

Runoff = 1.54 cfs @ 12.24 hrs, Volume= 0.157 af, Depth= 1.92"
Routed to Pond 2P : Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.05"

	Area (sf)	CN	Description
*	21,625	98	Pavement, Walks, Pads, Roof
	17,900	39	>75% Grass cover, Good, HSG A
	3,300	30	Woods, Good, HSG A
	42,825	68	Weighted Average
	21,200		49.50% Pervious Area
	21,625		50.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.6	30	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	55	0.0070	1.70		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
16.8	135	Total			

Summary for Subcatchment 3S: To South Abutter

Runoff = 0.00 cfs @ 22.18 hrs, Volume= 0.001 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.05"

	Area (sf)	CN	Description
	3,950	39	>75% Grass cover, Good, HSG A
*	12,250	30	Raised Bed Garden
	15,870	30	Woods, Good, HSG A
	32,070	31	Weighted Average
	32,070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.44"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	180	Total			

Summary for Subcatchment 4S: To Chambers

Runoff = 0.18 cfs @ 12.09 hrs, Volume= 0.013 af, Depth= 3.41"
Routed to Pond 3P : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Storm Rainfall=5.05"

	Area (sf)	CN	Description
*	1,550	98	Pavement
	450	39	>75% Grass cover, Good, HSG A
	2,000	85	Weighted Average
	450		22.50% Pervious Area
	1,550		77.50% Impervious Area

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

Summary for Pond 1P: Basin 1

Inflow Area = 0.715 ac, 46.96% Impervious, Inflow Depth = 1.69" for 10 Year Storm event
Inflow = 0.96 cfs @ 12.25 hrs, Volume= 0.101 af
Outflow = 0.14 cfs @ 13.45 hrs, Volume= 0.101 af, Atten= 85%, Lag= 71.8 min
Discarded = 0.14 cfs @ 13.45 hrs, Volume= 0.101 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.21' @ 13.45 hrs Surf.Area= 2,551 sf Storage= 1,598 cf

Plug-Flow detention time= 112.1 min calculated for 0.100 af (100% of inflow)
Center-of-Mass det. time= 112.1 min (982.8 - 870.7)

Volume	Invert	Avail.Storage	Storage Description
#1	16.50'	5,768 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.50	2,100	0	0
17.00	2,300	1,100	1,100
17.50	2,912	1,303	2,403
18.00	3,328	1,560	3,963
18.50	3,892	1,805	5,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	16.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.14 cfs @ 13.45 hrs HW=17.21' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.14 cfs)

Summary for Pond 2P: Basin 2

Inflow Area = 0.983 ac, 50.50% Impervious, Inflow Depth = 1.92" for 10 Year Storm event
Inflow = 1.54 cfs @ 12.24 hrs, Volume= 0.157 af
Outflow = 0.44 cfs @ 12.78 hrs, Volume= 0.157 af, Atten= 72%, Lag= 32.1 min
Discarded = 0.44 cfs @ 12.78 hrs, Volume= 0.157 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.52' @ 12.78 hrs Surf.Area= 7,810 sf Storage= 1,681 cf

Plug-Flow detention time= 26.0 min calculated for 0.157 af (100% of inflow)
Center-of-Mass det. time= 26.0 min (888.3 - 862.3)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	10,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	7,460	0	0
16.00	8,573	5,612	5,612
16.50	9,151	4,431	10,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.44 cfs @ 12.78 hrs HW=15.52' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.44 cfs)

Summary for Pond 3P: Chambers

Inflow Area = 0.046 ac, 77.50% Impervious, Inflow Depth = 3.41" for 10 Year Storm event
Inflow = 0.18 cfs @ 12.09 hrs, Volume= 0.013 af
Outflow = 0.06 cfs @ 12.38 hrs, Volume= 0.013 af, Atten= 66%, Lag= 17.6 min
Discarded = 0.06 cfs @ 12.38 hrs, Volume= 0.013 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 16.11' @ 12.38 hrs Surf.Area= 252 sf Storage= 95 cf

Plug-Flow detention time= 8.2 min calculated for 0.013 af (100% of inflow)
Center-of-Mass det. time= 8.2 min (815.3 - 807.1)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	219 cf	**7.00'W x 36.00'L x 2.50'H Crushed Stone** 630 cf Overall - 83 cf Embedded = 547 cf x 40.0% Voids
#2	15.80'	83 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.06 cfs @ 12.38 hrs HW=16.11' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.06 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: To Basin 1 Runoff Area=31,145 sf 46.96% Impervious Runoff Depth=2.39"
Flow Length=70' Tc=17.3 min CN=65 Runoff=1.39 cfs 0.142 af

Subcatchment 2S: To Basin 2 Runoff Area=42,825 sf 50.50% Impervious Runoff Depth=2.66"
Flow Length=135' Tc=16.8 min CN=68 Runoff=2.19 cfs 0.218 af

Subcatchment 3S: To South Abutter Runoff Area=32,070 sf 0.00% Impervious Runoff Depth=0.11"
Flow Length=180' Tc=12.3 min CN=31 Runoff=0.01 cfs 0.007 af

Subcatchment 4S: To Chambers Runoff Area=2,000 sf 77.50% Impervious Runoff Depth=4.35"
Tc=6.0 min CN=85 Runoff=0.23 cfs 0.017 af

Pond 1P: Basin 1 Peak Elev=17.56' Storage=2,579 cf Inflow=1.39 cfs 0.142 af
Outflow=0.17 cfs 0.142 af

