STORMWATER MANAGEMENT REPORT

Proposed Transfer Station
Land Off Carleton Drive
GEORGETOWN, MASSACHUSETTS
October 9, 2019
Revised: May 12, 2020

SUBMITTED TO:

TOWN OF GEORGETOWN
PLANNING BOARD
1 LIBRARY STREET
GEORGETOWN, MA 01833

APPLICANT:

G. MELLO DISPOSAL CORP.
95 TENNEY STREET
GEORGETOWN, MA 01833

SUBMITTED BY:

THE MORIN-CAMERON GROUP, INC
66 ELM STREET
DANVERS, MA 01923

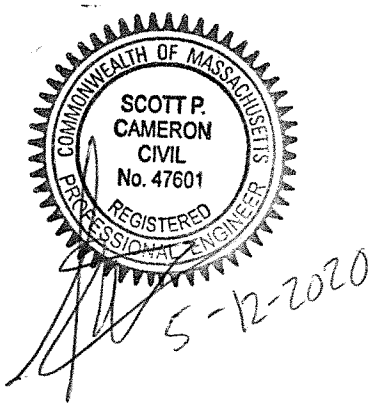

Table of Contents

PROJECT NARRATIVE

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Land Off Carleton Drive

I. Executive Summary

G. Mello Disposal Corp, the applicant, proposes to relocate its existing transfer station facility and operations currently operating at 203 E. Main Street, Georgetown, MA to the subject property located Off Carleton Drive in Georgetown, Massachusetts. The development of the property will consist of the construction of a new 30' access driveway along the westerly lot boundary, residential waste and recycling drop off center, 15,000 square foot waste handling building, scales and scale house, and operations and circulation areas around the building. The property is shown on the Town of Georgetown Assessor's Map 15, Lot 46 and is situated within the Business and Commercial (CC) Zoning District. This project requires Site Plan Approval from the Georgetown Planning Board. The property contains Bordering Vegetated Wetlands (BVW) and vernal pools. Alterations within the BVW and the 100' Buffer Zone must take place in order to provide access to the site. The following narrative contains a description of existing and proposed site conditions and a stormwater management summary.

II. Existing Site Description

The site located along the north side of Carleton Drive and consists of approximately 14.57 acres with the Business and Commercial (CC) Zoning District. The site is also in the Medical Marijuana overlay district and partially within the water resource and flood plain overlay districts. The site has been subject to construction of a gravel access drive along the easterly lot line, land clearing activities and storage of earth materials in the middle portion of the property and is otherwise undeveloped. The property is bordered to the east by Interstate Highway 95, to the north by undeveloped CC zoned property and developed and undeveloped residential zoned property, to the west by developed industrial property and to the south by Carleton Drive.

The majority of the soils on site are classified as Deerfield loamy find sand as defined in the Soil Resource Report for Essex County, Massachusetts. These soils are considered rapidly infiltrating and are in the NRCS Hydrologic Soil Group "A". On-site soil testing has not yet been performed but the ground surface has been altered in recent years and has many piles of stone and other fill material. It is difficult to break through the ground surface with a shovel. Topographically, the property is generally flat with a high elevation of approximately 87 along the west side line to a low elevation of 83 along the east side line. The land generally slopes from west to east towards Interstate 95. The flat topography results in low areas which are wetland resource areas subject to jurisdiction under the Massachusetts Wetland Protection Act and its Regulations found in 310 CMR 10 and the Georgetown Wetlands Protection Bylaw and its Regulations. The site also contains two vernal pools within the Bordering Vegetated Wetlands (BVW) in the northern portion of the site, triggering a 100' Special Conditions Setback from the BVW limit as outlined in section 14 of the Georgetown Wetlands Protection Regulations.

The rear portion of the property is partially within the flood plain overlay district according to the Georgetown Zoning Map. However, the property does not contain any land within the 100-year floodplain (Zone A) according to the most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map Community Panel No. 25009C-0254-F effective July 3, 2012.

III. Proposed Site Description

The proposed project features a proposed waste handling building for commercial solid waste and recycling. The site will require a 30' wide paved entry drive to provide access to building from Carleton Drive for employees and the public, who can use the exterior loading bays for household trash and recycling. The proposed site layout provides adequate circulation around the building as the proposed use as a waste handling facility requires that the facility be designed to accommodate heavy truck turning and circulation. The design of the facility was based on the American Association of State Highway and Transportation Officials (AASHTO) WB-65 trailer truck dimensions. A WB-65 truck measures 65 feet from front to rear bumper and an outside turning radius of 45 feet, meaning the facility's design can also accommodate emergency vehicle apparatus. All waste handling will be contained within the building or enclosed containers for the resident drop-off.

The existing wetlands Off Carleton Drive act as a sort of barrier to the middle of the site. The project proponent will seek an exception request from the Georgetown Conservation Commission to allow for alterations within both the resource area and the buffer zone to occur. The proposed access drive would create a permanent alteration to the BVW of 3,381 square feet, with an additional 740 square feet of temporary alteration due to construction. The site layout will cause a permanent alteration of 28,801 square feet to the buffer zone, with an additional 12,109 square feet of temporary alteration due to construction. The project proposes a wetland remediation plan that would restore nearly 65,000 square feet, over twice the footprint of permanent alteration, of existing buffer zone and resource area to a vegetated state.

The site will be filled to accommodate subsurface stormwater retention and groundwater recharge to attenuate peak runoff from the 2, 10 and 100-year storm events. This has resulted in a significant amount of retaining walls and reinforced slopes were incorporated into the site design. Where slopes exceed 3:1, reinforced vegetated slopes will be implemented to standardize the slope as well as to provide a more pleasing aesthetic in contrast to stone slope armoring. The portion of the site facing Interstate 95 has been graded to allow for the planting of trees to provide screening from the highway.

The property will be served by public water which will be extended from the main on Carleton Drive for domestic use and fire protection. Wastewater will be disposed of in a soil absorption system on site in accordance with 310 CMR 15 and Georgetown Health Regulations. Gas, electric and communications services will also be extended from Carleton Drive.

IV. Stormwater Management

The proposed stormwater management system for the project will consist of various Best Management Practice (BMP) techniques in both mitigating and renovating stormwater runoff. The entire stormwater system was designed in accordance with the Massachusetts Department of Environmental Protection Stormwater Management Handbook, the Stormwater Management Regulations, and the Town of Georgetown Erosion and Stormwater Control By-Law. A comprehensive Grading & Utility Plan is included in the Site Development Plan set. The existing watershed characteristics, flow paths and drainage patterns were generally matched in the proposed condition to ensure that there are no adverse impacts to adjacent properties. The following is a detailed narrative of the stormwater management system design.

A. Existing Watershed Characteristics

The analysis of stormwater and precipitation is referred to in the industry as hydrologic analysis or the study of hydrology. Hydrologic analysis takes into consideration various factors including time, intensity of precipitation, land area, ground cover and soil type in determining the peak rate of stormwater runoff for a given site. The first step in evaluating the impacts of a development project on hydrology is to evaluate the existing hydrologic conditions.

The property was divided into two (2) individual watersheds, also known as subcatchments, for analyzing the existing hydrology of the site. A third watershed is used to include off-site area flowing on to the property. The property Off Carleton Drive drains into three separate wetland systems. These wetland systems serve as the points where stormwater runoff leaves the watershed and shall herein be referred to as design points ("DP"). The undisturbed area within the wetland systems has not been included in the hydrologic analysis included in this report as it would return the same results in both pre- and post-development conditions. DP1 was identified at the wetland system along the eastern property line. DP2 was identified as the wetland system at the northern portion of the site, away from Carleton Drive. These design points and the tributary subcatchments are illustrated on Figure 5: Pre-Development Watershed Plan, included herein. The table below lists the total area associated with each subcatchment contributing to the design point.

Summary of Existing Watersheds

Existing Drainage Area (ES)	Total Area (SF)	% Impervious	Composite Curve Number
1	158,361	0	49
2	204,886	0	61
3	63,746	50.9	69
Total	**426,993 (9.80 acres)**	**7.6**	**58**

Description of Existing Watersheds

The watersheds analyzed in the existing condition can be described as follows:

- **Watershed ES1:** Located the eastern side of the site and bound by the eastern property line and watershed ES2. This watershed is partially within the BVW 100' Buffer Zone and

much of it has been altered in recent years. It is comprised of trees and vegetation as well as a gravel road and piles of gravel. ES1 flows east toward Interstate 95 and into the DP1 wetland system at the eastern property line. Part of the drainage plan as outlined in this report will remove the existing gravel road and restore the area to its historical drainage patterns.

- **Watershed ES2:** Located in the center of the site and stretching north toward the DP2 wetland system. Most of ES2 has been altered within recent years, leaving behind large piles of gravel and fill throughout a large portion the watershed. The remaining portion consists of trees and vegetation. The DP2 wetland system contains an outstanding resource water in the form of a vernal pool, thus making it a critical area.
- **Watershed ES3:** Consists of area of the abutting parcel and Carleton Drive to the west of the property that flows onto the subject property. This area consists of mainly pavement and landscaped area with small pockets of wooded areas. This area flows overland into the DP1 wetland system at the eastern property line.

B. Proposed Watershed Characteristics

The same design points used to evaluate the existing condition of the site are used to evaluate the impact of the proposed project. To understand and analyze the proposed impacts, smaller watersheds were delineated to analyze stormwater impacts on a more detailed scale. These design points and the tributary subcatchments are illustrated on Figure 6: Post-Development Watershed Plan, included herein.

The table on the following page provides the total area of each watershed and the percentage that will be impervious in the proposed condition.

Summary of Proposed Watersheds

Proposed Drainage Area (PS)	Total Area (SF)	% Impervious	Composite Curve Number
1	111,168	0	33
2	104,502	0	32
3	15,000	100	98
4	1,499	0	39
5	22,191	74.0	83
6	33,526	100	98
7	33,987	77.3	85
8	26,860	74.7	83
9	12,068	67.9	79
10	53,087	50.1	68
11	13,105	52.3	69
Total	**426,993 (9.80 acres)**	**36.5**	**57**

Description of Proposed Watersheds

The watersheds analyzed in the proposed condition can be described as follows:

- **Watershed PS1:** Located in the southern portion of the site along the Carleton Drive frontage and east of the proposed entry drive. This watershed is comprised of existing trees and vegetation as well as a portion of the wetland remediation area. Runoff flows to the DP1 wetland system.
- **Watershed PS2:** Located in the portion of the site north of the proposed on-site development. This watershed is comprised of existing trees and vegetation as well as the bulk of the wetland remediation area. Runoff from this watershed flows north in the DP2 wetland system.
- **Watershed PS3:** This watershed consists of the roof of the waste transfer building. Runoff from this watershed west into roof drains that discharge into Subsurface Infiltration System #2 (2P), which discharges north into an erosion control measure at existing grade before flowing to DP2.
- **Watershed PS4:** Located west of the westerly retaining walls, this watershed in comprised of a tiny portion of land that will be seeded in its proposed condition. What little runoff leaves this watershed in a major rainfall event will make its way to PS2 then subsequently into DP2.
- **Watershed PS5:** Consists of the central portion of the site between the waste transfer building and the exterior waste bins. The area contains pavement and seeded landscaped areas. Runoff flows into a catch basin and a trench drain, which are both routed to Subsurface Infiltration System #1 (1P), which discharges southeast to an erosion control measure at existing grade before flowing to DP1.
- **Watershed PS6:** Consists of the entire asphalt area east of the waste transfer building. Runoff flows into catch basins, which are routed to Subsurface Infiltration System #2 (2P).
- **Watershed PS7:** Consists of the northwestern portion of the developed site and consists of asphalt and seeded landscape area. Runoff flows to the northwest corner of the paved site and into a catch basin that is routed to Subsurface Infiltration System #3 (3P), which then discharges into a manhole prior to combining with flows from Subsurface Infiltration System #2.
- **Watershed PS8:** Consists of a portion of the entry drive as well as the public parking for the residential trash and recycling area. This area is mostly asphalt with some seeded landscape area. Runoff flows to a catch basin which discharges to a sediment forebay and then into an into an infiltration basin (4P). 4P is released through a standpipe which discharges southwest to an erosion control measure at existing grade before flowing to DP1.
- **Watershed PS9:** Consists of the length of the entry drive up to the western property line. This area is mostly asphalt with some seeded landscape area. Runoff will sheet from along the road and through a four-foot wide grass/gravel combination filter strip along the side of the road then into a constructed wetland detention basin (5P). The constructed wetland detention basin will release through a perforated riser pipe and discharge on the other side of the entry drive into an erosion control measure at existing grade before flowing into DP1.
- **Watershed PS10:** Consists of area of the abutting parcel and Carleton Drive to the west of the property that flows onto the subject property. This area consists of mainly pavement

and landscaped area with wooded areas. This area flows overland into and infiltration basin (5P). 4P is released through a standpipe which discharges east to an erosion control measure at existing grade before flowing to DP1.

- **Watershed PS11:** Consists of area of the abutting parcel and Carleton Drive to the west of the property that flows overland onto the subject property and is directed through a headwall to the wetlands and further to DP1. This area consists of mainly pavement and landscaped area with wooded area.

C. Hydrologic Analysis

The reason why hydrology is evaluated in the existing and proposed condition is to determine if the proposed development will adversely impact the land or surrounding land. The industry standard for stormwater management design in Massachusetts is the Stormwater Management Handbook published by the Mass Department of Environmental Protection, January 2008. The Regulations require development projects to comply with 10 standards. These standards address mitigation of peak rates of runoff, renovation or cleansing of stormwater runoff, construction phase stormwater management and erosion control and long term operation and maintenance of the stormwater system. A full discussion on the project compliance with the standards can be found at the end of this section. However, the following section will summarize the project's compliance with the mitigation standards 1 and 2 of the Handbook
relating to reducing peak rates of runoff and creating no adverse downstream impacts.

To demonstrate that there will be no downstream impacts as a result of developing the site, a stormwater analysis was performed using the U.S. Soil Conservation Service (S.C.S) method of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The software application HydroCAD was implemented to analyze the pre- and post-development watershed conditions. This application is widely used in the civil engineering industry and is an accepted means of performing a TR-20 analysis. It utilizes the latest techniques of the industry to accurately predict the consequences of various storm events. This analysis allows the engineer to verify that the designed drainage system is adequate for the area under consideration, and further allows the engineer to predict where flooding or erosion are most likely to occur so that it can be prevented.

The HydroCAD analysis was performed by examining the design points that are discussed above. The following is a summary of the peak rates of stormwater runoff for the pre- and post-development conditions. Three (3) storm intensities were evaluated, as is governed by the Stormwater Handbook. These storm "events" included the 2, 10 and 100-year rainfall events:

Comparison of Existing and Proposed Peak Rates of Runoff

Event (Frequency in yrs)	Existing Conditions (CFS)	Proposed Conditions (CFS)	Change in Peak (CFS)
DP1			
2	0.67	0.49	-0.18
10	2.31	1.93	-0.38
100	6.44	5.57	-0.87
DP2			
2	1.04	1.02	-0.02
10	4.02	2.93	-1.09
100	9.76	9.28	-0.48

The proposed development will reduce the peak flow rates at all design points for the 2, 10 and 100-year design storm events.

D. Review of Stormwater Management Standards

The development of site will comply with all Stormwater Management Standards and will improve existing hydrologic conditions. The drainage system has been designed to attenuate peak rates of stormwater runoff leaving the site design points so that they are no greater than in the existing condition. Stormwater will be recharged to groundwater using subsurface infiltration systems. Measures will also be implemented to provide the required total suspended solids (TSS) removal to ensure the stormwater runoff is renovated prior to discharge. The following is an assessment of each Standard:

1. No stormwater conveyance system discharges untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. There are no proposed stormwater conveyance systems that discharge untreated stormwater directly to on-site wetlands or to the waters of the Commonwealth.

   The proposed development meets this standard.

2. The stormwater management system has been designed such that post-development peak rates of stormwater runoff do not exceed pre-development rates of stormwater runoff for all storm events.

   The proposed development meets this standard.

3. Loss of annual recharge to groundwater is being managed by proposed subsurface infiltration systems. The recharge capacity in the proposed condition exceeds the recharge capacity of the site under existing conditions.

The proposed development meets this standard.

4. The proposed stormwater management system has been designed to remove a minimum of 80% of the average annual post-construction load of Total Suspended Solids (TSS). The best management practices treatment train utilizes deep-sump hooded catch basins and water quality units, which pretreat the runoff to at least 44% TSS removal prior to conveyance to the subsurface infiltration systems.
   The proposed development meets the standard.

5. Land Uses with Higher Potential Pollutant Load.
   This standard does not apply.

6. Discharges to critical areas.
   The standard does not apply.

7. Redevelopment Projects.
   This standard does not apply.

8. A Construction Phase Operation and Maintenance Plan: A Stormwater Pollution Prevention Plan following the EPA guidelines under the National Pollutant Discharge Elimination System is required since the disturbed land is greater than an acre. A NPDES submission will be made prior to initiation of construction.
   The proposed development meets this standard.

9. A Long-Term Operation and Maintenance Plan: A long-term O&M has been prepared to provide guidance for future owners to inspect and maintain the stormwater management systems in perpetuity. A copy of this O&M plan is included herein.
   The proposed development meets this standard.

10. Illicit discharges: To the best of our knowledge and belief there are no illicit discharges to the stormwater management system on this site. A certification is included herein.
    The proposed development meets this standard.

For questions regarding this report, please contact The Morin-Cameron Group, Inc. between the hours of 8:30am to 4:30pm at (978) 373-0310.