Pond 2P: Basin 2 Peak Elev=15.67' Storage=2,895 cf Inflow=2.19 cfs 0.218 af
Outflow=0.45 cfs 0.218 af

Pond 3P: Chambers Peak Elev=16.46' Storage=146 cf Inflow=0.23 cfs 0.017 af
Outflow=0.07 cfs 0.017 af

Total Runoff Area = 2.480 ac Runoff Volume = 0.383 af Average Runoff Depth = 1.85"
65.01% Pervious = 1.612 ac 34.99% Impervious = 0.868 ac

Summary for Subcatchment 1S: To Basin 1

Runoff = 1.39 cfs @ 12.25 hrs, Volume= 0.142 af, Depth= 2.39"
Routed to Pond 1P : Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.05"

	Area (sf)	CN	Description
*	14,625	98	Parking Lot, Walks, Roof Area
	9,470	39	>75% Grass cover, Good, HSG A
	7,050	30	Woods, Good, HSG A
	31,145	65	Weighted Average
	16,520		53.04% Pervious Area
	14,625		46.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	50	0.0080	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.1	20	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	70	Total			

Summary for Subcatchment 2S: To Basin 2

Runoff = 2.19 cfs @ 12.23 hrs, Volume= 0.218 af, Depth= 2.66"
Routed to Pond 2P : Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.05"

	Area (sf)	CN	Description
*	21,625	98	Pavement, Walks, Pads, Roof
	17,900	39	>75% Grass cover, Good, HSG A
	3,300	30	Woods, Good, HSG A
	42,825	68	Weighted Average
	21,200		49.50% Pervious Area
	21,625		50.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.6	30	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	55	0.0070	1.70		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
16.8	135	Total			

Summary for Subcatchment 3S: To South Abutter

Runoff = 0.01 cfs @ 15.18 hrs, Volume= 0.007 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.05"

	Area (sf)	CN	Description
	3,950	39	>75% Grass cover, Good, HSG A
*	12,250	30	Raised Bed Garden
	15,870	30	Woods, Good, HSG A
	32,070	31	Weighted Average
	32,070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.44"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	180	Total			

Summary for Subcatchment 4S: To Chambers

Runoff = 0.23 cfs @ 12.09 hrs, Volume= 0.017 af, Depth= 4.35"
Routed to Pond 3P : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Storm Rainfall=6.05"

	Area (sf)	CN	Description
*	1,550	98	Pavement
	450	39	>75% Grass cover, Good, HSG A
	2,000	85	Weighted Average
	450		22.50% Pervious Area
	1,550		77.50% Impervious Area

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

Summary for Pond 1P: Basin 1

Inflow Area = 0.715 ac, 46.96% Impervious, Inflow Depth = 2.39" for 25 Year Storm event
Inflow = 1.39 cfs @ 12.25 hrs, Volume= 0.142 af
Outflow = 0.17 cfs @ 13.87 hrs, Volume= 0.142 af, Atten= 88%, Lag= 97.6 min
Discarded = 0.17 cfs @ 13.87 hrs, Volume= 0.142 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.56' @ 13.87 hrs Surf.Area= 2,962 sf Storage= 2,579 cf

Plug-Flow detention time= 168.6 min calculated for 0.142 af (100% of inflow)
Center-of-Mass det. time= 168.6 min (1,028.8 - 860.2)

Volume	Invert	Avail.Storage	Storage Description
#1	16.50'	5,768 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.50	2,100	0	0
17.00	2,300	1,100	1,100
17.50	2,912	1,303	2,403
18.00	3,328	1,560	3,963
18.50	3,892	1,805	5,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	16.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.17 cfs @ 13.87 hrs HW=17.56' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.17 cfs)

Summary for Pond 2P: Basin 2

Inflow Area = 0.983 ac, 50.50% Impervious, Inflow Depth = 2.66" for 25 Year Storm event
Inflow = 2.19 cfs @ 12.23 hrs, Volume= 0.218 af
Outflow = 0.45 cfs @ 12.92 hrs, Volume= 0.218 af, Atten= 79%, Lag= 41.1 min
Discarded = 0.45 cfs @ 12.92 hrs, Volume= 0.218 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.67' @ 12.92 hrs Surf.Area= 8,053 sf Storage= 2,895 cf

Plug-Flow detention time= 49.2 min calculated for 0.218 af (100% of inflow)
Center-of-Mass det. time= 49.2 min (901.7 - 852.6)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	10,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	7,460	0	0
16.00	8,573	5,612	5,612
16.50	9,151	4,431	10,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.45 cfs @ 12.92 hrs HW=15.67' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.45 cfs)

Summary for Pond 3P: Chambers

Inflow Area = 0.046 ac, 77.50% Impervious, Inflow Depth = 4.35" for 25 Year Storm event
Inflow = 0.23 cfs @ 12.09 hrs, Volume= 0.017 af
Outflow = 0.07 cfs @ 12.42 hrs, Volume= 0.017 af, Atten= 71%, Lag= 20.2 min
Discarded = 0.07 cfs @ 12.42 hrs, Volume= 0.017 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 16.46' @ 12.42 hrs Surf.Area= 252 sf Storage= 146 cf

Plug-Flow detention time= 12.2 min calculated for 0.017 af (100% of inflow)
Center-of-Mass det. time= 12.1 min (812.5 - 800.3)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	219 cf	**7.00'W x 36.00'L x 2.50'H Crushed Stone** 630 cf Overall - 83 cf Embedded = 547 cf x 40.0% Voids
#2	15.80'	83 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.07 cfs @ 12.42 hrs HW=16.46' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.07 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: To Basin 1 Runoff Area=31,145 sf 46.96% Impervious Runoff Depth=3.57"
Flow Length=70' Tc=17.3 min CN=65 Runoff=2.13 cfs 0.213 af

Subcatchment 2S: To Basin 2 Runoff Area=42,825 sf 50.50% Impervious Runoff Depth=3.90"
Flow Length=135' Tc=16.8 min CN=68 Runoff=3.25 cfs 0.320 af

Subcatchment 3S: To South Abutter Runoff Area=32,070 sf 0.00% Impervious Runoff Depth=0.39"
Flow Length=180' Tc=12.3 min CN=31 Runoff=0.07 cfs 0.024 af

Subcatchment 4S: To Chambers Runoff Area=2,000 sf 77.50% Impervious Runoff Depth=5.83"
Tc=6.0 min CN=85 Runoff=0.30 cfs 0.022 af

Pond 1P: Basin 1 Peak Elev=18.13' Storage=4,390 cf Inflow=2.13 cfs 0.213 af
Outflow=0.19 cfs 0.213 af

Pond 2P: Basin 2 Peak Elev=15.94' Storage=5,105 cf Inflow=3.25 cfs 0.320 af
Outflow=0.47 cfs 0.320 af

Pond 3P: Chambers Peak Elev=17.09' Storage=229 cf Inflow=0.30 cfs 0.022 af
Outflow=0.08 cfs 0.022 af

Total Runoff Area = 2.480 ac Runoff Volume = 0.579 af Average Runoff Depth = 2.80"
65.01% Pervious = 1.612 ac 34.99% Impervious = 0.868 ac

Summary for Subcatchment 1S: To Basin 1

Runoff = 2.13 cfs @ 12.24 hrs, Volume= 0.213 af, Depth= 3.57"
Routed to Pond 1P : Basin 1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.60"

	Area (sf)	CN	Description
*	14,625	98	Parking Lot, Walks, Roof Area
	9,470	39	>75% Grass cover, Good, HSG A
	7,050	30	Woods, Good, HSG A
	31,145	65	Weighted Average
	16,520		53.04% Pervious Area
	14,625		46.96% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.2	50	0.0080	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.1	20	0.1300	5.80		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	70	Total			

Summary for Subcatchment 2S: To Basin 2

Runoff = 3.25 cfs @ 12.23 hrs, Volume= 0.320 af, Depth= 3.90"
Routed to Pond 2P : Basin 2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.60"

	Area (sf)	CN	Description
*	21,625	98	Pavement, Walks, Pads, Roof
	17,900	39	>75% Grass cover, Good, HSG A
	3,300	30	Woods, Good, HSG A
	42,825	68	Weighted Average
	21,200		49.50% Pervious Area
	21,625		50.50% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.7	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.44"
0.6	30	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.5	55	0.0070	1.70		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
16.8	135	Total			

Summary for Subcatchment 3S: To South Abutter

Runoff = 0.07 cfs @ 12.52 hrs, Volume= 0.024 af, Depth= 0.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.60"

	Area (sf)	CN	Description
	3,950	39	>75% Grass cover, Good, HSG A
*	12,250	30	Raised Bed Garden
	15,870	30	Woods, Good, HSG A
	32,070	31	Weighted Average
	32,070		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.4	50	0.0100	0.08		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.44"
1.9	130	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
12.3	180	Total			

Summary for Subcatchment 4S: To Chambers

Runoff = 0.30 cfs @ 12.09 hrs, Volume= 0.022 af, Depth= 5.83"
Routed to Pond 3P : Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Storm Rainfall=7.60"

	Area (sf)	CN	Description
*	1,550	98	Pavement
	450	39	>75% Grass cover, Good, HSG A
	2,000	85	Weighted Average
	450		22.50% Pervious Area
	1,550		77.50% Impervious Area

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

Summary for Pond 1P: Basin 1

Inflow Area = 0.715 ac, 46.96% Impervious, Inflow Depth = 3.57" for 100 Year Storm event
Inflow = 2.13 cfs @ 12.24 hrs, Volume= 0.213 af
Outflow = 0.19 cfs @ 14.38 hrs, Volume= 0.213 af, Atten= 91%, Lag= 128.3 min
Discarded = 0.19 cfs @ 14.38 hrs, Volume= 0.213 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 18.13' @ 14.38 hrs Surf.Area= 3,470 sf Storage= 4,390 cf

Plug-Flow detention time= 255.9 min calculated for 0.213 af (100% of inflow)
Center-of-Mass det. time= 255.9 min (1,104.2 - 848.3)

Volume	Invert	Avail.Storage	Storage Description
#1	16.50'	5,768 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
16.50	2,100	0	0
17.00	2,300	1,100	1,100
17.50	2,912	1,303	2,403
18.00	3,328	1,560	3,963
18.50	3,892	1,805	5,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	16.50'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.19 cfs @ 14.38 hrs HW=18.13' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.19 cfs)

Summary for Pond 2P: Basin 2

Inflow Area = 0.983 ac, 50.50% Impervious, Inflow Depth = 3.90" for 100 Year Storm event
Inflow = 3.25 cfs @ 12.23 hrs, Volume= 0.320 af
Outflow = 0.47 cfs @ 13.16 hrs, Volume= 0.320 af, Atten= 85%, Lag= 55.5 min
Discarded = 0.47 cfs @ 13.16 hrs, Volume= 0.320 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.94' @ 13.16 hrs Surf.Area= 8,479 sf Storage= 5,105 cf