FIGURES

ORTHO IMAGERY OBTAINED FROM GOOGLE EARTH

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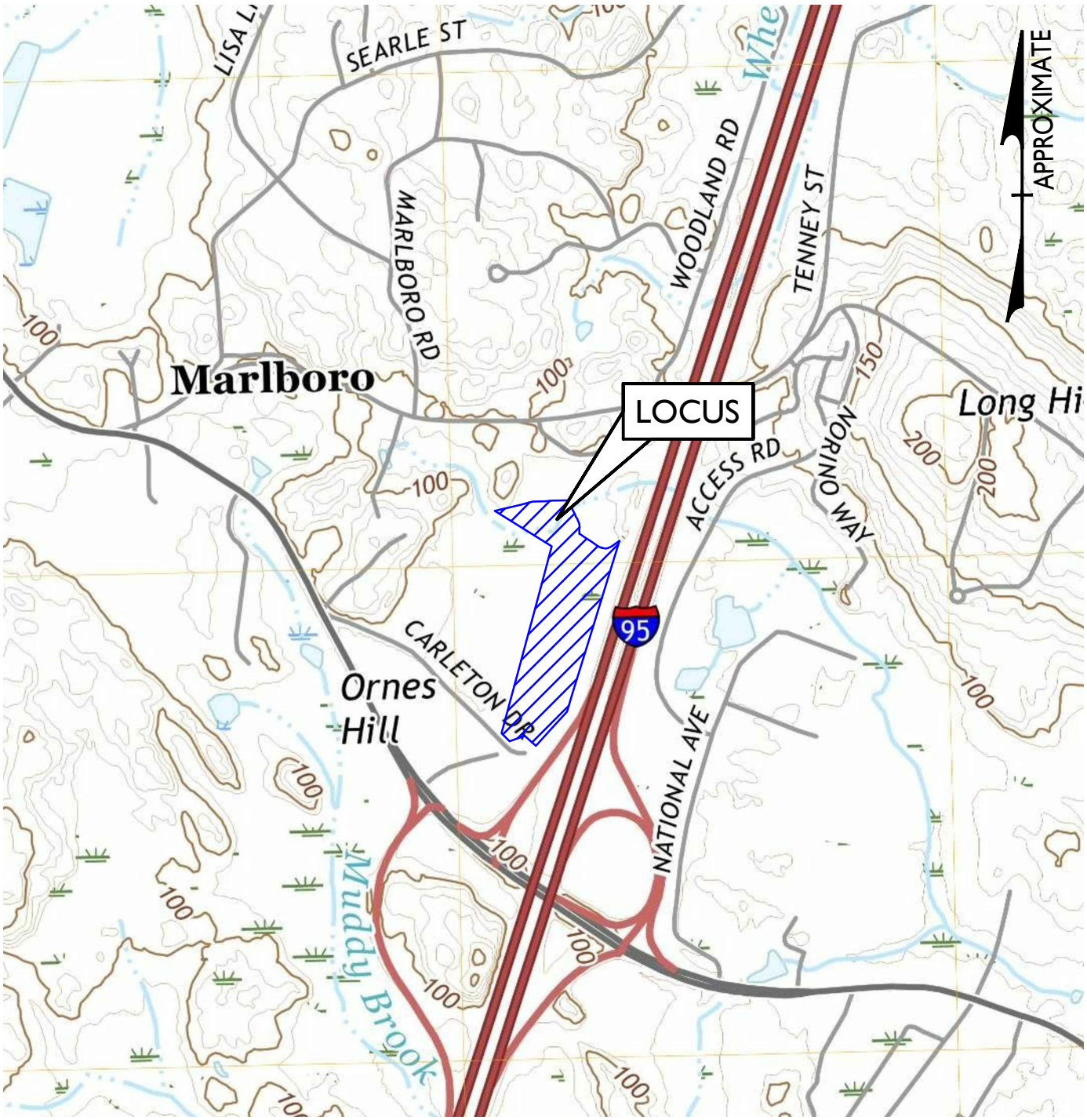
ORTHO MAP
OFF CARLETON DRIVE
IN
GEORGETOWN, MA

DATE: OCTOBER 9, 2019

Scale: 1" = 500'

FIGURE #1



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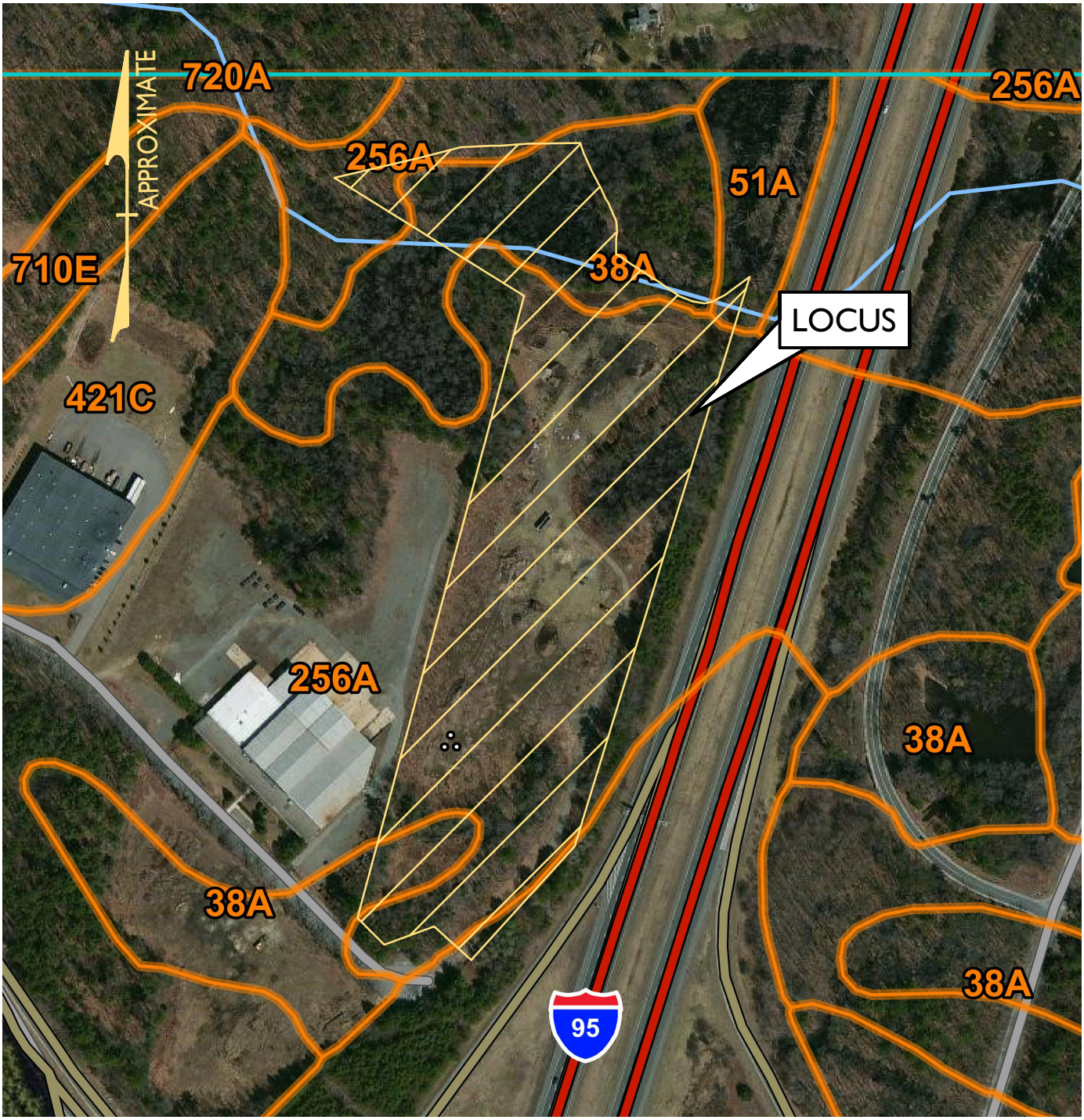
USGS MAP
OFF CARLETON DRIVE
IN
GEORGETOWN, MA

DATE: OCTOBER 9, 2019

Scale: 1" = 1000'

FIGURE #2



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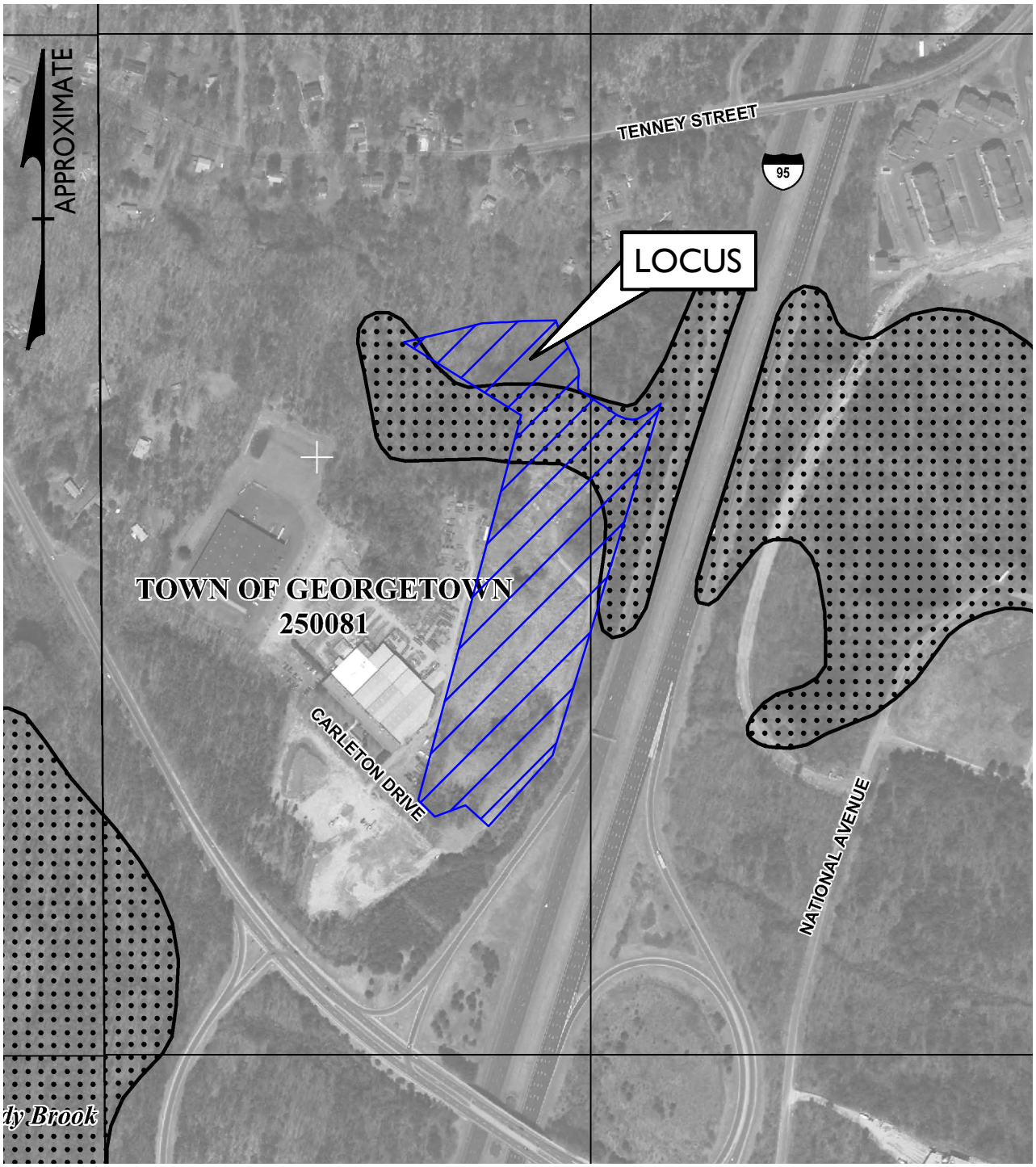
SCS SOIL MAP
OFF CARLETON DRIVE
IN
GEORGETOWN, MA

DATE: OCTOBER 9, 2019

Scale: 1" = 300'

FIGURE #3



FEMA FLOOD MAP NO. 25009C0254F

0 250 500 1,000

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FEMA FLOOD MAP OFF CARLETON DRIVE IN GEORGETOWN, MA

DATE: OCTOBER 9, 2019

Scale: 1" = 500'

FIGURE #4

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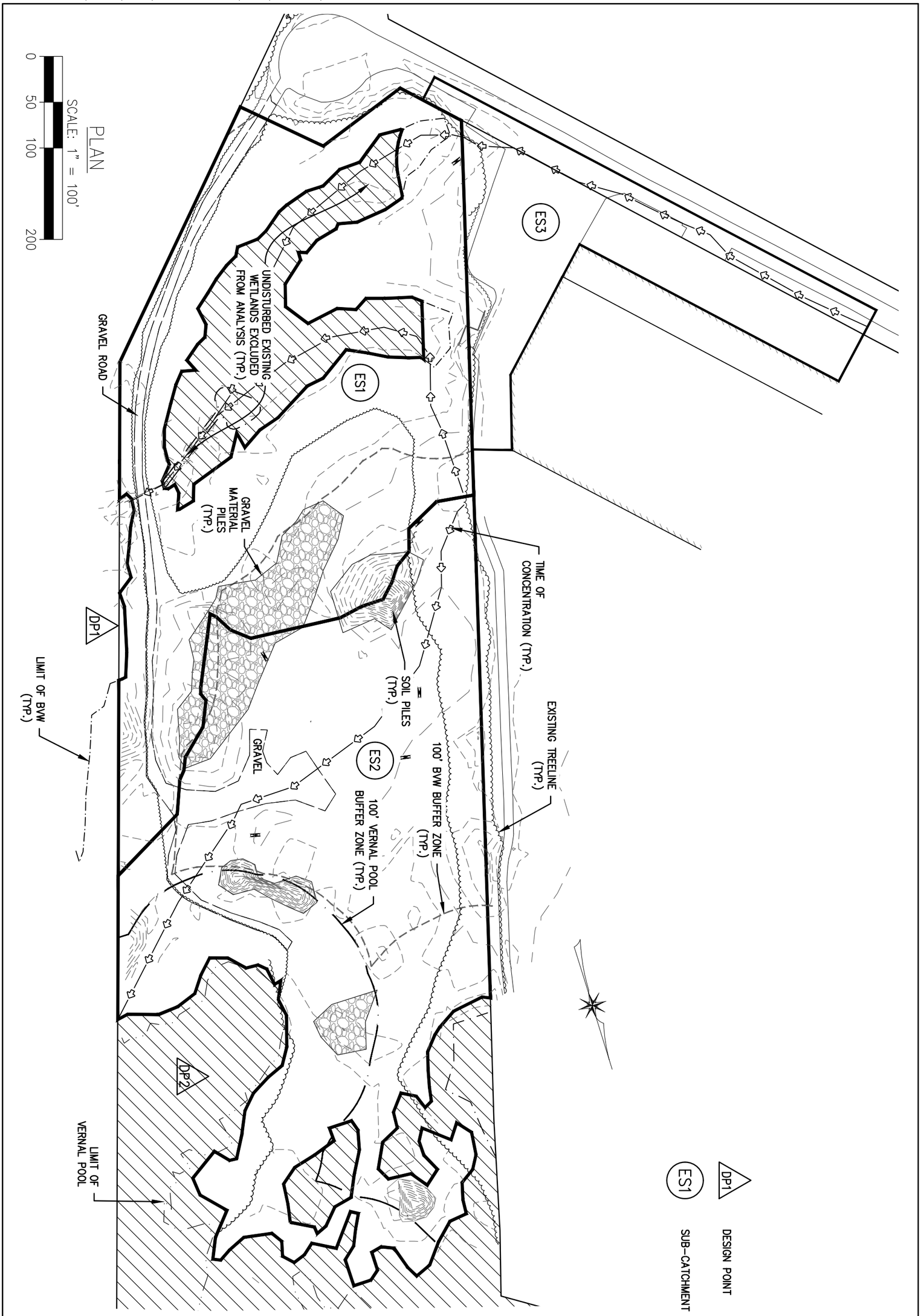

FIGURE 5:
PRE-DEVELOPMENT WATERSHED

AT:

LAND OFF CARLETON DRIVE
GEORGETOWN, MASSACHUSETTS

DATE: 10/8/19

REV: 3/26/2020

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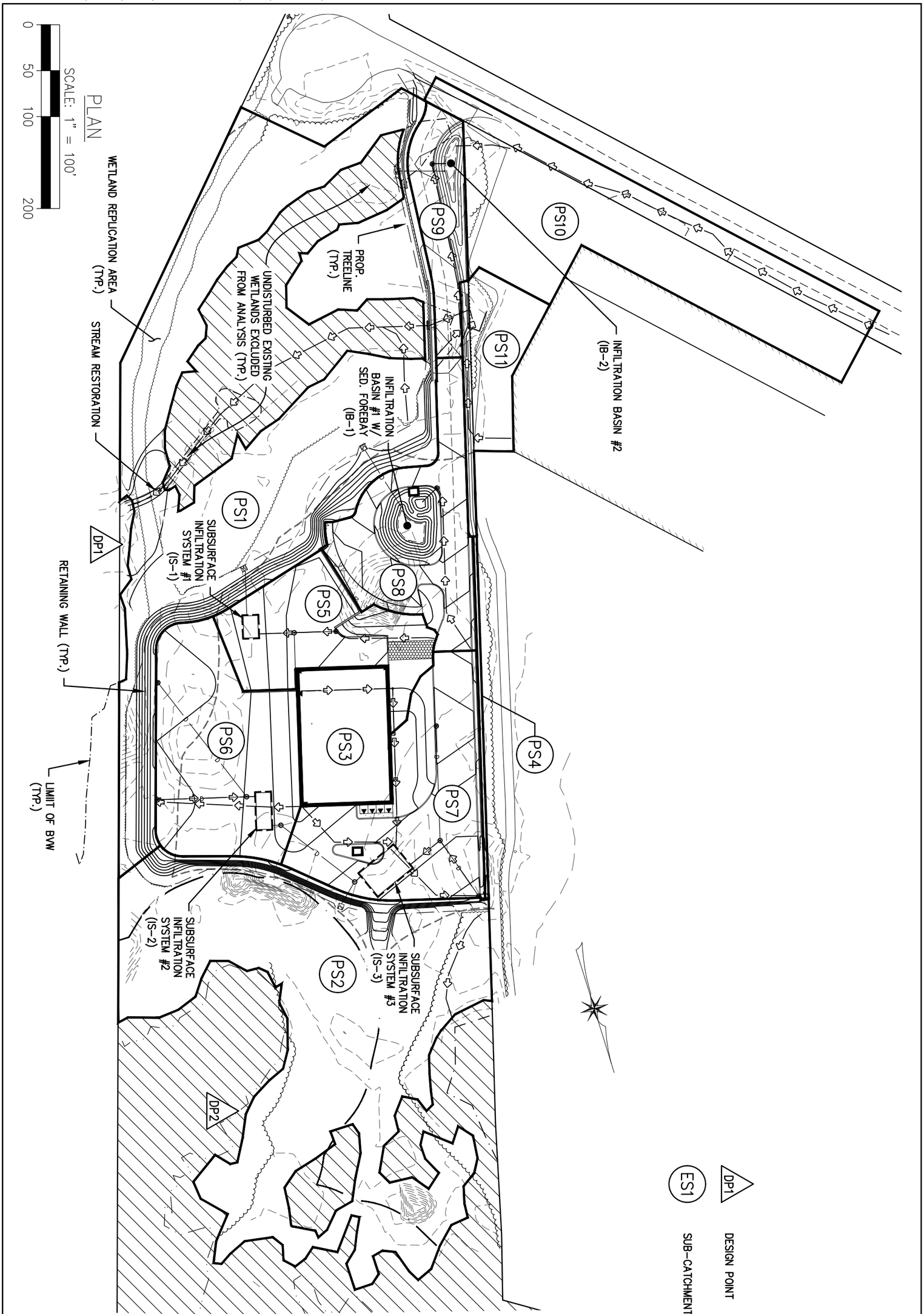

FIGURE 6:
POST-DEVELOPMENT WATERSHED

AT:

LAND OFF CARLETON DRIVE
GEORGETOWN, MASSACHUSETTS

DATE: 10/8/19

REV: 3/26/2020

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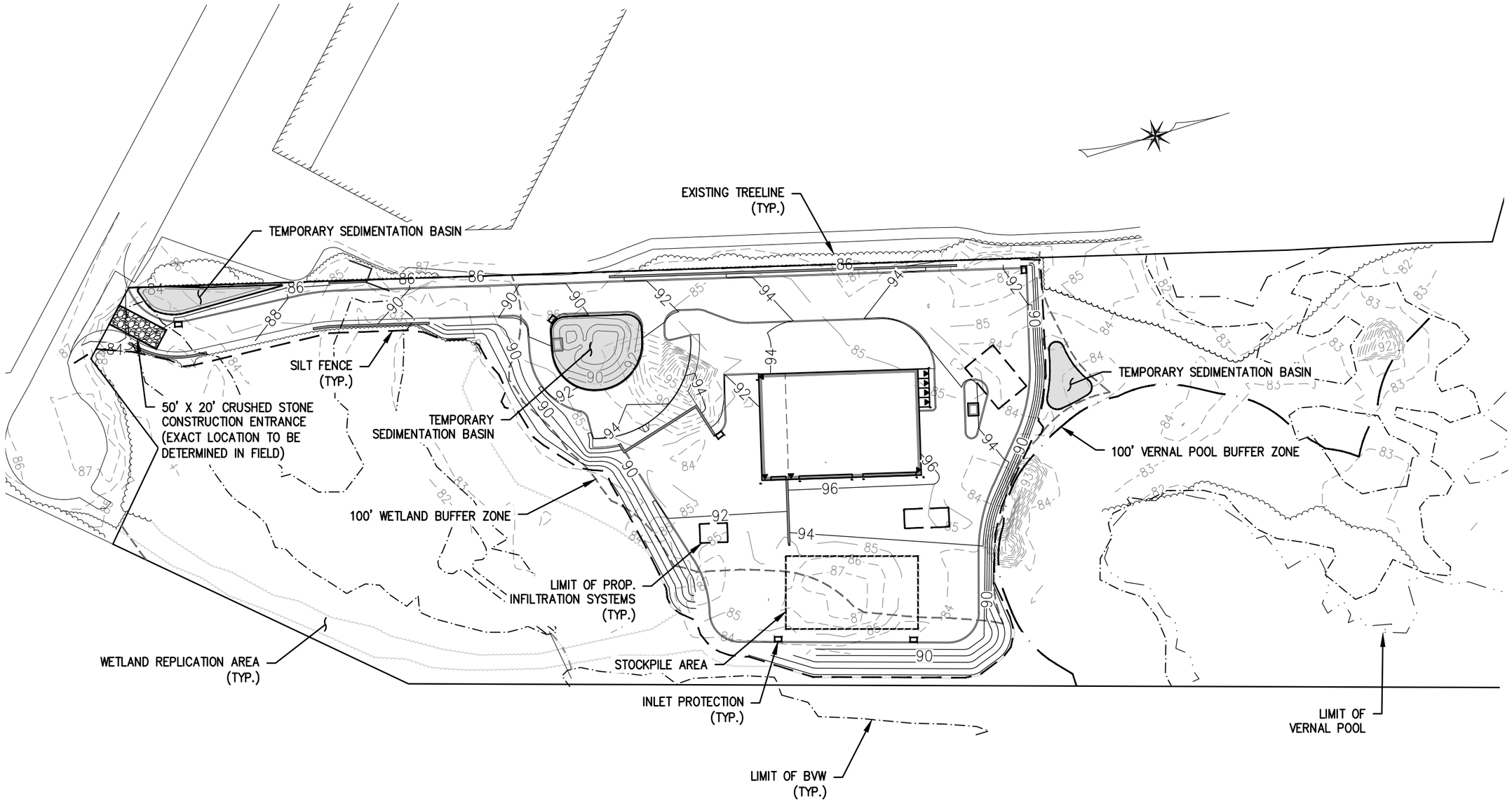

PLAN

SCALE: 1" = 100'

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FIGURE 7:
EROSION CONTROL PLAN
AT:
LAND OFF CARLETON DRIVE
GEORGETOWN, MASSACHUSETTS

PROJ. #3794

APPENDIX A:

MASSDEP STORMWATER

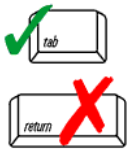
MANAGEMENT REPORT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

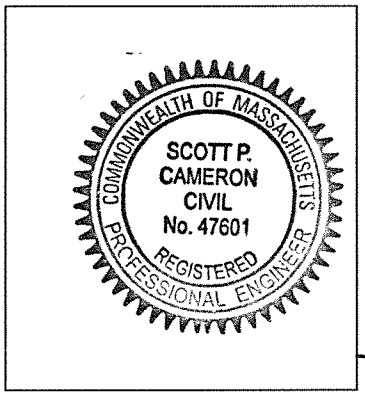
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



5-12-2020

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): Hydrodynamic Separators, Subsurface Infiltration Systems, Infiltration Basins

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

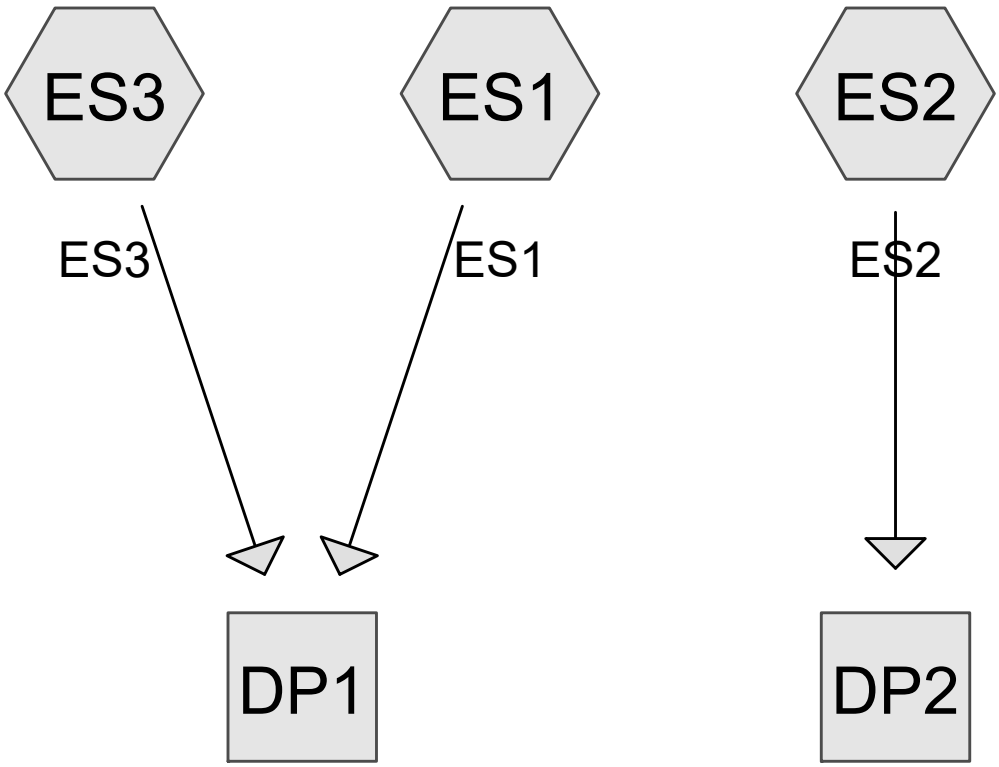
☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B:

EXISTING CONDITIONS

HYDROLOGIC ANALYSIS



Subcat Reach Pond Link

Routing Diagram for 3794 - Pre-Development
Prepared by The Morin-Cameron Group, Inc., Printed 3/26/2020

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
169,894	68	<50% Grass cover, Poor, HSG A (ES1, ES2)
27,869	39	>75% Grass cover, Good, HSG A (ES3)
40,353	96	Gravel surface, HSG A (ES1, ES2)
32,470	98	Paved roads w/curbs & sewers, HSG A (ES3)
3,407	30	Woods, Good, HSG A (ES3)
153,000	32	Woods/grass comb., Good, HSG A (ES1, ES2)

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
426,993	HSG A	ES1, ES2, ES3
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	

Summary for Subcatchment ES1: ES1

Runoff = 0.04 cfs @ 14.02 hrs, Volume= 1,198 cf, Depth= 0.09"

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 Rainfall=3.10"

Area (sf)	CN	Description
99,103	32	Woods/grass comb., Good, HSG A
20,378	96	Gravel surface, HSG A
38,880	68	<50% Grass cover, Poor, HSG A
158,361	49	Weighted Average
158,361		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
11.7	350	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
19.2	565	Total			

Summary for Subcatchment ES2: ES2

Runoff = 1.04 cfs @ 12.28 hrs, Volume= 6,895 cf, Depth= 0.40"

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 Rainfall=3.10"

Area (sf)	CN	Description
53,897	32	Woods/grass comb., Good, HSG A
19,975	96	Gravel surface, HSG A
131,014	68	<50% Grass cover, Poor, HSG A
204,886	61	Weighted Average
204,886		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.9	195	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	102	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8	262	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.6	609	Total			

Summary for Subcatchment ES3: ES3

Runoff = 0.67 cfs @ 12.38 hrs, Volume= 3,846 cf, Depth= 0.72"

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 Rainfall=3.10"

Area (sf)	CN	Description
32,470	98	Paved roads w/curbs & sewers, HSG A
27,869	39	>75% Grass cover, Good, HSG A
3,407	30	Woods, Good, HSG A
63,746	69	Weighted Average
31,276		49.06% Pervious Area
32,470		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.8	143	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	61	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.7	75	0.0020	0.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	136	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	320	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
23.4	950	Total			

Summary for Reach DP1: Design Point 1

Inflow Area = 222,107 sf, 14.62% Impervious, Inflow Depth = 0.27" for 2-Year event
Inflow = 0.67 cfs @ 12.38 hrs, Volume= 5,044 cf
Outflow = 0.67 cfs @ 12.38 hrs, Volume= 5,044 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Design Point 2

Inflow Area = 204,886 sf, 0.00% Impervious, Inflow Depth = 0.40" for 2-Year event
Inflow = 1.04 cfs @ 12.28 hrs, Volume= 6,895 cf
Outflow = 1.04 cfs @ 12.28 hrs, Volume= 6,895 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Subcatchment ES1: ES1

Runoff = 0.71 cfs @ 12.48 hrs, Volume= 6,017 cf, Depth= 0.46"

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 Rainfall=4.50"

Area (sf)	CN	Description
99,103	32	Woods/grass comb., Good, HSG A
20,378	96	Gravel surface, HSG A
38,880	68	<50% Grass cover, Poor, HSG A
158,361	49	Weighted Average
158,361		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
11.7	350	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
19.2	565	Total			

Summary for Subcatchment ES2: ES2

Runoff = 4.02 cfs @ 12.21 hrs, Volume= 18,427 cf, Depth= 1.08"

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 Rainfall=4.50"

Area (sf)	CN	Description
53,897	32	Woods/grass comb., Good, HSG A
19,975	96	Gravel surface, HSG A
131,014	68	<50% Grass cover, Poor, HSG A
204,886	61	Weighted Average
204,886		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.9	195	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	102	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8	262	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.6	609	Total			

Summary for Subcatchment ES3: ES3

Runoff = 1.67 cfs @ 12.35 hrs, Volume= 8,512 cf, Depth= 1.60"

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 Rainfall=4.50"

Area (sf)	CN	Description
32,470	98	Paved roads w/curbs & sewers, HSG A
27,869	39	>75% Grass cover, Good, HSG A
3,407	30	Woods, Good, HSG A
63,746	69	Weighted Average
31,276		49.06% Pervious Area
32,470		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.8	143	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	61	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.7	75	0.0020	0.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	136	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	320	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
23.4	950	Total			

Summary for Reach DP1: Design Point 1

Inflow Area = 222,107 sf, 14.62% Impervious, Inflow Depth = 0.79" for 10-Year event
Inflow = 2.31 cfs @ 12.38 hrs, Volume= 14,530 cf
Outflow = 2.31 cfs @ 12.38 hrs, Volume= 14,530 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Design Point 2

Inflow Area = 204,886 sf, 0.00% Impervious, Inflow Depth = 1.08" for 10-Year event
Inflow = 4.02 cfs @ 12.21 hrs, Volume= 18,427 cf
Outflow = 4.02 cfs @ 12.21 hrs, Volume= 18,427 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Subcatchment ES1: ES1

Runoff = 3.11 cfs @ 12.31 hrs, Volume= 17,376 cf, Depth= 1.32"

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 Rainfall=6.50"

Area (sf)	CN	Description
99,103	32	Woods/grass comb., Good, HSG A
20,378	96	Gravel surface, HSG A
38,880	68	<50% Grass cover, Poor, HSG A
158,361	49	Weighted Average
158,361		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
11.7	350	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
19.2	565	Total			

Summary for Subcatchment ES2: ES2

Runoff = 9.76 cfs @ 12.20 hrs, Volume= 40,076 cf, Depth= 2.35"

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 Rainfall=6.50"

Area (sf)	CN	Description
53,897	32	Woods/grass comb., Good, HSG A
19,975	96	Gravel surface, HSG A
131,014	68	<50% Grass cover, Poor, HSG A
204,886	61	Weighted Average
204,886		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
2.9	195	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.2	102	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.8	262	0.0050	1.14		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
13.6	609	Total			

Summary for Subcatchment ES3: ES3

Runoff = 3.34 cfs @ 12.33 hrs, Volume= 16,512 cf, Depth= 3.11"

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 100-Year Rainfall=6.50"

Area (sf)	CN	Description
32,470	98	Paved roads w/curbs & sewers, HSG A
27,869	39	>75% Grass cover, Good, HSG A
3,407	30	Woods, Good, HSG A
63,746	69	Weighted Average
31,276		49.06% Pervious Area
32,470		50.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.8	143	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	61	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.7	75	0.0020	0.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	136	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
10.7	320	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
23.4	950	Total			

Summary for Reach DP1: Design Point 1

Inflow Area = 222,107 sf, 14.62% Impervious, Inflow Depth = 1.83" for 100-Year event
Inflow = 6.44 cfs @ 12.33 hrs, Volume= 33,888 cf
Outflow = 6.44 cfs @ 12.33 hrs, Volume= 33,888 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Design Point 2

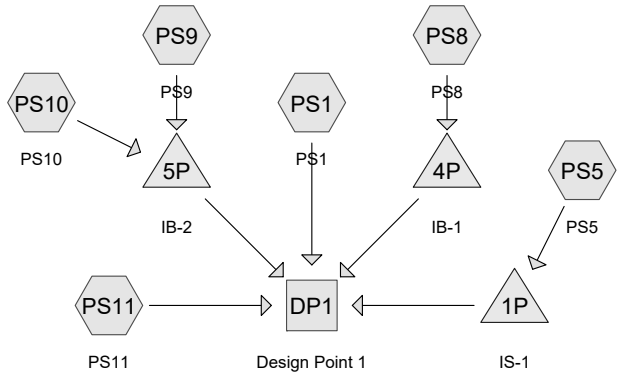
Inflow Area = 204,886 sf, 0.00% Impervious, Inflow Depth = 2.35" for 100-Year event
Inflow = 9.76 cfs @ 12.20 hrs, Volume= 40,076 cf
Outflow = 9.76 cfs @ 12.20 hrs, Volume= 40,076 cf, Atten= 0%, Lag= 0.0 min