Plug-Flow detention time= 93.4 min calculated for 0.320 af (100% of inflow)
Center-of-Mass det. time= 93.4 min (934.8 - 841.4)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	10,043 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
15.30	7,460	0	0
16.00	8,573	5,612	5,612
16.50	9,151	4,431	10,043

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**2.410 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.47 cfs @ 13.16 hrs HW=15.94' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.47 cfs)

Summary for Pond 3P: Chambers

Inflow Area = 0.046 ac, 77.50% Impervious, Inflow Depth = 5.83" for 100 Year Storm event
Inflow = 0.30 cfs @ 12.09 hrs, Volume= 0.022 af
Outflow = 0.08 cfs @ 12.46 hrs, Volume= 0.022 af, Atten= 74%, Lag= 22.3 min
Discarded = 0.08 cfs @ 12.46 hrs, Volume= 0.022 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 17.09' @ 12.46 hrs Surf.Area= 252 sf Storage= 229 cf

Plug-Flow detention time= 18.1 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 18.1 min (810.3 - 792.2)

Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	219 cf	**7.00'W x 36.00'L x 2.50'H Crushed Stone** 630 cf Overall - 83 cf Embedded = 547 cf x 40.0% Voids
#2	15.80'	83 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.08 cfs @ 12.46 hrs HW=17.09' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.08 cfs)

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

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

Location: 242 Marion Road, Wareham

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
FD-3HC CB unit	0.80	1.00	0.80	0.20
Infiltration Chambers	0.80	0.20	0.16	0.04

Total TSS Removal = 96 %

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

Project: Damien's Food Pantry
Prepared By: G.A.F. Engineering
Date: April 12, 2023

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

Water Quality Volume Calculation

Required Water Quality Depth = 1.00 inch volume from impervious surfaces.

Impervious Area to Cultec Chambers Pond 3P = 1,550 sf

WQV = 1,550 sf x 1.00 in x 1 ft/12 in = 129.2 cf

Volume Available in Cultec Chambers = 302 cf (HydroCAD)

302 cf > 129.2 cf OK

G.A.F. Engineering, Inc.
April 12, 2023
G.A.F. Job No.: 22-9838

Water Quality Volume to Discharge Rate Calculation

This project specifies a proprietary drainage structure in order to achieve greater than 44% TSS removal prior to discharge to the infiltration chambers. A flow rate is required to be calculated based on the required water quality volume and total amount of impervious surface directed to the proprietary structure. The calculations are based on the standardized method developed by DEP effective October 15, 2013.

Equation: $Q = (qu)(A)(WQV)$

Where: Q = peak flow rate associated with first 1.00 inches of runoff
(qu) = the unit peak discharge, in csm/in.
A = impervious surface drainage area (in square miles)
WQV = water quality volume in watershed inches (1.00 inches in this case)

The determination of qu is based on the time of concentration and Figure 4 Table in the DEP guidance document. The area draining to the proprietary structure has a time of concentration of 6 minutes.

Water Quality Catch Basin 1:

$Q = (774)(0.000056)(1.00) = 0.04$ cfs

Hydro International FD-3HC unit provides greater than 80% TSS removal up to 1.06 cfs

1.06 cfs > 0.04 cfs OK

G.A.F. Engineering, Inc.
April 12, 2023
G.A.F. Job No.: 22-9838

First Defense® - High Capacity

particle sizes range of 50 µm to 150 µm (D_{50}=108µm). A comparison of the two gradations is shown in Figure 3, which shows the test sand gradation to be slightly finer than OK110 between 50µm and 100µm. For example, the test sand had 15% finer than 75 microns compared to the OK110 PSD that had only 3% less than 75 microns. Given finer particles are more difficult to settle, performance results based on the "OK110" particle size band of the test sand is considered conservative.

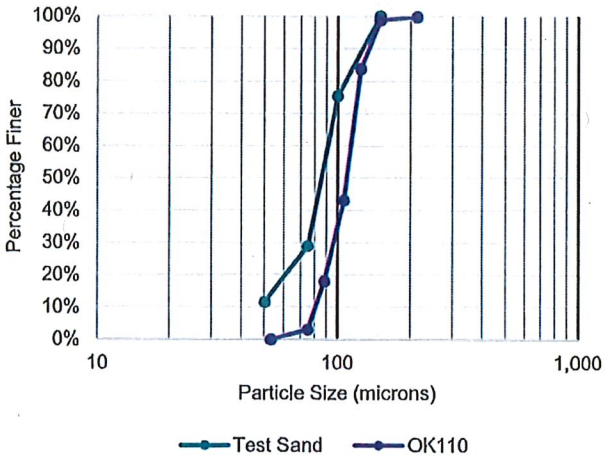


Figure 3 - Particle Size Distribution Comparison

Removal Efficiency Testing

Removal efficiency testing with the feed sediment was conducted in accordance with Section 5 of the NJDEP Laboratory Protocol for Manufactured Treatment Devices. Five flow rates ranging from 25% to 125% of the design treatment flow rate were evaluated.

The test sediment was fed into the flow stream at a rate that was equivalent to 200 mg/L. The average influent TSS concentration was calculated using the total sediment mass and volume of water added during dosing. The influent concentration for each particle size band was calculated using the percentage of particles in each particle size band and known average inlet concentration. Three time-spaced effluent grab samples were composited and analyzed using laser diffraction (ISO 13320) to evaluate the effluent particle sizes.

Table 1 – OK110 Particle Size Range Test Results

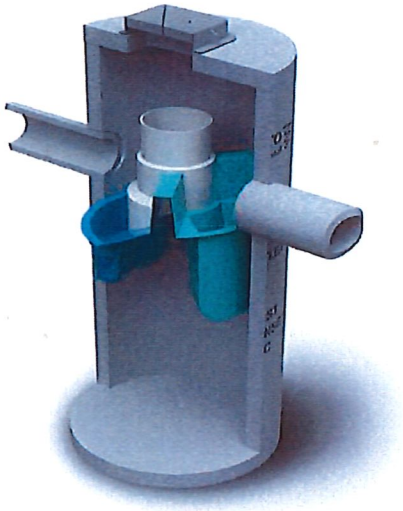
Flow	Inlet Conc.	Outlet Conc.	Removal
cfs (L/s)	mg/L	mg/L	%
0.38 (10.8)	84	4.44	95
0.75 (21.2)	83	5.50	93
1.13 (32.0)	78	4.00	95
1.5 (42.5)	83	6.57	92
1.88 (53.2)	79	8.81	89

The average effluent sediment concentration of the three composited samples was also measured for each flow rate in accordance with ASTM D3977-97. The effluent concentration for each particle size band was then calculated using the average effluent composite concentration and percentage of particles in each particle size band.

Percent removed at each of the five tested flow rates is shown in Table 1. Inlet concentrations of the OK110 particle size range varied from 79-84 mg/L compared to 4-8.5 mg/L at the outlet. As expected, the highest concentration measured at the outlet was at the highest tested flow rate of 1.88 cfs (53.2 L/s). In general, the 4-ft FDHC removed greater than 80% of the OK110 particle size range for all tested flow rates. Table 2 provides "Treatment Flow Rates" for the available models.

Table 2 – FDHC Treatment Flow Rate for > 80% TSS

Model:	FD-3HC	FD-4HC	FD-5HC	FD-6HC	FD-8HC
Size:	3 ft (900 mm)	4 ft (1.2 m)	5 ft (1.5 m)	6 ft (1.8 m)	8 ft (2.4m)
cfs:	1.06	1.88	2.94	4.23	7.52
L/s:	29.9	53.2	83.2	119.8	212.9



For design purposes the selected model's Treatment Flow Rate must be equal or greater to the site's required Water Quality Flow Rate. The peak flow rate and maximum pipe size must be considered to determine whether an online or offline configuration is appropriate. Full removal curves are available on request.

Refer First Defense product information brochure or visit www.hydro-int.com/us for more information

Hydro International. 94 Hutchins Drive. Portland. ME 04102
Tel: 207.756.6200 Fax: 207.756.6212
Email: stormwaterinquiry@hydro-int.com Web: www.hydro-int.com

Stormwater Solutions

Required Recharge Volume Calculation

Leaching Chambers

Total Impervious Area to Cultec Chambers = 1,550 sf

Required Recharge Depth = 0.6 inches (HSG A Soil)

Required Recharge Volume = 1,550 sf x 0.6"/12 = 77.5 cf

Available Storage = 302 cf (HydroCAD)

302 cf > 77.5 cf - OK

Recharge System Drawdown time (72 hours maximum for 100 year storm volume)

$$\text{Time} = \frac{\text{Storage Volume}}{(\text{Rawls Rate})\ (\text{Bottom Area})}$$

$$\text{Time} = \frac{229\ \text{cf}}{(8.27\ \text{inches/hour})\ (1\text{ft}/12\text{inches})\ (252\ \text{sf})}$$

= 1.3 hours < 72 hours – OK

G.A.F. Engineering, Inc.
April 12, 2023
G.A.F. Job No.: 22-9838

Long Term Operation and Maintenance Plan

Responsible Party: The Family Pantry – Damien's Place Corp.
242 Marion Road
Wareham, MA 02751

The property owner is responsible for the inspection, operation and maintenance of the Stormwater Management System. The director of the facility will be provided with copies of the approved site design and as-built plans to make them aware of the locations of system components. A copy of this Operation and Maintenance (O & M) Plan should also be provided.

System Description: The drainage system consists of a number of Best Management Practices, BMPs, which collect, treat, and infiltrate stormwater runoff from all storm events up to and including the 100 year storm event. The majority of the runoff flows to low points on the edge of pavement and enters a paved waterway which discharges to a sediment forebay. The sediment forebay removes silt and sand as the runoff flows through and over a crushed stone check dam into an infiltration basin. The infiltration basin stores and infiltrates the runoff providing final treatment of the runoff prior to reaching groundwater. One of these basins is located in the northeast corner of the site while another is on the south side of the access driveway to Swift's Beach Road. A small portion of the entrance drive to Marion Road/Route 6 is collected in a proprietary catch basin for pretreatment prior to discharge to an infiltration system comprised of underground storage chambers surrounded by crushed stone.

Parking Lot Sweeping: Parking lot sweeping is an effective non-structural source control that will remove sediment from paved surfaces. Sweeping should be done with a high efficiency vacuum sweeper or regenerative air sweeper. Sweeping should be done twice per year. Once removed from paved surfaces, the sweepings must be handled and disposed of properly in one of the ways approved by MassDEP. (See Policy #BAW-18-001: Reuse and Disposal of Street Sweepings)

Sediment Forebays: Sediment forebays are excavated pits with crushed stone check dams, bermed areas designed to slow incoming stormwater runoff and facilitate the gravity separation of suspended solids. Sediment forebays shall be inspected monthly and cleaned out at least four times per year. Inspect stone check dams and reset rip rap as necessary. When mowing grasses, set the mower blades no lower than three inches. Mow when the height approaches six inches. Check for signs of rilling and gullying and repair as needed. After removing sediment, replace any vegetation damaged during the cleanout by reseeding or installing sod. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure that no scour occurs in the forebay while the seeds germinate and develop roots.