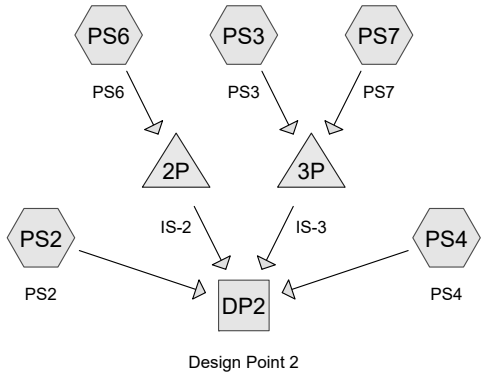
Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

APPENDIX C:

PROPOSED CONDITIONS

HYDROLOGIC ANALYSIS





Subcat Reach Pond Link

Routing Diagram for 3794 - Post Development
Prepared by The Morin-Cameron Group, Inc., Printed 4/24/2020

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
85,384	39	>75% Grass cover, Good, HSG A (PS1, PS10, PS11, PS2, PS4, PS5, PS7, PS8, PS9)
110,726	98	Paved parking, HSG A (PS11, PS5, PS6, PS7, PS8, PS9)
26,618	98	Paved roads w/curbs & sewers, HSG A (PS10)
15,600	98	Roofs, HSG A (PS3, PS7, PS8)
3,406	30	Woods, Good, HSG A (PS10, PS11)
185,259	32	Woods/grass comb., Good, HSG A (PS1, PS2)

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
426,993	HSG A	PS1, PS10, PS11, PS2, PS3, PS4, PS5, PS6, PS7, PS8, PS9
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	

Summary for Subcatchment PS1: PS1

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, 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 Rainfall=3.10"

Area (sf)	CN	Description
87,371	32	Woods/grass comb., Good, HSG A
23,797	39	>75% Grass cover, Good, HSG A
111,168	33	Weighted Average
111,168		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.8	270	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.3	320	Total			

Summary for Subcatchment PS10: PS10

Runoff = 0.64 cfs @ 12.21 hrs, Volume= 3,003 cf, Depth= 0.68"

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 Rainfall=3.10"

Area (sf)	CN	Description
26,618	98	Paved roads w/curbs & sewers, HSG A
24,552	39	>75% Grass cover, Good, HSG A
1,917	30	Woods, Good, HSG A
53,087	68	Weighted Average
26,469		49.86% Pervious Area
26,618		50.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.8	143	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	61	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.7	75	0.0020	0.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	136	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	60	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
13.0	690	Total			

Summary for Subcatchment PS11: PS11

Runoff = 0.22 cfs @ 12.10 hrs, Volume= 791 cf, Depth= 0.72"

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 Rainfall=3.10"

Area (sf)	CN	Description
4,760	39	>75% Grass cover, Good, HSG A
6,856	98	Paved parking, HSG A
1,489	30	Woods, Good, HSG A
13,105	69	Weighted Average
6,249		47.68% Pervious Area
6,856		52.32% Impervious Area

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

Summary for Subcatchment PS2: PS2

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, 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 Rainfall=3.10"

Area (sf)	CN	Description
97,888	32	Woods/grass comb., Good, HSG A
6,614	39	>75% Grass cover, Good, HSG A
104,502	32	Weighted Average
104,502		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	76	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.1	126	Total			

Summary for Subcatchment PS3: PS3

Runoff = 1.04 cfs @ 12.08 hrs, Volume= 3,585 cf, Depth= 2.87"

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 Rainfall=3.10"

Area (sf)	CN	Description
15,000	98	Roofs, HSG A
15,000		100.00% Impervious Area

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

Summary for Subcatchment PS4: PS4

Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0 cf, 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 Rainfall=3.10"

Area (sf)	CN	Description
1,499	39	>75% Grass cover, Good, HSG A
1,499		100.00% Pervious Area

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

Summary for Subcatchment PS5: PS5

Runoff = 0.91 cfs @ 12.09 hrs, Volume= 2,825 cf, Depth= 1.53"

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 Rainfall=3.10"

Area (sf)	CN	Description
16,423	98	Paved parking, HSG A
5,768	39	>75% Grass cover, Good, HSG A
22,191	83	Weighted Average
5,768		25.99% Pervious Area
16,423		74.01% Impervious Area

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

Summary for Subcatchment PS6: PS6

Runoff = 2.31 cfs @ 12.08 hrs, Volume= 8,012 cf, Depth= 2.87"

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 Rainfall=3.10"

Area (sf)	CN	Description
33,526	98	Paved parking, HSG A
33,526		100.00% Impervious Area

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

Summary for Subcatchment PS7: PS7

Runoff = 1.53 cfs @ 12.09 hrs, Volume= 4,737 cf, Depth= 1.67"

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 Rainfall=3.10"

Area (sf)	CN	Description
25,793	98	Paved parking, HSG A
480	98	Roofs, HSG A
7,714	39	>75% Grass cover, Good, HSG A
33,987	85	Weighted Average
7,714		22.70% Pervious Area
26,273		77.30% Impervious Area

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

Summary for Subcatchment PS8: PS8

Runoff = 1.10 cfs @ 12.09 hrs, Volume= 3,419 cf, Depth= 1.53"

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 Rainfall=3.10"

Area (sf)	CN	Description
19,940	98	Paved parking, HSG A
120	98	Roofs, HSG A
6,800	39	>75% Grass cover, Good, HSG A
26,860	83	Weighted Average
6,800		25.32% Pervious Area
20,060		74.68% Impervious Area

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

Summary for Subcatchment PS9: PS9

Runoff = 0.40 cfs @ 12.09 hrs, Volume= 1,269 cf, Depth= 1.26"

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 Rainfall=3.10"

Area (sf)	CN	Description
8,188	98	Paved parking, HSG A
3,880	39	>75% Grass cover, Good, HSG A
12,068	79	Weighted Average
3,880		32.15% Pervious Area
8,188		67.85% Impervious Area

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

Summary for Reach DP1: Design Point 1

Inflow Area = 238,479 sf, 32.77% Impervious, Inflow Depth = 0.09" for 2-Year event
Inflow = 0.49 cfs @ 12.48 hrs, Volume= 1,797 cf
Outflow = 0.49 cfs @ 12.48 hrs, Volume= 1,797 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Design Point 2

Inflow Area = 188,514 sf, 39.68% Impervious, Inflow Depth = 0.17" for 2-Year event
Inflow = 1.02 cfs @ 12.24 hrs, Volume= 2,703 cf
Outflow = 1.02 cfs @ 12.24 hrs, Volume= 2,703 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: IS-1

Inflow Area = 22,191 sf, 74.01% Impervious, Inflow Depth = 1.53" for 2-Year event
Inflow = 0.91 cfs @ 12.09 hrs, Volume= 2,825 cf
Outflow = 0.34 cfs @ 12.37 hrs, Volume= 2,825 cf, Atten= 62%, Lag= 16.9 min
Discarded = 0.12 cfs @ 12.37 hrs, Volume= 2,210 cf
Primary = 0.22 cfs @ 12.37 hrs, Volume= 614 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.49' @ 12.37 hrs Surf.Area= 468 sf Storage= 630 cf

Plug-Flow detention time= 19.8 min calculated for 2,824 cf (100% of inflow)
Center-of-Mass det. time= 19.8 min (854.2 - 834.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.50'	217 cf	**26.00'W x 18.00'L x 4.17'H Field A** 1,950 cf Overall - 1,408 cf Embedded = 542 cf x 40.0% Voids
#2A	84.00'	976 cf	**retain_it retain_it 3.0'** x 6 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 3 Rows adjusted for 47.2 cf perimeter wall
		1,193 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.50'	**12.0" Round Culvert** L= 69.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 84.50' / 84.00' S= 0.0072 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	84.50'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	86.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	83.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.12 cfs @ 12.37 hrs HW=85.49' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.12 cfs)

Primary OutFlow Max=0.22 cfs @ 12.37 hrs HW=85.49' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.22 cfs of 2.54 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.22 cfs @ 4.49 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: IS-1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
3 Rows adjusted for 47.2 cf perimeter wall

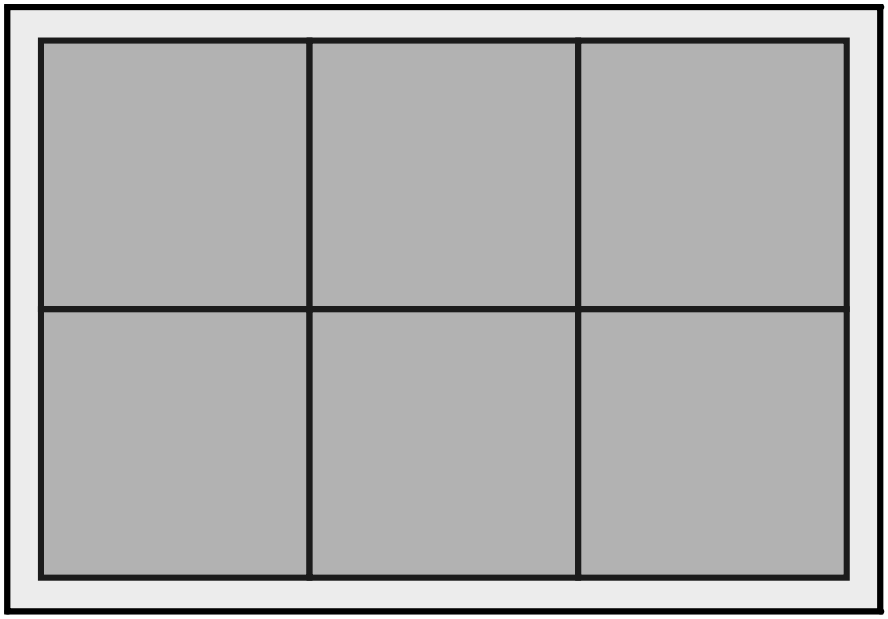
2 Chambers/Row x 8.00' Long = 16.00' Row Length +12.0" End Stone x 2 = 18.00' Base Length
3 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 26.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 2 x 2 + 4.7 cf Endwall x 3 x 2 = 47.2 cf Perimeter Wall
6 Chambers x 170.6 cf - 47.2 cf Perimeter wall = 976.5 cf Chamber Storage
6 Chambers x 234.7 cf = 1,408.0 cf Displacement

1,950.0 cf Field - 1,408.0 cf Chambers = 542.0 cf Stone x 40.0% Voids = 216.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,193.3 cf = 0.027 af
Overall Storage Efficiency = 61.2%
Overall System Size = 18.00' x 26.00' x 4.17'

6 Chambers
72.2 cy Field
20.1 cy Stone



Summary for Pond 2P: IS-2

Inflow Area = 33,526 sf,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event
Inflow = 2.31 cfs @ 12.08 hrs, Volume= 8,012 cf
Outflow = 1.23 cfs @ 12.21 hrs, Volume= 8,012 cf, Atten= 47%, Lag= 7.6 min
Discarded = 0.21 cfs @ 12.21 hrs, Volume= 5,564 cf
Primary = 1.02 cfs @ 12.21 hrs, Volume= 2,448 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 87.45' @ 12.21 hrs Surf.Area= 756 sf Storage= 1,601 cf

Plug-Flow detention time= 18.7 min calculated for 8,012 cf (100% of inflow)
Center-of-Mass det. time= 18.7 min (775.8 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	321 cf	**42.00'W x 18.00'L x 4.17'H Field A** 3,150 cf Overall - 2,347 cf Embedded = 803 cf x 40.0% Voids
#2A	85.00'	1,640 cf	**retain_it retain_it 3.0'** x 10 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 5 Rows adjusted for 66.1 cf perimeter wall
		1,961 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.50'	**12.0" Round Culvert** L= 120.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.50' / 84.50' S= 0.0083 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.50'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	86.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	87.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	87.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Discarded	84.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.21 cfs @ 12.21 hrs HW=87.45' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=1.02 cfs @ 12.21 hrs HW=87.45' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.02 cfs of 4.05 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.32 cfs @ 6.50 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.48 cfs @ 5.44 fps)
  ├**4=Orifice/Grate** (Orifice Controls 0.22 cfs @ 2.54 fps)
  └**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 2P: IS-2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
5 Rows adjusted for 66.1 cf perimeter wall

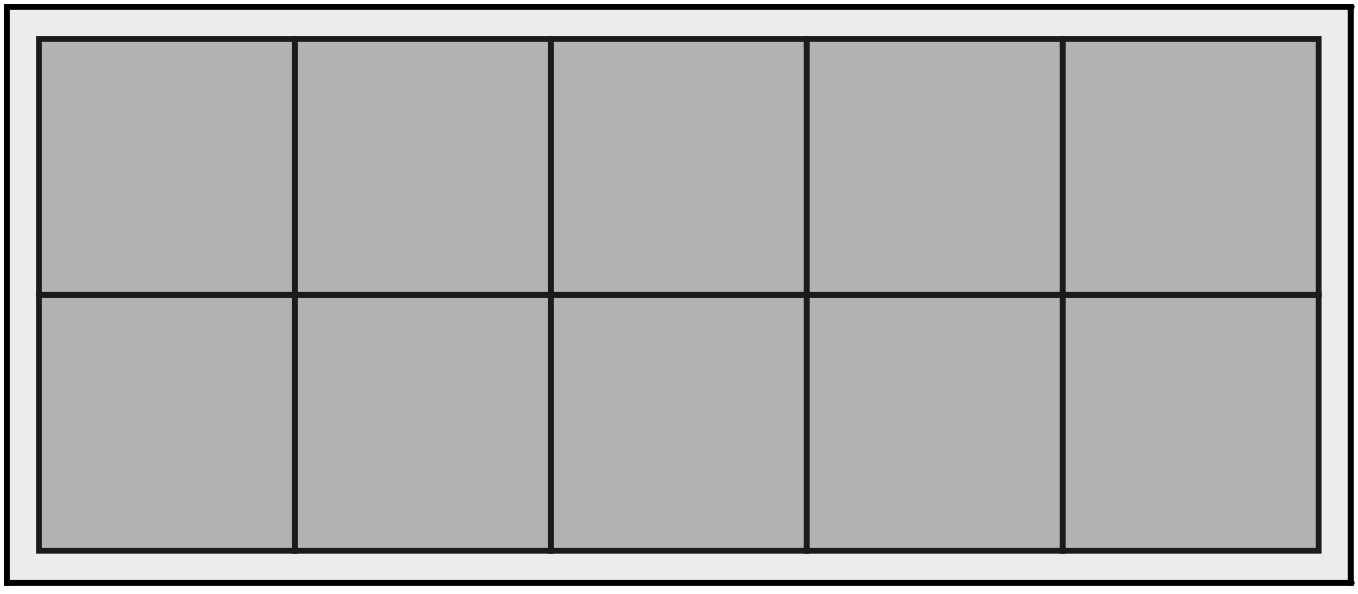
2 Chambers/Row x 8.00' Long = 16.00' Row Length +12.0" End Stone x 2 = 18.00' Base Length
5 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 42.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 2 x 2 + 4.7 cf Endwall x 5 x 2 = 66.1 cf Perimeter Wall
10 Chambers x 170.6 cf - 66.1 cf Perimeter wall = 1,640.0 cf Chamber Storage
10 Chambers x 234.7 cf = 2,346.7 cf Displacement

3,150.0 cf Field - 2,346.7 cf Chambers = 803.3 cf Stone x 40.0% Voids = 321.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,961.3 cf = 0.045 af
Overall Storage Efficiency = 62.3%
Overall System Size = 18.00' x 42.00' x 4.17'

10 Chambers
116.7 cy Field
29.8 cy Stone



Summary for Pond 3P: IS-3

Inflow Area = 48,987 sf, 84.25% Impervious, Inflow Depth = 2.04" for 2-Year event
Inflow = 2.56 cfs @ 12.09 hrs, Volume= 8,322 cf
Outflow = 0.39 cfs @ 12.59 hrs, Volume= 8,322 cf, Atten= 85%, Lag= 30.1 min
Discarded = 0.33 cfs @ 11.71 hrs, Volume= 8,067 cf
Primary = 0.06 cfs @ 12.59 hrs, Volume= 255 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.57' @ 12.59 hrs Surf.Area= 1,700 sf Storage= 2,531 cf

Plug-Flow detention time= 47.8 min calculated for 8,320 cf (100% of inflow)
Center-of-Mass det. time= 47.8 min (845.0 - 797.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.50'	581 cf	**50.00'W x 34.00'L x 4.17'H Field A** 7,083 cf Overall - 5,632 cf Embedded = 1,451 cf x 40.0% Voids
#2A	84.00'	4,000 cf	**retain_it retain_it 3.0'** x 24 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 6 Rows adjusted for 94.4 cf perimeter wall
		4,581 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.10'	**12.0" Round Culvert** L= 43.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.10' / 84.50' S= 0.0140 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.10'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.70'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	86.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	86.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Discarded	83.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.33 cfs @ 11.71 hrs HW=83.54' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=0.06 cfs @ 12.59 hrs HW=85.57' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.06 cfs of 0.83 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.06 cfs @ 2.98 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  ├**4=Orifice/Grate** (Controls 0.00 cfs)
  └**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: IS-3 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
6 Rows adjusted for 94.4 cf perimeter wall