Infiltration Basins: The basin should be inspected monthly for bare spots and re-seeded if necessary. Any debris, trash, or sediment should be removed. Mowing of the basin will be infrequent, once or twice a year, primarily to prevent the growth of undesirable weeds, trees, and shrubs. Check the emergency outlet spillway for erosion and reset the stone and concrete curb if necessary. Remove any sediment which has entered the basin. Dispose of any sediment in accordance with local, state, and federal guidelines and regulations.

Proprietary Catch Basins: Proprietary catch basins are underground drainage structures designed to remove a greater percentage of total suspended solids when compared to traditional deep sump catch basins. They also remove trash, debris, and coarse sediment from stormwater and provide temporary spill containment for floatables such as oil and grease. Inspect the units monthly, and clean at least two times per year at the end of the foliage and snow removal seasons. Sediments must also be removed when sediment has reached the depth recommended for cleanout per the manufacturer's specifications. If there is evidence that they have been contaminated by a spill or other means, the cleanings must be evaluated in accordance with the MassDEP hazardous waste regulations, 310 CMR 30.00 and handled as hazardous waste.

Leaching Trenches and Chambers: Leaching trenches and chambers shall be inspected after every major storm event for the first few months after installation to ensure proper stabilization and function. Thereafter inspection shall occur annually. Water depth in the chambers should be observed in the inspection ports after major storms to determine proper function. Exfiltration rates are determined by the drop in water level over the time it takes for the unit to empty. A comparison of exfiltration rate measurements taken over a period of years can provide helpful information in the event that clogging problems occur.

Public Safety Features: The drainage system frames, grates, and covers have all been specified for H20 loading. Catch basin grates are bicycle and pedestrian safe. The infiltration basins are only two feet deep with 3:1 side slopes.

Operation and Maintenance Budget: The estimated annual cost for inspection, mowing, and sediment removal associated with the maintenance of the Stormwater Management System is $2,500.

Reference: For full details on drainage system Construction, Operation and Maintenance refer to the current edition of the Massachusetts Stormwater Handbook.

Groundwater Mounding Calculations

Groundwater Mounding Analysis based on a 2 inch volume 24 hour storm event.
Chamber System Exfiltration Rate entered into HydroCAD is 8.27 inches/hour for HSG A soils.

Infiltration Chambers

Discarded Storm Volume = 0.003 acre-feet
Bottom Area = 252 square feet
Duration of Exfiltration = 14 hours (Hydrograph)

Calculate the infiltrated volume of runoff to a rate in feet per day

0.003 af x 43,560 sf/acre = 130.7 cf

130.7 cf ÷ 252 sf = 0.52 feet

0.52 feet ÷ 14 hours x 24 hours/day = 0.89 feet/day

Using the Hantush calculator input R = 0.89 feet/day and K = 8.90 feet/day

Groundwater Mound = 0.185 feet at the center of the chambers

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Input Values		
0.8900	*R*	**Recharge (infiltration) rate (feet/day)**
0.200	Sy	**Specific yield, Sy (dimensionless, between 0 and 1)**
8.90	K	**Horizontal hydraulic conductivity, Kh (feet/day)***
18.000	x	**1/2 length of basin (x direction, in feet)**
3.500	y	**1/2 width of basin (y direction, in feet)**
0.580	t	**duration of infiltration period (days)**
40.000	hi(0)	**initial thickness of saturated zone (feet)**

40.185	h(max)	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
0.185	Δh(max)	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

Conversion Table

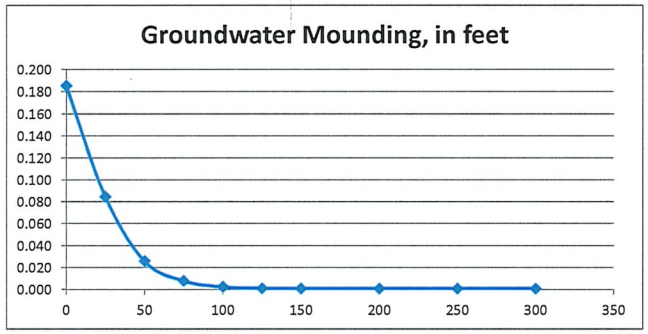
inch/hour	feet/day
0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
0.185	0
0.085	25
0.026	50
0.008	75
0.003	100
0.001	125
0.001	150
0.001	200
0.001	250
0.001	300

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.

Summary for Pond 3P: Chambers

Inflow Area = 0.046 ac, 77.50% Impervious, Inflow Depth = 0.80" for Two Inch Storm event
Inflow = 0.04 cfs @ 12.09 hrs, Volume= 0.003 af
Outflow = 0.04 cfs @ 12.11 hrs, Volume= 0.003 af, Atten= 2%, Lag= 0.9 min
Discarded = 0.04 cfs @ 12.11 hrs, Volume= 0.003 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 15.32' @ 12.11 hrs Surf.Area= 252 sf Storage= 2 cf

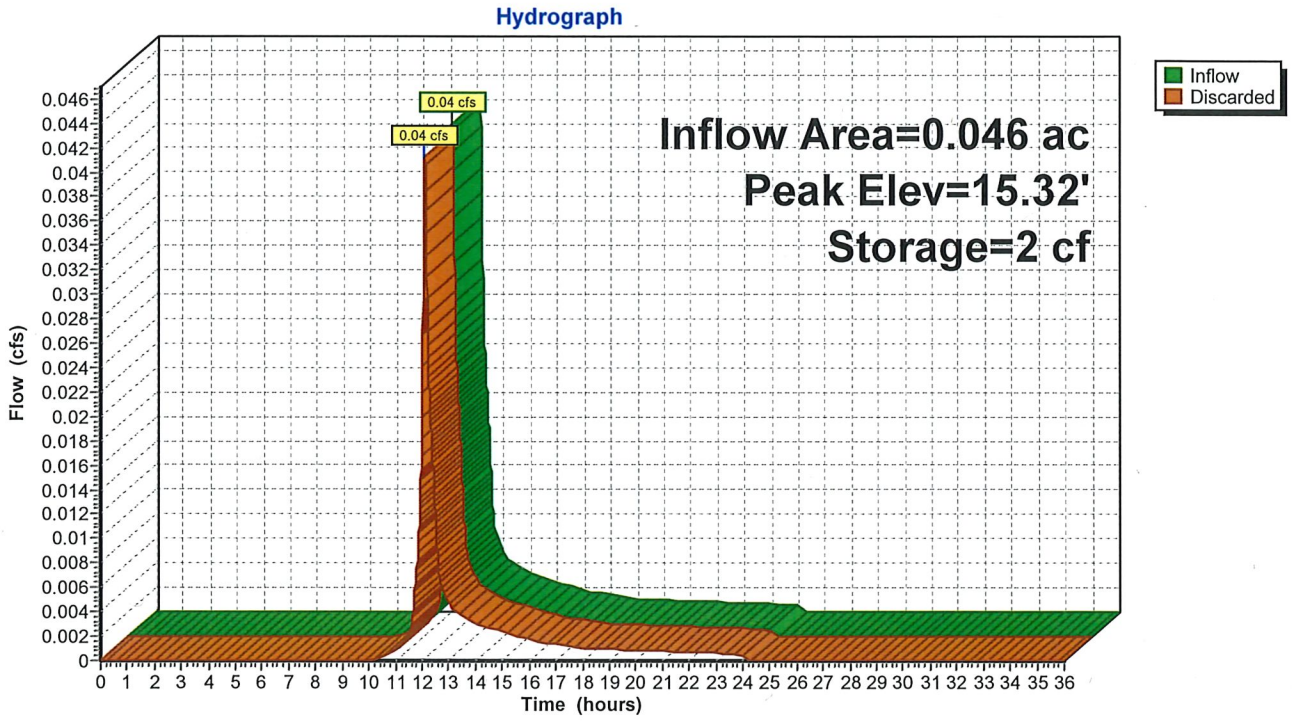
Plug-Flow detention time= 0.9 min calculated for 0.003 af (100% of inflow)
Center-of-Mass det. time= 0.9 min (850.1 - 849.2)

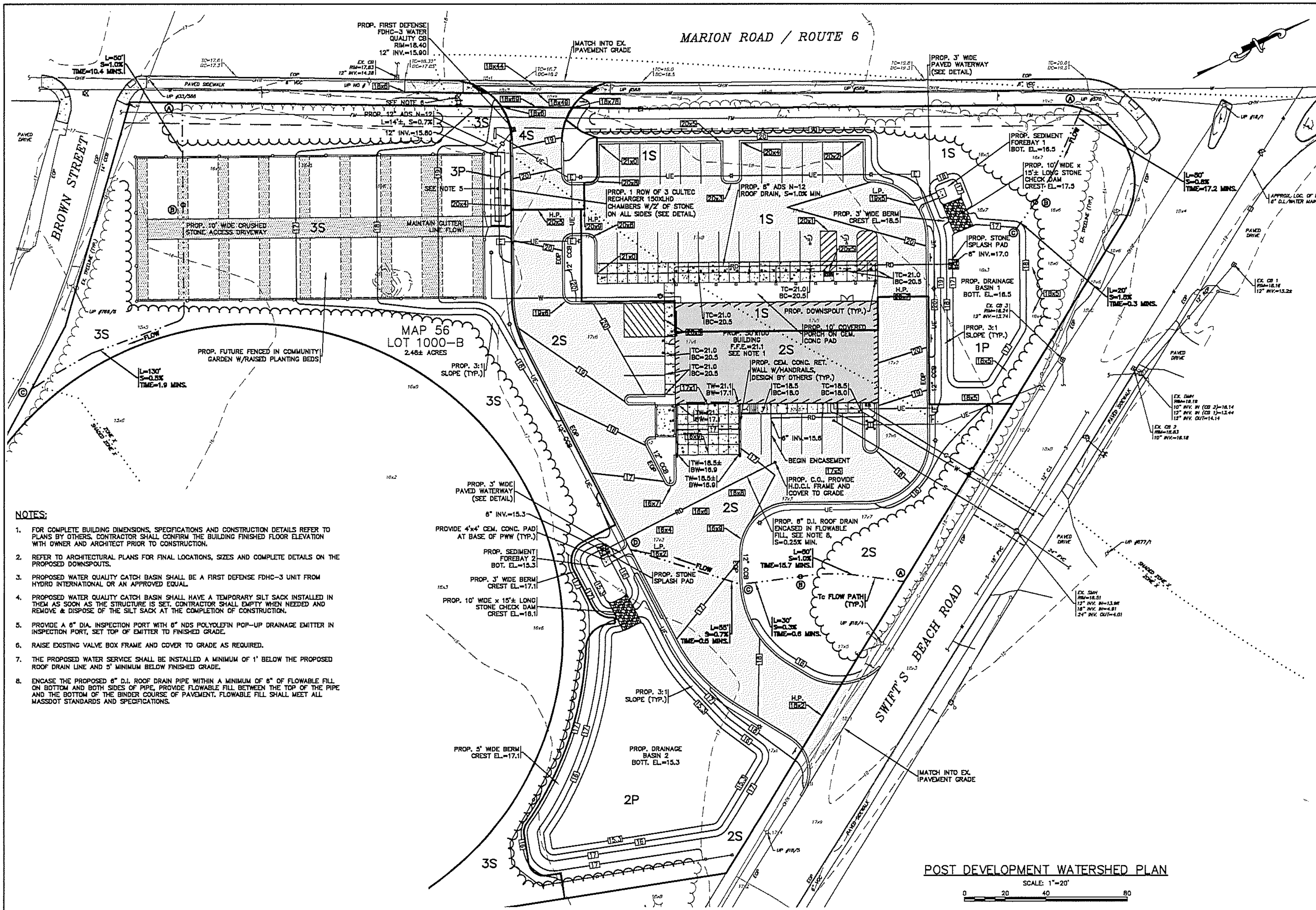
Volume	Invert	Avail.Storage	Storage Description
#1	15.30'	219 cf	**7.00'W x 36.00'L x 2.50'H Crushed Stone** 630 cf Overall - 83 cf Embedded = 547 cf x 40.0% Voids
#2	15.80'	83 cf	**Cultec R-150XLHD** x 3 Inside #1 Effective Size= 29.8"W x 18.0"H => 2.65 sf x 10.25'L = 27.2 cf Overall Size= 33.0"W x 18.5"H x 11.00'L with 0.75' Overlap Row Length Adjustment= +0.75' x 2.65 sf x 1 rows
		302 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Discarded	15.30'	**8.270 in/hr Exfiltration over Wetted area**