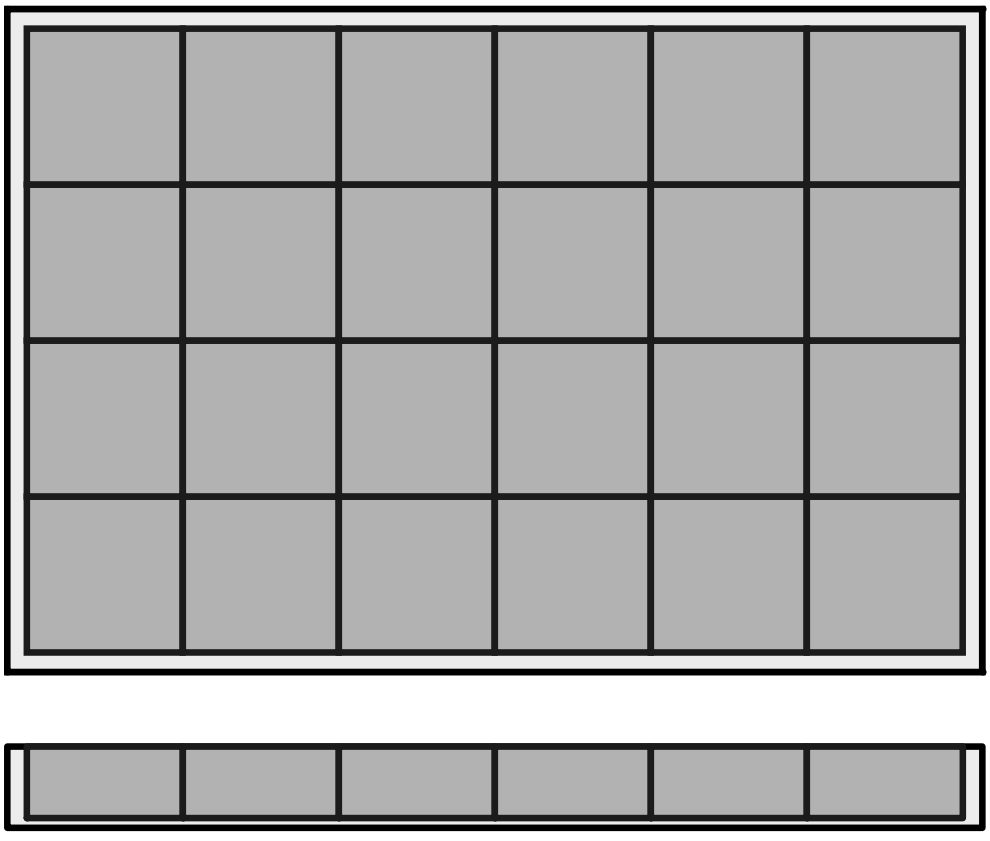
4 Chambers/Row x 8.00' Long = 32.00' Row Length +12.0" End Stone x 2 = 34.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 4 x 2 + 4.7 cf Endwall x 6 x 2 = 94.4 cf Perimeter Wall
24 Chambers x 170.6 cf - 94.4 cf Perimeter wall = 4,000.2 cf Chamber Storage
24 Chambers x 234.7 cf = 5,632.0 cf Displacement

7,083.3 cf Field - 5,632.0 cf Chambers = 1,451.3 cf Stone x 40.0% Voids = 580.5 cf Stone Storage

Chamber Storage + Stone Storage = 4,580.8 cf = 0.105 af
Overall Storage Efficiency = 64.7%
Overall System Size = 34.00' x 50.00' x 4.17'

24 Chambers
262.3 cy Field
53.8 cy Stone



Summary for Pond 4P: IB-1

Inflow Area = 26,860 sf, 74.68% Impervious, Inflow Depth = 1.53" for 2-Year event
Inflow = 1.10 cfs @ 12.09 hrs, Volume= 3,419 cf
Outflow = 0.20 cfs @ 12.56 hrs, Volume= 3,419 cf, Atten= 82%, Lag= 28.4 min
Discarded = 0.20 cfs @ 12.56 hrs, Volume= 3,419 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 83.78' @ 12.56 hrs Surf.Area= 1,036 sf Storage= 1,036 cf

Plug-Flow detention time= 40.4 min calculated for 3,418 cf (100% of inflow)
Center-of-Mass det. time= 40.4 min (874.9 - 834.4)

Volume	Invert	Avail.Storage	Storage Description
#1	82.50'	8,358 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
82.50	600	0	0	600
83.00	759	339	339	766
84.00	1,121	934	1,273	1,143
84.67	1,778	963	2,236	1,806
85.00	1,993	622	2,858	2,027
86.00	2,808	2,389	5,247	2,861
87.00	3,425	3,111	8,358	3,508

Device	Routing	Invert	Outlet Devices
#1	Primary	85.00'	**12.0" Round Culvert** L= 80.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.00' / 84.00' S= 0.0125 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	86.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	82.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.20 cfs @ 12.56 hrs HW=83.78' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.50' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Controls 0.00 cfs)
  ├**2=Orifice/Grate** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 5P: IB-2

Inflow Area = 65,155 sf, 53.42% Impervious, Inflow Depth = 0.79" for 2-Year event
Inflow = 0.91 cfs @ 12.16 hrs, Volume= 4,273 cf
Outflow = 0.43 cfs @ 12.54 hrs, Volume= 4,273 cf, Atten= 53%, Lag= 22.7 min
Discarded = 0.22 cfs @ 12.54 hrs, Volume= 3,880 cf
Primary = 0.21 cfs @ 12.54 hrs, Volume= 392 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 83.78' @ 12.54 hrs Surf.Area= 1,148 sf Storage= 967 cf

Plug-Flow detention time= 33.8 min calculated for 4,272 cf (100% of inflow)
Center-of-Mass det. time= 33.8 min (912.8 - 879.1)

Volume	Invert	Avail.Storage	Storage Description
#1	82.50'	2,949 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
82.50	421	0	0	421
83.00	656	267	267	660
83.50	963	402	669	971
84.00	1,303	564	1,234	1,316
84.50	1,667	741	1,974	1,686
85.00	2,247	975	2,949	2,271

Device	Routing	Invert	Outlet Devices
#1	Primary	83.50'	**12.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 83.50' / 83.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	83.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	84.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	82.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.22 cfs @ 12.54 hrs HW=83.78' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=0.21 cfs @ 12.54 hrs HW=83.78' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.21 cfs of 0.33 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 1.81 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Subcatchment PS1: PS1

Runoff = 0.00 cfs @ 23.01 hrs, Volume= 86 cf, Depth= 0.01"

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 Rainfall=4.50"

Area (sf)	CN	Description
87,371	32	Woods/grass comb., Good, HSG A
23,797	39	>75% Grass cover, Good, HSG A
111,168	33	Weighted Average
111,168		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.8	270	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.3	320	Total			

Summary for Subcatchment PS10: PS10

Runoff = 1.66 cfs @ 12.19 hrs, Volume= 6,779 cf, Depth= 1.53"

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 Rainfall=4.50"

Area (sf)	CN	Description
26,618	98	Paved roads w/curbs & sewers, HSG A
24,552	39	>75% Grass cover, Good, HSG A
1,917	30	Woods, Good, HSG A
53,087	68	Weighted Average
26,469		49.86% Pervious Area
26,618		50.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.8	143	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	61	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.7	75	0.0020	0.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	136	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	60	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
13.0	690	Total			

Summary for Subcatchment PS11: PS11

Runoff = 0.55 cfs @ 12.09 hrs, Volume= 1,750 cf, Depth= 1.60"

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 Rainfall=4.50"

Area (sf)	CN	Description
4,760	39	>75% Grass cover, Good, HSG A
6,856	98	Paved parking, HSG A
1,489	30	Woods, Good, HSG A
13,105	69	Weighted Average
6,249		47.68% Pervious Area
6,856		52.32% Impervious Area

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

Summary for Subcatchment PS2: PS2

Runoff = 0.00 cfs @ 23.99 hrs, Volume= 25 cf, 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 10-Year Rainfall=4.50"

Area (sf)	CN	Description
97,888	32	Woods/grass comb., Good, HSG A
6,614	39	>75% Grass cover, Good, HSG A
104,502	32	Weighted Average
104,502		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	76	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.1	126	Total			

Summary for Subcatchment PS3: PS3

Runoff = 1.51 cfs @ 12.08 hrs, Volume= 5,330 cf, Depth= 4.26"

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 Rainfall=4.50"

Area (sf)	CN	Description
15,000	98	Roofs, HSG A
15,000		100.00% Impervious Area

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

Summary for Subcatchment PS4: PS4

Runoff = 0.00 cfs @ 14.70 hrs, Volume= 14 cf, 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 10-Year Rainfall=4.50"

Area (sf)	CN	Description
1,499	39	>75% Grass cover, Good, HSG A
1,499		100.00% Pervious Area

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

Summary for Subcatchment PS5: PS5

Runoff = 1.63 cfs @ 12.09 hrs, Volume= 5,040 cf, Depth= 2.73"

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 Rainfall=4.50"

Area (sf)	CN	Description
16,423	98	Paved parking, HSG A
5,768	39	>75% Grass cover, Good, HSG A
22,191	83	Weighted Average
5,768		25.99% Pervious Area
16,423		74.01% Impervious Area

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

Summary for Subcatchment PS6: PS6

Runoff = 3.38 cfs @ 12.08 hrs, Volume= 11,913 cf, Depth= 4.26"

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 Rainfall=4.50"

Area (sf)	CN	Description
33,526	98	Paved parking, HSG A
33,526		100.00% Impervious Area

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

Summary for Subcatchment PS7: PS7

Runoff = 2.65 cfs @ 12.09 hrs, Volume= 8,239 cf, Depth= 2.91"

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 Rainfall=4.50"

Area (sf)	CN	Description
25,793	98	Paved parking, HSG A
480	98	Roofs, HSG A
7,714	39	>75% Grass cover, Good, HSG A
33,987	85	Weighted Average
7,714		22.70% Pervious Area
26,273		77.30% Impervious Area

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

Summary for Subcatchment PS8: PS8

Runoff = 1.97 cfs @ 12.09 hrs, Volume= 6,101 cf, Depth= 2.73"

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 Rainfall=4.50"

Area (sf)	CN	Description
19,940	98	Paved parking, HSG A
120	98	Roofs, HSG A
6,800	39	>75% Grass cover, Good, HSG A
26,860	83	Weighted Average
6,800		25.32% Pervious Area
20,060		74.68% Impervious Area

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

Summary for Subcatchment PS9: PS9

Runoff = 0.77 cfs @ 12.09 hrs, Volume= 2,390 cf, Depth= 2.38"

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 Rainfall=4.50"

Area (sf)	CN	Description
8,188	98	Paved parking, HSG A
3,880	39	>75% Grass cover, Good, HSG A
12,068	79	Weighted Average
3,880		32.15% Pervious Area
8,188		67.85% Impervious Area

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

Summary for Reach DP1: Design Point 1

Inflow Area = 238,479 sf, 32.77% Impervious, Inflow Depth = 0.34" for 10-Year event
Inflow = 1.93 cfs @ 12.19 hrs, Volume= 6,664 cf
Outflow = 1.93 cfs @ 12.19 hrs, Volume= 6,664 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Design Point 2

Inflow Area = 188,514 sf, 39.68% Impervious, Inflow Depth = 0.47" for 10-Year event
Inflow = 2.93 cfs @ 12.13 hrs, Volume= 7,451 cf
Outflow = 2.93 cfs @ 12.13 hrs, Volume= 7,451 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: IS-1

Inflow Area = 22,191 sf, 74.01% Impervious, Inflow Depth = 2.73" for 10-Year event
Inflow = 1.63 cfs @ 12.09 hrs, Volume= 5,040 cf
Outflow = 1.11 cfs @ 12.17 hrs, Volume= 5,040 cf, Atten= 32%, Lag= 5.1 min
Discarded = 0.14 cfs @ 12.17 hrs, Volume= 3,196 cf
Primary = 0.97 cfs @ 12.17 hrs, Volume= 1,844 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 86.26' @ 12.17 hrs Surf.Area= 468 sf Storage= 903 cf

Plug-Flow detention time= 19.0 min calculated for 5,039 cf (100% of inflow)
Center-of-Mass det. time= 19.0 min (836.8 - 817.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.50'	217 cf	**26.00'W x 18.00'L x 4.17'H Field A** 1,950 cf Overall - 1,408 cf Embedded = 542 cf x 40.0% Voids
#2A	84.00'	976 cf	**retain_it retain_it 3.0'** x 6 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 3 Rows adjusted for 47.2 cf perimeter wall
		1,193 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.50'	**12.0" Round Culvert** L= 69.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 84.50' / 84.00' S= 0.0072 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	84.50'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	86.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	83.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.14 cfs @ 12.17 hrs HW=86.25' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.14 cfs)

Primary OutFlow Max=0.97 cfs @ 12.17 hrs HW=86.25' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.97 cfs of 3.86 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.30 cfs @ 6.15 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.67 cfs @ 3.42 fps)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Pond 1P: IS-1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
3 Rows adjusted for 47.2 cf perimeter wall

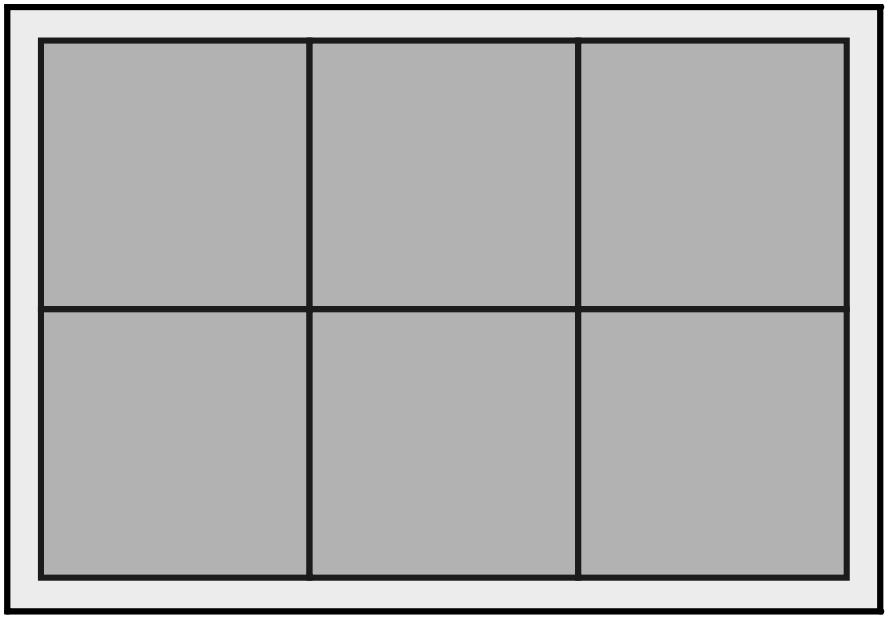
2 Chambers/Row x 8.00' Long = 16.00' Row Length +12.0" End Stone x 2 = 18.00' Base Length
3 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 26.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 2 x 2 + 4.7 cf Endwall x 3 x 2 = 47.2 cf Perimeter Wall
6 Chambers x 170.6 cf - 47.2 cf Perimeter wall = 976.5 cf Chamber Storage
6 Chambers x 234.7 cf = 1,408.0 cf Displacement

1,950.0 cf Field - 1,408.0 cf Chambers = 542.0 cf Stone x 40.0% Voids = 216.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,193.3 cf = 0.027 af
Overall Storage Efficiency = 61.2%
Overall System Size = 18.00' x 26.00' x 4.17'

6 Chambers
72.2 cy Field
20.1 cy Stone



Summary for Pond 2P: IS-2

Inflow Area = 33,526 sf,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event
Inflow = 3.38 cfs @ 12.08 hrs, Volume= 11,913 cf
Outflow = 3.06 cfs @ 12.12 hrs, Volume= 11,913 cf, Atten= 9%, Lag= 2.3 min
Discarded = 0.22 cfs @ 12.12 hrs, Volume= 7,209 cf
Primary = 2.84 cfs @ 12.12 hrs, Volume= 4,704 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 87.98' @ 12.12 hrs Surf.Area= 756 sf Storage= 1,919 cf

Plug-Flow detention time= 19.1 min calculated for 11,910 cf (100% of inflow)
Center-of-Mass det. time= 19.1 min (768.9 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	321 cf	**42.00'W x 18.00'L x 4.17'H Field A** 3,150 cf Overall - 2,347 cf Embedded = 803 cf x 40.0% Voids
#2A	85.00'	1,640 cf	**retain_it retain_it 3.0'** x 10 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 5 Rows adjusted for 66.1 cf perimeter wall
		1,961 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.50'	**12.0" Round Culvert** L= 120.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.50' / 84.50' S= 0.0083 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.50'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	86.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	87.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	87.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Discarded	84.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.22 cfs @ 12.12 hrs HW=87.98' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.22 cfs)

Primary OutFlow Max=2.83 cfs @ 12.12 hrs HW=87.98' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 2.83 cfs of 4.57 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 7.39 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.57 cfs @ 6.48 fps)
  ├**4=Orifice/Grate** (Orifice Controls 0.38 cfs @ 4.34 fps)
  └**5=Orifice/Grate** (Weir Controls 1.52 cfs @ 1.73 fps)

Pond 2P: IS-2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
5 Rows adjusted for 66.1 cf perimeter wall