Discarded OutFlow Max=0.05 cfs @ 12.11 hrs HW=15.32' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.05 cfs)

Pond 3P: Chambers





NOTES:

1. FOR COMPLETE BUILDING DIMENSIONS, SPECIFICATIONS AND CONSTRUCTION DETAILS REFER TO PLANS BY OTHERS. CONTRACTOR SHALL CONFIRM THE BUILDING FINISHED FLOOR ELEVATION WITH OWNER AND ARCHITECT PRIOR TO CONSTRUCTION.
2. REFER TO ARCHITECTURAL PLANS FOR FINAL LOCATIONS, SIZES AND COMPLETE DETAILS ON THE PROPOSED DOWNSPOUTS.
3. PROPOSED WATER QUALITY CATCH BASIN SHALL BE A FIRST DEFENSE FDHC-3 UNIT FROM HYDRO INTERNATIONAL OR AN APPROVED EQUAL.
4. PROPOSED WATER QUALITY CATCH BASIN SHALL HAVE A TEMPORARY SILT SACK INSTALLED IN THEM AS SOON AS THE STRUCTURE IS SET. CONTRACTOR SHALL EMPTY WHEN NEEDED AND REMOVE & DISPOSE OF THE SILT SACK AT THE COMPLETION OF CONSTRUCTION.
5. PROVIDE A 6" DIA. INSPECTION PORT WITH 6" NDS POLYOLEFIN POP-UP DRAINAGE EMITTER IN INSPECTION PORT, SET TOP OF EMITTER TO FINISHED GRADE.
6. RAISE EXISTING VALVE BOX FRAME AND COVER TO GRADE AS REQUIRED.
7. THE PROPOSED WATER SERVICE SHALL BE INSTALLED A MINIMUM OF 1' BELOW THE PROPOSED ROOF DRAIN LINE AND 5' MINIMUM BELOW FINISHED GRADE.
8. ENCASE THE PROPOSED 6" D.I. ROOF DRAIN PIPE WITHIN A MINIMUM OF 6" OF FLOWABLE FILL ON BOTTOM AND BOTH SIDES OF PIPE, PROVIDE FLOWABLE FILL BETWEEN THE TOP OF THE PIPE AND THE BOTTOM OF THE BINDER COURSE OF PAVEMENT. FLOWABLE FILL SHALL MEET ALL MASSDOT STANDARDS AND SPECIFICATIONS.

REV.	DATE	BY	APP'D	DESCRIPTION
1	4/12/23	JWP	WFM	ADDED WATER QUALITY CB, CULTEC CHAMBERS, SITE GRADING, BASIN 1 EL'S, REAR BUILDING ROOF DRAIN PIPING

DATE: AUGUST 4, 2022
DRAWN BY: JWP
CHECKED BY: RJR
JOB NO.: 22-9838
SCALE: 1" = 20'

APPROVED BY:

APPROVED BY:

G.A.F. ENGINEERING, INC.
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POST DEVELOPMENT WATERSHED PLAN

242 MARION ROAD WAREHAM, MA

PREPARED FOR:

DAMIEN'S FOOD PANTRY

P.O. BOX 730 WAREHAM, MA

JOB NO.: 22-9838

DWG. 2 OF 2