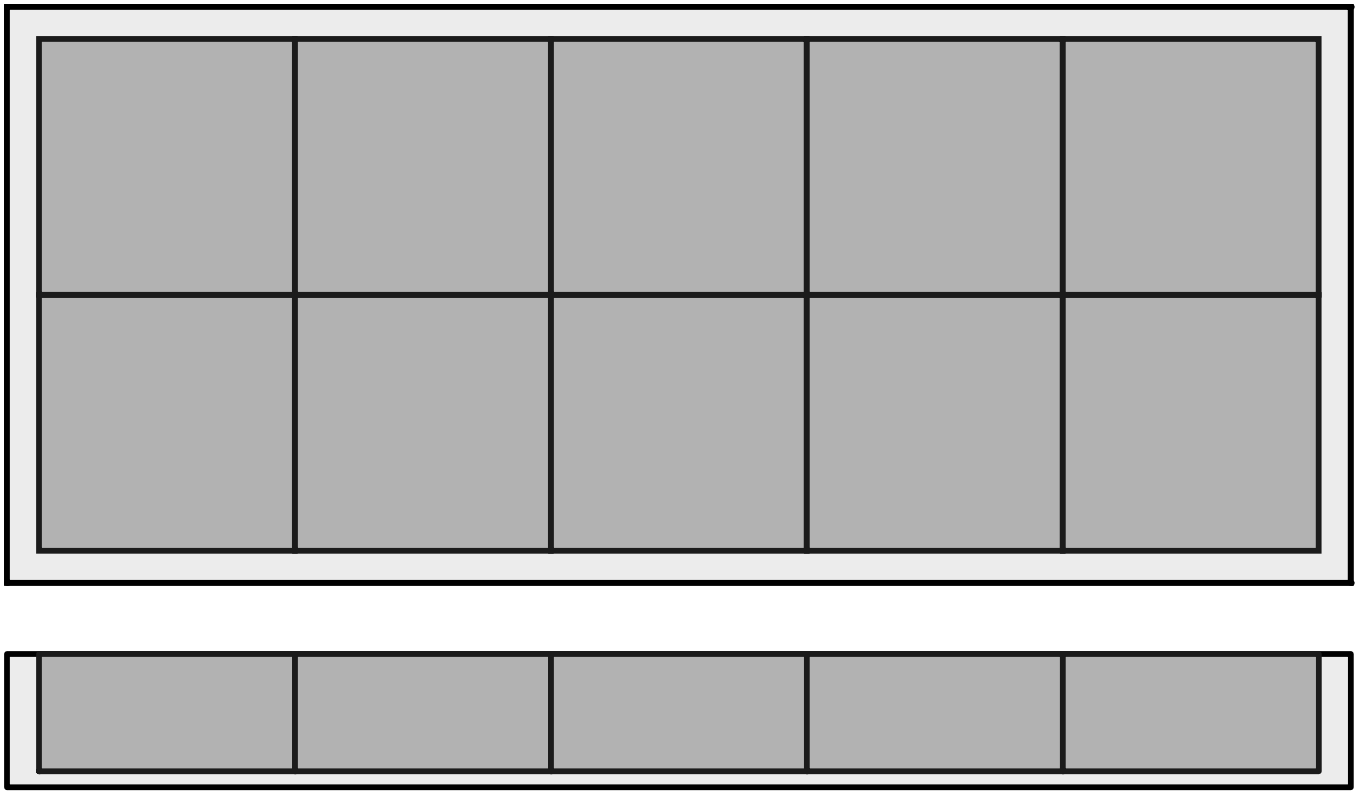
2 Chambers/Row x 8.00' Long = 16.00' Row Length +12.0" End Stone x 2 = 18.00' Base Length
5 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 42.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 2 x 2 + 4.7 cf Endwall x 5 x 2 = 66.1 cf Perimeter Wall
10 Chambers x 170.6 cf - 66.1 cf Perimeter wall = 1,640.0 cf Chamber Storage
10 Chambers x 234.7 cf = 2,346.7 cf Displacement

3,150.0 cf Field - 2,346.7 cf Chambers = 803.3 cf Stone x 40.0% Voids = 321.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,961.3 cf = 0.045 af
Overall Storage Efficiency = 62.3%
Overall System Size = 18.00' x 42.00' x 4.17'

10 Chambers
116.7 cy Field
29.8 cy Stone



Summary for Pond 3P: IS-3

Inflow Area = 48,987 sf, 84.25% Impervious, Inflow Depth = 3.32" for 10-Year event
Inflow = 4.16 cfs @ 12.09 hrs, Volume= 13,569 cf
Outflow = 1.47 cfs @ 12.36 hrs, Volume= 13,569 cf, Atten= 65%, Lag= 16.3 min
Discarded = 0.33 cfs @ 11.50 hrs, Volume= 10,862 cf
Primary = 1.15 cfs @ 12.36 hrs, Volume= 2,708 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 86.42' @ 12.36 hrs Surf.Area= 1,700 sf Storage= 3,720 cf

Plug-Flow detention time= 50.2 min calculated for 13,566 cf (100% of inflow)
Center-of-Mass det. time= 50.2 min (837.6 - 787.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.50'	581 cf	**50.00'W x 34.00'L x 4.17'H Field A** 7,083 cf Overall - 5,632 cf Embedded = 1,451 cf x 40.0% Voids
#2A	84.00'	4,000 cf	**retain_it retain_it 3.0'** x 24 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 6 Rows adjusted for 94.4 cf perimeter wall
		4,581 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.10'	**12.0" Round Culvert** L= 43.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.10' / 84.50' S= 0.0140 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.10'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.70'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	86.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	86.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Discarded	83.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.33 cfs @ 11.50 hrs HW=83.54' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=1.15 cfs @ 12.36 hrs HW=86.42' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 1.15 cfs of 3.42 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.12 cfs @ 5.35 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.65 cfs @ 3.29 fps)
  ├**4=Orifice/Grate** (Orifice Controls 0.38 cfs @ 2.20 fps)
  └**5=Orifice/Grate** (Controls 0.00 cfs)

Pond 3P: IS-3 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
6 Rows adjusted for 94.4 cf perimeter wall

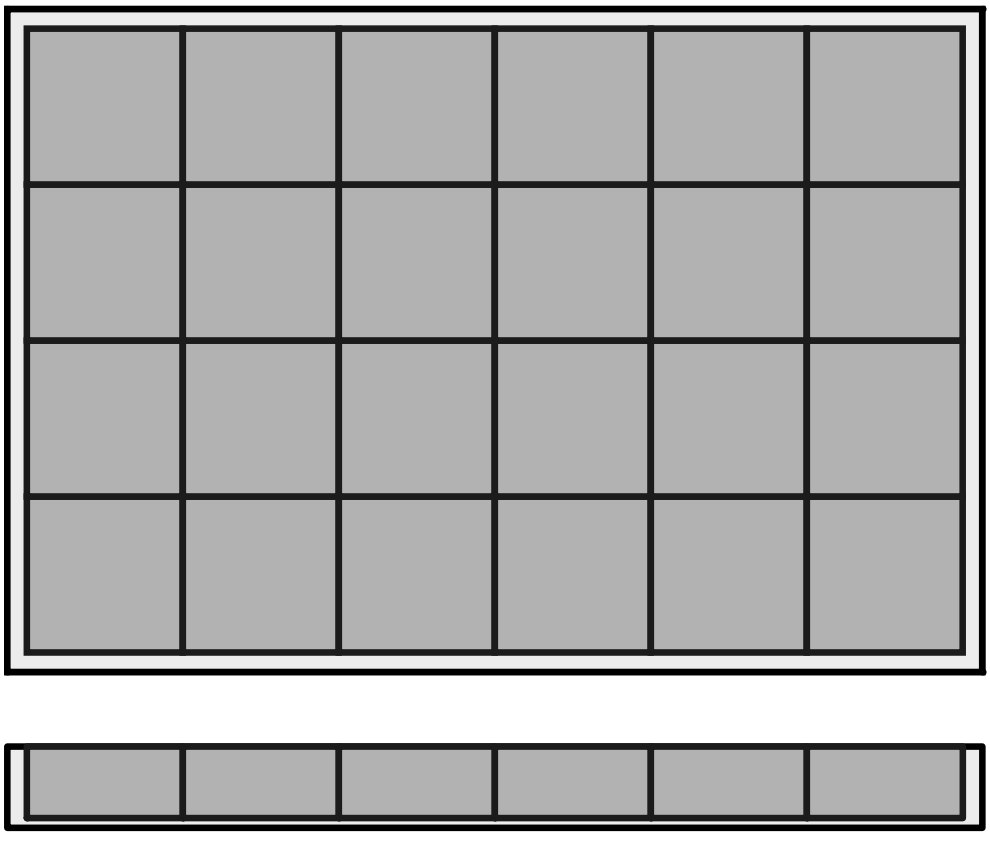
4 Chambers/Row x 8.00' Long = 32.00' Row Length +12.0" End Stone x 2 = 34.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 4 x 2 + 4.7 cf Endwall x 6 x 2 = 94.4 cf Perimeter Wall
24 Chambers x 170.6 cf - 94.4 cf Perimeter wall = 4,000.2 cf Chamber Storage
24 Chambers x 234.7 cf = 5,632.0 cf Displacement

7,083.3 cf Field - 5,632.0 cf Chambers = 1,451.3 cf Stone x 40.0% Voids = 580.5 cf Stone Storage

Chamber Storage + Stone Storage = 4,580.8 cf = 0.105 af
Overall Storage Efficiency = 64.7%
Overall System Size = 34.00' x 50.00' x 4.17'

24 Chambers
262.3 cy Field
53.8 cy Stone



Summary for Pond 4P: IB-1

Inflow Area = 26,860 sf, 74.68% Impervious, Inflow Depth = 2.73" for 10-Year event
Inflow = 1.97 cfs @ 12.09 hrs, Volume= 6,101 cf
Outflow = 0.33 cfs @ 12.57 hrs, Volume= 6,101 cf, Atten= 83%, Lag= 28.8 min
Discarded = 0.33 cfs @ 12.57 hrs, Volume= 6,101 cf
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 84.60' @ 12.57 hrs Surf.Area= 1,703 sf Storage= 2,116 cf

Plug-Flow detention time= 63.9 min calculated for 6,099 cf (100% of inflow)
Center-of-Mass det. time= 63.9 min (881.7 - 817.8)

Volume	Invert	Avail.Storage	Storage Description
#1	82.50'	8,358 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
82.50	600	0	0	600
83.00	759	339	339	766
84.00	1,121	934	1,273	1,143
84.67	1,778	963	2,236	1,806
85.00	1,993	622	2,858	2,027
86.00	2,808	2,389	5,247	2,861
87.00	3,425	3,111	8,358	3,508

Device	Routing	Invert	Outlet Devices
#1	Primary	85.00'	**12.0" Round Culvert** L= 80.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.00' / 84.00' S= 0.0125 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	86.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	82.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.33 cfs @ 12.57 hrs HW=84.60' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=82.50' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Controls 0.00 cfs)
  ├**2=Orifice/Grate** (Controls 0.00 cfs)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 5P: IB-2

Inflow Area = 65,155 sf, 53.42% Impervious, Inflow Depth = 1.69" for 10-Year event
Inflow = 2.19 cfs @ 12.15 hrs, Volume= 9,169 cf
Outflow = 1.15 cfs @ 12.46 hrs, Volume= 9,169 cf, Atten= 47%, Lag= 18.3 min
Discarded = 0.32 cfs @ 12.46 hrs, Volume= 6,186 cf
Primary = 0.83 cfs @ 12.46 hrs, Volume= 2,984 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 84.51' @ 12.46 hrs Surf.Area= 1,675 sf Storage= 1,987 cf

Plug-Flow detention time= 33.1 min calculated for 9,167 cf (100% of inflow)
Center-of-Mass det. time= 33.1 min (889.2 - 856.1)

Volume	Invert	Avail.Storage	Storage Description
#1	82.50'	2,949 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
82.50	421	0	0	421
83.00	656	267	267	660
83.50	963	402	669	971
84.00	1,303	564	1,234	1,316
84.50	1,667	741	1,974	1,686
85.00	2,247	975	2,949	2,271

Device	Routing	Invert	Outlet Devices
#1	Primary	83.50'	**12.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 83.50' / 83.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	83.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	84.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	82.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.32 cfs @ 12.46 hrs HW=84.51' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.32 cfs)

Primary OutFlow Max=0.83 cfs @ 12.46 hrs HW=84.51' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.83 cfs of 2.69 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.82 cfs @ 4.19 fps)
  └**3=Orifice/Grate** (Weir Controls 0.01 cfs @ 0.28 fps)

Summary for Subcatchment PS1: PS1

Runoff = 0.10 cfs @ 12.97 hrs, Volume= 2,424 cf, Depth= 0.26"

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 Rainfall=6.50"

Area (sf)	CN	Description
87,371	32	Woods/grass comb., Good, HSG A
23,797	39	>75% Grass cover, Good, HSG A
111,168	33	Weighted Average
111,168		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
2.8	270	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
19.3	320	Total			

Summary for Subcatchment PS10: PS10

Runoff = 3.41 cfs @ 12.18 hrs, Volume= 13,318 cf, Depth= 3.01"

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 Rainfall=6.50"

Area (sf)	CN	Description
26,618	98	Paved roads w/curbs & sewers, HSG A
24,552	39	>75% Grass cover, Good, HSG A
1,917	30	Woods, Good, HSG A
53,087	68	Weighted Average
26,469		49.86% Pervious Area
26,618		50.14% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0200	0.15		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.8	143	0.0070	1.35		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.7	61	0.0050	1.44		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
1.7	75	0.0020	0.72		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0	136	0.0125	2.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.3	60	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.8	165	0.0100	1.50		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
13.0	690	Total			

Summary for Subcatchment PS11: PS11

Runoff = 1.09 cfs @ 12.09 hrs, Volume= 3,395 cf, Depth= 3.11"

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 100-Year Rainfall=6.50"

Area (sf)	CN	Description
4,760	39	>75% Grass cover, Good, HSG A
6,856	98	Paved parking, HSG A
1,489	30	Woods, Good, HSG A
13,105	69	Weighted Average
6,249		47.68% Pervious Area
6,856		52.32% Impervious Area

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

Summary for Subcatchment PS2: PS2

Runoff = 0.07 cfs @ 13.74 hrs, Volume= 1,876 cf, Depth= 0.22"

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 Rainfall=6.50"

Area (sf)	CN	Description
97,888	32	Woods/grass comb., Good, HSG A
6,614	39	>75% Grass cover, Good, HSG A
104,502	32	Weighted Average
104,502		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	50	0.0500	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.4	76	0.0330	2.92		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.1	126	Total			

Summary for Subcatchment PS3: PS3

Runoff = 2.19 cfs @ 12.08 hrs, Volume= 7,827 cf, Depth= 6.26"

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 Rainfall=6.50"

Area (sf)	CN	Description
15,000	98	Roofs, HSG A
15,000		100.00% Impervious Area

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

Summary for Subcatchment PS4: PS4

Runoff = 0.01 cfs @ 12.30 hrs, Volume= 75 cf, Depth= 0.60"

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 Rainfall=6.50"

Area (sf)	CN	Description
1,499	39	>75% Grass cover, Good, HSG A
1,499		100.00% Pervious Area

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

Summary for Subcatchment PS5: PS5

Runoff = 2.68 cfs @ 12.09 hrs, Volume= 8,428 cf, Depth= 4.56"

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 Rainfall=6.50"

Area (sf)	CN	Description
16,423	98	Paved parking, HSG A
5,768	39	>75% Grass cover, Good, HSG A
22,191	83	Weighted Average
5,768		25.99% Pervious Area
16,423		74.01% Impervious Area

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

Summary for Subcatchment PS6: PS6

Runoff = 4.91 cfs @ 12.08 hrs, Volume= 17,493 cf, Depth= 6.26"

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 Rainfall=6.50"

Area (sf)	CN	Description
33,526	98	Paved parking, HSG A
33,526		100.00% Impervious Area

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

Summary for Subcatchment PS7: PS7

Runoff = 4.27 cfs @ 12.09 hrs, Volume= 13,527 cf, Depth= 4.78"

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 Rainfall=6.50"

Area (sf)	CN	Description
25,793	98	Paved parking, HSG A
480	98	Roofs, HSG A
7,714	39	>75% Grass cover, Good, HSG A
33,987	85	Weighted Average
7,714		22.70% Pervious Area
26,273		77.30% Impervious Area

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

Summary for Subcatchment PS8: PS8

Runoff = 3.24 cfs @ 12.09 hrs, Volume= 10,201 cf, Depth= 4.56"

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 Rainfall=6.50"

Area (sf)	CN	Description
19,940	98	Paved parking, HSG A
120	98	Roofs, HSG A
6,800	39	>75% Grass cover, Good, HSG A
26,860	83	Weighted Average
6,800		25.32% Pervious Area
20,060		74.68% Impervious Area

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

Summary for Subcatchment PS9: PS9

Runoff = 1.34 cfs @ 12.09 hrs, Volume= 4,153 cf, Depth= 4.13"

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 Rainfall=6.50"

Area (sf)	CN	Description
8,188	98	Paved parking, HSG A
3,880	39	>75% Grass cover, Good, HSG A
12,068	79	Weighted Average
3,880		32.15% Pervious Area
8,188		67.85% Impervious Area

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

Summary for Reach DP1: Design Point 1

Inflow Area = 238,479 sf, 32.77% Impervious, Inflow Depth = 0.96" for 100-Year event
Inflow = 5.57 cfs @ 12.17 hrs, Volume= 19,046 cf
Outflow = 5.57 cfs @ 12.17 hrs, Volume= 19,046 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Design Point 2

Inflow Area = 188,514 sf, 39.68% Impervious, Inflow Depth = 1.14" for 100-Year event
Inflow = 9.28 cfs @ 12.13 hrs, Volume= 17,845 cf
Outflow = 9.28 cfs @ 12.13 hrs, Volume= 17,845 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: IS-1

Inflow Area = 22,191 sf, 74.01% Impervious, Inflow Depth = 4.56" for 100-Year event
Inflow = 2.68 cfs @ 12.09 hrs, Volume= 8,428 cf
Outflow = 2.58 cfs @ 12.11 hrs, Volume= 8,428 cf, Atten= 4%, Lag= 1.5 min
Discarded = 0.15 cfs @ 12.11 hrs, Volume= 4,350 cf
Primary = 2.43 cfs @ 12.11 hrs, Volume= 4,078 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 86.92' @ 12.11 hrs Surf.Area= 468 sf Storage= 1,142 cf

Plug-Flow detention time= 18.1 min calculated for 8,426 cf (100% of inflow)
Center-of-Mass det. time= 18.1 min (821.3 - 803.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.50'	217 cf	**26.00'W x 18.00'L x 4.17'H Field A** 1,950 cf Overall - 1,408 cf Embedded = 542 cf x 40.0% Voids
#2A	84.00'	976 cf	**retain_it retain_it 3.0'** x 6 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 3 Rows adjusted for 47.2 cf perimeter wall
		1,193 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	84.50'	**12.0" Round Culvert** L= 69.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 84.50' / 84.00' S= 0.0072 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	84.50'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	86.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Discarded	83.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.15 cfs @ 12.11 hrs HW=86.92' (Free Discharge)
└**5=Exfiltration** (Exfiltration Controls 0.15 cfs)

Primary OutFlow Max=2.43 cfs @ 12.11 hrs HW=86.92' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 2.43 cfs of 4.77 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.36 cfs @ 7.29 fps)
  ├**3=Orifice/Grate** (Orifice Controls 1.02 cfs @ 5.20 fps)
  └**4=Orifice/Grate** (Weir Controls 1.05 cfs @ 1.53 fps)

Pond 1P: IS-1 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
3 Rows adjusted for 47.2 cf perimeter wall

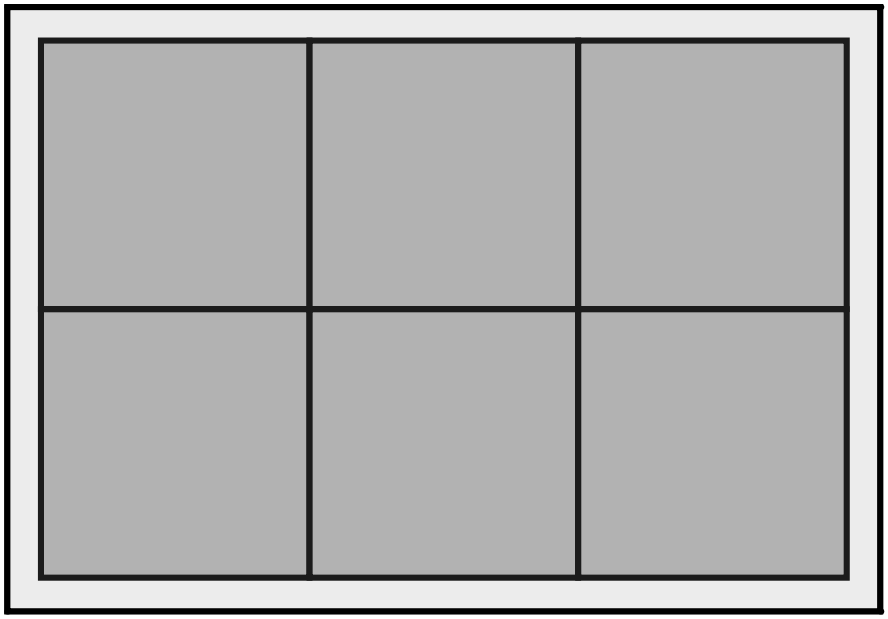
2 Chambers/Row x 8.00' Long = 16.00' Row Length +12.0" End Stone x 2 = 18.00' Base Length
3 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 26.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 2 x 2 + 4.7 cf Endwall x 3 x 2 = 47.2 cf Perimeter Wall
6 Chambers x 170.6 cf - 47.2 cf Perimeter wall = 976.5 cf Chamber Storage
6 Chambers x 234.7 cf = 1,408.0 cf Displacement

1,950.0 cf Field - 1,408.0 cf Chambers = 542.0 cf Stone x 40.0% Voids = 216.8 cf Stone Storage

Chamber Storage + Stone Storage = 1,193.3 cf = 0.027 af
Overall Storage Efficiency = 61.2%
Overall System Size = 18.00' x 26.00' x 4.17'

6 Chambers
72.2 cy Field
20.1 cy Stone



Summary for Pond 2P: IS-2

Inflow Area = 33,526 sf,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event
Inflow = 4.91 cfs @ 12.08 hrs, Volume= 17,493 cf
Outflow = 4.90 cfs @ 12.09 hrs, Volume= 17,493 cf, Atten= 0%, Lag= 0.3 min
Discarded = 0.23 cfs @ 12.09 hrs, Volume= 9,034 cf
Primary = 4.66 cfs @ 12.09 hrs, Volume= 8,459 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 88.40' @ 12.09 hrs Surf.Area= 756 sf Storage= 1,949 cf

Plug-Flow detention time= 19.4 min calculated for 17,488 cf (100% of inflow)
Center-of-Mass det. time= 19.4 min (763.4 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	84.50'	321 cf	**42.00'W x 18.00'L x 4.17'H Field A** 3,150 cf Overall - 2,347 cf Embedded = 803 cf x 40.0% Voids
#2A	85.00'	1,640 cf	**retain_it retain_it 3.0'** x 10 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 5 Rows adjusted for 66.1 cf perimeter wall
		1,961 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.50'	**12.0" Round Culvert** L= 120.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.50' / 84.50' S= 0.0083 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.50'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	86.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	87.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	87.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Discarded	84.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.23 cfs @ 12.09 hrs HW=88.40' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.23 cfs)

Primary OutFlow Max=4.66 cfs @ 12.09 hrs HW=88.40' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 4.66 cfs of 4.95 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.39 cfs @ 8.02 fps)
  ├**3=Orifice/Grate** (Orifice Controls 0.63 cfs @ 7.20 fps)
  ├**4=Orifice/Grate** (Orifice Controls 0.47 cfs @ 5.35 fps)
  └**5=Orifice/Grate** (Orifice Controls 3.17 cfs @ 4.03 fps)

Pond 2P: IS-2 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
5 Rows adjusted for 66.1 cf perimeter wall

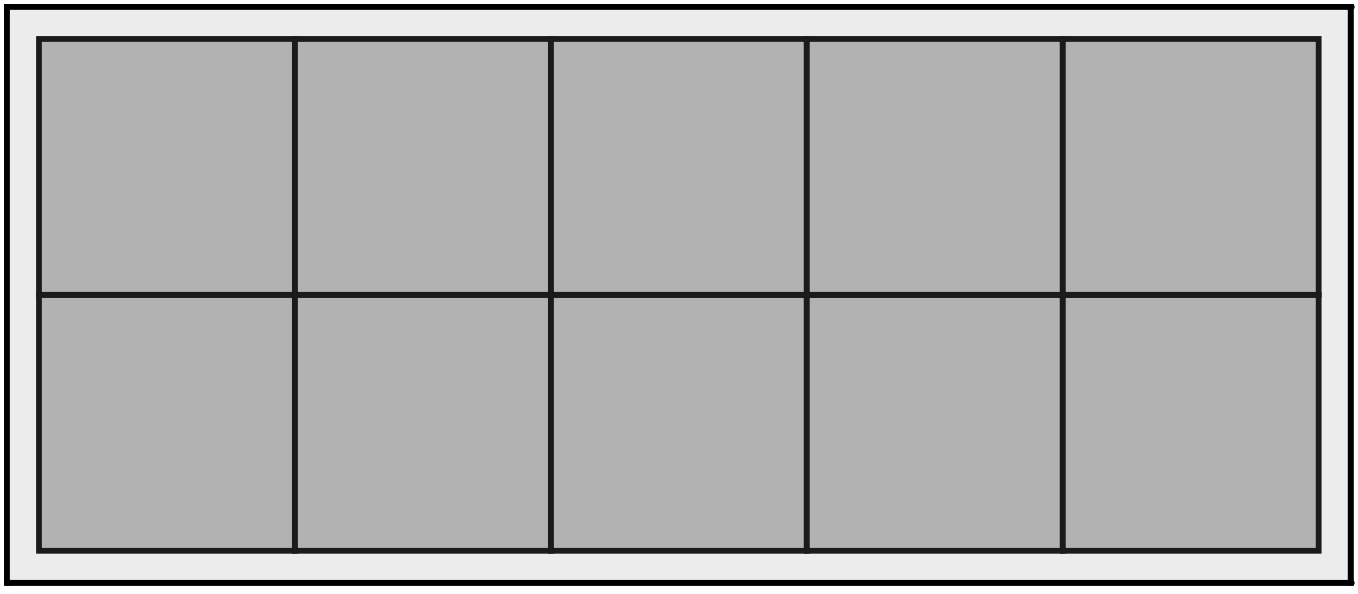
2 Chambers/Row x 8.00' Long = 16.00' Row Length +12.0" End Stone x 2 = 18.00' Base Length
5 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 42.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 2 x 2 + 4.7 cf Endwall x 5 x 2 = 66.1 cf Perimeter Wall
10 Chambers x 170.6 cf - 66.1 cf Perimeter wall = 1,640.0 cf Chamber Storage
10 Chambers x 234.7 cf = 2,346.7 cf Displacement

3,150.0 cf Field - 2,346.7 cf Chambers = 803.3 cf Stone x 40.0% Voids = 321.3 cf Stone Storage

Chamber Storage + Stone Storage = 1,961.3 cf = 0.045 af
Overall Storage Efficiency = 62.3%
Overall System Size = 18.00' x 42.00' x 4.17'

10 Chambers
116.7 cy Field
29.8 cy Stone



Summary for Pond 3P: IS-3

Inflow Area = 48,987 sf, 84.25% Impervious, Inflow Depth = 5.23" for 100-Year event
Inflow = 6.46 cfs @ 12.08 hrs, Volume= 21,353 cf
Outflow = 5.58 cfs @ 12.13 hrs, Volume= 21,353 cf, Atten= 14%, Lag= 3.0 min
Discarded = 0.33 cfs @ 10.87 hrs, Volume= 13,919 cf
Primary = 5.25 cfs @ 12.13 hrs, Volume= 7,435 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 87.50' @ 12.13 hrs Surf.Area= 1,700 sf Storage= 4,570 cf

Plug-Flow detention time= 44.6 min calculated for 21,347 cf (100% of inflow)
Center-of-Mass det. time= 44.6 min (822.6 - 778.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	83.50'	581 cf	**50.00'W x 34.00'L x 4.17'H Field A** 7,083 cf Overall - 5,632 cf Embedded = 1,451 cf x 40.0% Voids
#2A	84.00'	4,000 cf	**retain_it retain_it 3.0'** x 24 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 6 Rows adjusted for 94.4 cf perimeter wall
		4,581 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	85.10'	**12.0" Round Culvert** L= 43.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.10' / 84.50' S= 0.0140 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.10'	**2.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	85.70'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	86.00'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Device 1	86.70'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#6	Discarded	83.50'	**8.270 in/hr Exfiltration over Surface area** Phase-In= 0.01'

Discarded OutFlow Max=0.33 cfs @ 10.87 hrs HW=83.54' (Free Discharge)
└**6=Exfiltration** (Exfiltration Controls 0.33 cfs)

Primary OutFlow Max=5.15 cfs @ 12.13 hrs HW=87.46' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 5.15 cfs @ 6.56 fps)
  ├**2=Orifice/Grate** (Passes < 0.16 cfs potential flow)
  ├**3=Orifice/Grate** (Passes < 1.16 cfs potential flow)
  ├**4=Orifice/Grate** (Passes < 1.04 cfs potential flow)
  └**5=Orifice/Grate** (Passes < 3.29 cfs potential flow)

Pond 3P: IS-3 - Chamber Wizard Field A

Chamber Model = retain_it retain_it 3.0' (retain-it®)
Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf
Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf
6 Rows adjusted for 94.4 cf perimeter wall

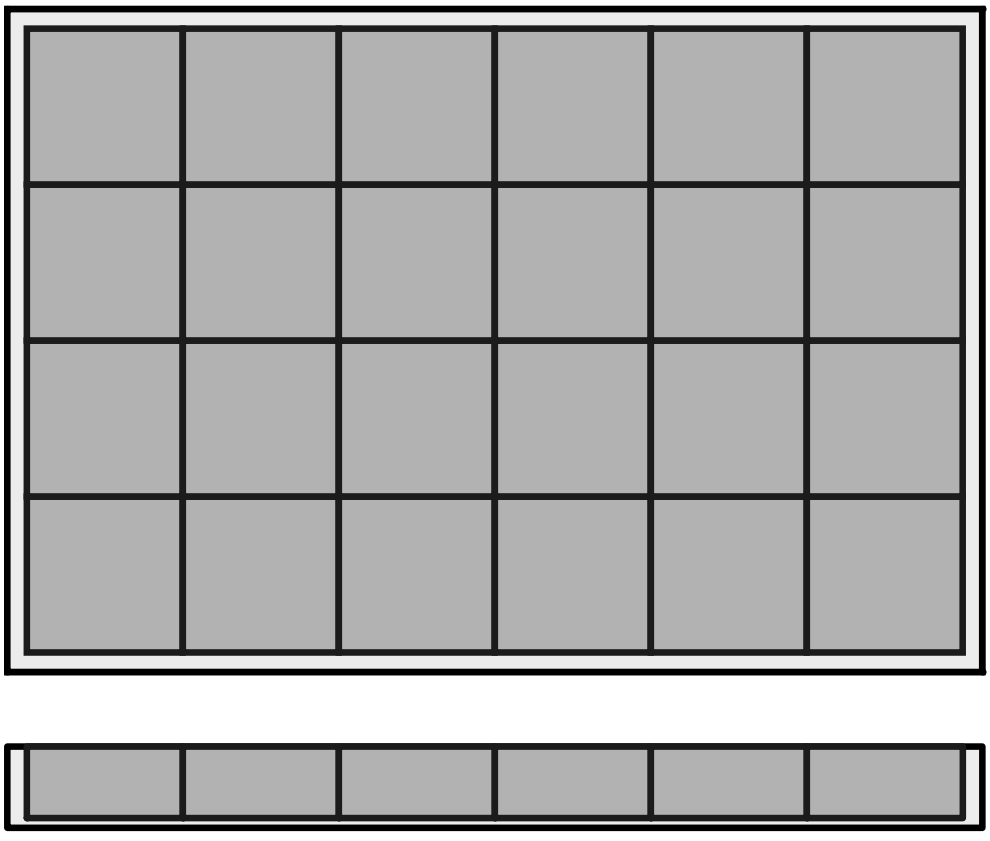
4 Chambers/Row x 8.00' Long = 32.00' Row Length +12.0" End Stone x 2 = 34.00' Base Length
6 Rows x 96.0" Wide + 12.0" Side Stone x 2 = 50.00' Base Width
6.0" Stone Base + 44.0" Chamber Height = 4.17' Field Height

4.7 cf Sidewall x 4 x 2 + 4.7 cf Endwall x 6 x 2 = 94.4 cf Perimeter Wall
24 Chambers x 170.6 cf - 94.4 cf Perimeter wall = 4,000.2 cf Chamber Storage
24 Chambers x 234.7 cf = 5,632.0 cf Displacement

7,083.3 cf Field - 5,632.0 cf Chambers = 1,451.3 cf Stone x 40.0% Voids = 580.5 cf Stone Storage

Chamber Storage + Stone Storage = 4,580.8 cf = 0.105 af
Overall Storage Efficiency = 64.7%
Overall System Size = 34.00' x 50.00' x 4.17'

24 Chambers
262.3 cy Field
53.8 cy Stone



Summary for Pond 4P: IB-1

Inflow Area = 26,860 sf, 74.68% Impervious, Inflow Depth = 4.56" for 100-Year event
Inflow = 3.24 cfs @ 12.09 hrs, Volume= 10,201 cf
Outflow = 0.58 cfs @ 12.54 hrs, Volume= 10,201 cf, Atten= 82%, Lag= 27.5 min
Discarded = 0.45 cfs @ 12.54 hrs, Volume= 9,753 cf
Primary = 0.13 cfs @ 12.54 hrs, Volume= 449 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 85.43' @ 12.54 hrs Surf.Area= 2,329 sf Storage= 3,792 cf

Plug-Flow detention time= 79.9 min calculated for 10,199 cf (100% of inflow)
Center-of-Mass det. time= 79.8 min (883.0 - 803.2)

Volume	Invert	Avail.Storage	Storage Description
#1	82.50'	8,358 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
82.50	600	0	0	600
83.00	759	339	339	766
84.00	1,121	934	1,273	1,143
84.67	1,778	963	2,236	1,806
85.00	1,993	622	2,858	2,027
86.00	2,808	2,389	5,247	2,861
87.00	3,425	3,111	8,358	3,508

Device	Routing	Invert	Outlet Devices
#1	Primary	85.00'	**12.0" Round Culvert** L= 80.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 85.00' / 84.00' S= 0.0125 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	85.00'	**3.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	86.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	82.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.45 cfs @ 12.54 hrs HW=85.43' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.45 cfs)

Primary OutFlow Max=0.13 cfs @ 12.54 hrs HW=85.43' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 0.13 cfs of 0.73 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.13 cfs @ 2.67 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 5P: IB-2

Inflow Area = 65,155 sf, 53.42% Impervious, Inflow Depth = 3.22" for 100-Year event
Inflow = 4.33 cfs @ 12.15 hrs, Volume= 17,470 cf
Outflow = 3.76 cfs @ 12.24 hrs, Volume= 17,470 cf, Atten= 13%, Lag= 5.5 min
Discarded = 0.41 cfs @ 12.24 hrs, Volume= 8,770 cf
Primary = 3.35 cfs @ 12.24 hrs, Volume= 8,700 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 84.88' @ 12.24 hrs Surf.Area= 2,106 sf Storage= 2,698 cf

Plug-Flow detention time= 29.3 min calculated for 17,465 cf (100% of inflow)
Center-of-Mass det. time= 29.3 min (867.1 - 837.8)

Volume	Invert	Avail.Storage	Storage Description
#1	82.50'	2,949 cf	**Custom Stage Data (Conic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
82.50	421	0	0	421
83.00	656	267	267	660
83.50	963	402	669	971
84.00	1,303	564	1,234	1,316
84.50	1,667	741	1,974	1,686
85.00	2,247	975	2,949	2,271

Device	Routing	Invert	Outlet Devices
#1	Primary	83.50'	**12.0" Round Culvert** L= 50.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 83.50' / 83.00' S= 0.0100 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Device 1	83.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	84.50'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Discarded	82.50'	**8.270 in/hr Exfiltration over Wetted area** Phase-In= 0.01'

Discarded OutFlow Max=0.41 cfs @ 12.24 hrs HW=84.88' (Free Discharge)
└**4=Exfiltration** (Exfiltration Controls 0.41 cfs)

Primary OutFlow Max=3.35 cfs @ 12.24 hrs HW=84.88' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Passes 3.35 cfs of 3.52 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 1.01 cfs @ 5.13 fps)
  └**3=Orifice/Grate** (Orifice Controls 2.34 cfs @ 2.99 fps)

APPENDIX D:

SUPPLEMENTAL STORMWATER MANAGEMENT CALCULATIONS

Stormwater Management Calculations

STANDARD 3: Recharge to Groundwater: Static Method

(On site only)

- Calculate Impervious Area
  (From HydroCAD Model)

  Impervious Area HSG A Soil = 119,470 SF

- Determine Rainfall Depth to be Recharged
  (MassDEP Stormwater Management Handbook: Table 2.3.2)

Hydrologic Soil Group	Recharge Rainfall Depth
A	0.60"

- Calculate Recharge Volume

  '*Rv*' = [0.60" x 119,470 SF] = 71,682 SF
  '*Rv*' = [71,682 SF] / 12 SF-In = 5,974 CF
  '*Rv*' = 5,974 CF

- Capture Area Adjustment
  Schedule of Areas Tributary to Recharge Systems

HCAD System ID	Tributary Impervious Area
1P	16,423 sf
2P	33,526 sf
3P	41,273 sf
4P	20,060 sf
5P	8,188 sf
Total:	**119,470 sf**

- Calculate Provided Recharge
  Schedule of Proposed Recharge System Volumes

HCAD System ID	Bottom of System	Lowest System Outlet	Total Recharge Volume Provided	Description
1P	83.50	84.50	273 cf	Concrete Galleys
2P	84.50	85.50	448 cf	Concrete Galleys
3P	83.50	85.10	1,879 cf	Concrete Galleys
4P	82.50	84.80	2,858 cf	Infiltration Basin
5P	82.50	83.50	669 cf	Infiltration Basin
		Total Volume: 6,127 CF		

Recharge volume provided measured to lowest system outlet.

Required Recharge Volume Summary of Results

Total Volume Provided Below Outlet = 6,127 CF
Total Volume Required = 5,974 CF

Verify Drawdown, Maximum 72-Hours: Static Method

HCAD System ID	Recharge Volume (CF)	Bottom Surface Area (SF)	Rawls Rate Inches/Hour	Drawdown Time Rv / (K x A) - Hours	Description
1P	273	468	8.27	0.8	Concrete Galleys
2P	448	756	8.27	0.9	Concrete Galleys
3P	1,879	1,700	8.27	1.6	Concrete Galleys
4P	2,858	600	8.27	6.9	Infiltration Basin
5P	669	421	8.27	2.3	Infiltration Basin

Design Complies with Recharge Volume Standard

- **Sediment Forebay Sizing**

Sediment Forebay for 4P – Infiltration Basin
Volume = 0.1" × 20,060 SF / 12 = 168 CF required
268 CF of storage provided at Elevation 87.6'

STANDARD 4: Water Quality Volume (WQV)

1" Water Quality Volume:

HCAD System ID	Tributary Imp. Area	Treatment Volume 1"	Minimum Volume (CF)	Provided Volume (CF)
1P	16,423 s.f.	1	1,369	*
2P	33,526 s.f.	1	2,794	*
3P	26,273 s.f.	1	2,190	*
4P	20,060 s.f.	1	1,672	2,858
5P	8,188 s.f.	1	682	*

**Treatment volume met through proprietary treatment structure*

APPENDIX E:

CONSTRUCTION PHASE

BEST MANAGEMENT PRACTICES PLAN

Construction Phase Best Management Practices (BMP's)

Erosion and Sedimentation will be controlled at the site by utilizing Structural Practices, Stabilization Practices, and Dust Control. These practices correspond with plans entitled "Site Plan of Land in Georgetown, Massachusetts Off Carleton Drive", prepared by The Morin-Cameron Group, Inc. dated October 9, 2019 as revised and approved by the Georgetown Zoning Board, hereinafter referred to as the Site Plans.

Responsible Party Contact Information:

Stormwater Management System Owner:	G. Mello Waste Disposal Corp. 95 Tenney Street Georgetown, MA 01833 P: (978) 352-8581
Georgetown Public Works Department:	1 Library Street Georgetown, MA 01833 P: (978) 352-5710
Georgetown Zoning Board:	1 Library Street Georgetown, MA 01833 P: (978) 352-5710
Site Design Engineer Information:	The Morin-Cameron Group, Inc. 66 Elm Street Danvers, MA 01923 Phone: (978) 777-8586

Structural Practices:

1) **Mulch Sock** – A mulch sock sediment barrier will be constructed around the limit of work as indicated on the Grading and Utility Plan to prevent the spreading of fine sediments from the site. This control will be installed prior to major soil disturbance on the site.

Mulch Sock Requirements *

a) Locate the mulch sock upland where identified on the plans.
b) The mulch sock should be nearly level through most of its length to impound a broad, temporary pool. The last 10 to 20 feet at each end of the mulch sock should be swung slightly uphill (approximately 0.5 feet in elevation) to provide storage capacity.
c) Stake the mulch sock in accordance with the construction details.
d) The mulch sock should be removed when it has served its useful purpose, but not before the upslope area has been permanently stabilized through one growing season and only following approval by the Conservation Commission or their representative. Retained sediment must be removed and properly disposed of, or mulched and seeded.

Mulch Sock Inspection/Maintenance *

a) Mulch socks should be inspected immediately after each rainfall event of 1-inch or greater, and at least daily during prolonged rainfall. Inspect the depth of sediment, tears, if the mulch sock is securely attached to the stakes, and to see that the stakes are firmly in the ground. Repair or replace as necessary.
b) Remove sediment deposits promptly after storm events to provide adequate storage volume for the next rain and to reduce pressure on the mulch sock. Sediment will be removed from behind the mulch sock when it becomes about 4" deep at the mulch sock. Take care to avoid undermining the mulch sock during cleanout.
c) If the mulch sock tears, decomposes, or in any way becomes ineffective, replace it immediately.
d) Remove all mulch sock materials after the contributing drainage area has been properly stabilized. The mulch can remain at the discretion of the owner as this will decompose over time. However, any fabric or stakes should be removed. Sediment deposits remaining after the mulch sock has been removed should be graded to conform to the existing topography and vegetation.

2) **Sediment Track-Out:** Stabilized Construction Exit: Prior to the commencement of site work, crushed stone anti-tracking pads will be installed at the entrance to the site. This will prevent trucks from tracking material onto the road from the construction site. If, at any point during the project, the tracking pad becomes ineffective due to accumulation of soil, the crushed stone shall be replaced. Details for construction of the stabilized entrance can be found in the Detail Sheets that are a part of the comprehensive permit plan set associated with the project. The site supervisor will inspect the tracking pads weekly to ensure that they are properly limiting the tracking of soil onto the road. If tracking onto the roadway is noted, it shall be removed immediately via a mechanical street sweeper.

Stabilization Practices:

Stabilization measures shall be implemented as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased, with the following exceptions.

- Where the initiation of stabilization measures by the 14th day after construction activity temporary or permanently cease is precluded by snow cover, stabilization measures shall be initiated as soon as practicable.

- Where construction activity will resume on a portion of the site within 21 days from when activities ceased, (e.g. the total time period that construction activity is temporarily ceased is less than 21 days) then stabilization measures do not have to be initiated on that portion of the site by the 14th day after construction activity temporarily ceased.

1) **Temporary Seeding** – Temporary seeding will allow a short-term vegetative cover on disturbed site areas that may be in danger of erosion. Temporary seeding will be done at stock piles and disturbed portions of the site where construction activity will temporarily cease for at least 21 days. The temporary seeding will stabilize cleared and unvegetated areas that will not be brought into final grade for several weeks or months.

   Temporary Seeding Planting Procedures *

   a) Planting should preferably be done between April 1st and June 30th, and September 1st through September 31st. If planting is done in the months of July and August, irrigation may be required. If planting is done between October 1st and March 31st, mulching should be applied immediately after planting. If seeding is done during the summer months, irrigation of some sort will probably be necessary.

b) Before seeding, install structural practice controls. Utilize Amoco supergro or equivalent.

c) Select the appropriate seed species for temporary cover from the following table.

Species	Seeding Rate (lbs./1,000 sq.)	Seeding Rate (lbs./acre)	Recommended Seeding Dates	Seed Cover required
Annual Ryegrass	1	40	April 1st to June 1st August 15th to Sept. 15th	¼ inch
Foxtail Millet	0.7	30	May 1st to June 30th	½ to ¾ inch
Oats	2	80	April 1st to July 1st August 15th to Sept. 15th	1 to 1-½ inch
Winter Rye	3	120	August 15th to Oct. 15th	1 to 1-½ inch

Apply the seed uniformly by hydroseeding, broadcasting, or by hand.

d) Use effective mulch, such as clean grain straw; tacked and/or tied with netting to protect seedbed and encourage plant growth.

Temporary Seeding Inspection/Maintenance *

a) Inspect within 6 weeks of planting to see if stands are adequate. Check for damage within 24 hours of the end to a heavy rainfall, defined as a 2-year storm event (i.e., 3.2 inches of rainfall within a twenty-four-hour period). Stands should be uniform and dense. Reseed and mulch damaged and sparse areas immediately. Tack or tie down mulch as necessary.

b) Seeds should be supplied with adequate moisture. Furnish water as needed, especially in abnormally hot or dry weather. Water application rates should be controlled to prevent runoff.

2) **Geotextiles** - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

Practice	Manufacturer	Product	Remarks
Sediment Fence	Amoco	Woven polypropylene 1198 or equivalent	0.425 mm opening
Construction Entrance	Amoco	Woven polypropylene 2002 or equivalent	0.300 mm opening

Outlet Protection	Amoco	Nonwoven polypropylene 4551 or equivalent	0.150 mm opening
Erosion Control (slope stability)	Amoco	Supergro or equivalent	Erosion control revegetation mix, open polypropylene fiber on degradable polypropylene net scrim

Amoco may be reached at (800) 445-7732

Geotextile Installation

a) Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

Geotextile Inspection/Maintenance *

a) In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.

3) **Mulching and Netting** – Mulching will provide immediate protection to exposed soils during the period of short construction delays, or over winter months through the application of plant residues, or other suitable materials, to exposed soil areas. In areas, which have been seeded either for temporary or permanent cover, mulching should immediately follow seeding. On steep slopes, mulch must be supplemented with netting. The preferred mulching material is straw.

Mulch (Hay or Straw) Materials and Installation

a) Straw has been found to be one of the most effective organic mulch materials. The specifications for straw are described below, but other material may be appropriate. The straw should be air-dried; free of undesirable seeds & coarse materials. The application rate per 1,000 sq. is 90-100 lbs. (2-3 bales) and the application rate per acre is 2 tons (100-120 bales). The application should cover about 90% of the surface. The use of straw mulch is appropriate where mulch is maintained for more than three months. Straw mulch is subject to wind blowing unless anchored, is the most commonly used mulching material, and has the best microenvironment for germinating seeds.

Mulch Maintenance *

a) Inspect after rainstorms to check for movement of mulch or erosion. If washout, breakage, or erosion occurs, repair surface, reseed, remulch, and install new netting.

b) Straw or grass mulches that blow or wash away should be repaired promptly.

c) If plastic netting is used to anchor mulch, care should be taken during initial mowing to keep the mower height high. Otherwise, the netting can wrap up on the mower blade shafts. After a period of time, the netting degrades and becomes less of a problem.

d) Continue inspections until vegetation is well established.

4) **Land Grading** – Grading on fill slopes, cut slopes, and stockpile areas will be done with full siltation controls in place.

Land Grading Design/Installation Requirements

a) Areas to be graded should be cleared and grubbed of all timber, logs, brush, rubbish, and vegetated matter that will interfere with the grading operation. Topsoil should be stripped and stockpiled for use on critical disturbed areas for establishment of vegetation. Cut slopes to be topsoiled should be thoroughly scarified to a minimum depth of 3-inches prior to placement of topsoil.

b) Fill materials should be generally free of brush, rubbish, rocks, and stumps. Frozen materials or soft and easily compressible materials should not be used in fills intended to support buildings, parking lots, roads, conduits, or other structures.

c) Earth fill intended to support structural measures should be compacted to a minimum of 90 percent of Standard Proctor Test density with proper moisture control, or as otherwise specified by the engineer responsible for the design. Compaction of other fills should be to the density required to control sloughing, erosion or excessive moisture content. Maximum thickness of fill layers prior to compaction should not exceed 9 inches.

d) The uppermost one foot of fill slopes should be compacted to at least 85 percent of the maximum unit weight (based on the modified AASHTO compaction test). This is usually accomplished by running heavy equipment over the fill.

e) Fill should consist of material from borrow areas and excess cut will be stockpiled in areas shown on the Site Plans. All disturbed areas should be free draining, left with a neat and finished appearance, and should be protected from erosion.

Land Grading Stabilization Inspection/Maintenance *

a) All slopes should be checked periodically to see that vegetation is in good condition. Any rills or damage from erosion and animal burrowing should be repaired immediately to avoid further damage.

b) If seeps develop on the slopes, the area should be evaluated to determine if the seep will cause an unstable condition. Subsurface drains or a gravel mulch may be required to solve seep problems. However, no seeps are anticipated.

c) Areas requiring revegetation should be repaired immediately. Control undesirable vegetation such as weeds and woody growth to avoid bank stability problems in the future.

5) **Topsoiling *** – Topsoiling will help establish vegetation on all disturbed areas throughout the site during the seeding process. The soil texture of the topsoil to be used will be a sandy loam to a silt loam texture with 15% to 20% organic content.

Topsoiling Placement

a) Topsoil should not be placed while in a frozen or muddy condition, when the subgrade is excessively wet, or when conditions exist that may otherwise be detrimental to proper grading or proposed seeding.

b) Do not place topsoil on slopes steeper than 2.5:1, as it will tend to erode.

c) If topsoil and subsoil are not properly bonded, water will not infiltrate the soil profile evenly and it will be difficult to establish vegetation. The best method is to actually work the topsoil into the layer below for a depth of at least 6 inches.

6) **Permanent Seeding** – Permanent Seeding should be done immediately after the final design grades are achieved. Native species of plants should be used to establish perennial vegetative cover on disturbed areas. The revegetation should be done early enough in the fall so that a good cover is established before cold weather comes and growth stops until the spring. A good cover is defined as vegetation covering 75 percent or more of the ground surface.

Permanent Seeding Seedbed Preparation

a) In infertile or coarse-textured subsoil, it is best to stockpile topsoil and re-spread it over the finished slope at a minimum 2 to 6-inch depth and roll it to provide a firm seedbed. The topsoil must have a sandy loam to silt loam texture with 15% to 20% organic content. If construction fill operations have left soil exposed with a loose, rough, or irregular surface, smooth with blade and roll.

b) Loosen the soil to a depth of 3-5 inches with suitable agricultural or construction equipment.

c) Areas not to receive topsoil shall be treated to firm the seedbed after incorporation of the lime and fertilizer so that it is depressed no more than ½ - 1 inch when stepped on with a shoe. Areas to receive topsoil shall not be firmed until after topsoiling and lime and fertilizer is applied and incorporated, at which time it shall be treated to firm the seedbed as described above.

Permanent Seeding Grass Selection/Application

a) Select an appropriate cool or warm season grass based on site conditions and seeding date. Apply the seed uniformly by hydro-seeding, broadcasting, or by hand. Uniform seed distribution is essential. On steep slopes, hydroseeding may be the most effective seeding method. Surface roughening is particularly important when preparing slopes for hydroseeding.

b) Lime and fertilize. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

c) Mulch the seedings with straw applied at the rate of ½ tons per acre. Anchor the mulch with erosion control netting or fabric on sloping areas. Amoco supergro or equivalent should be utilized.

Permanent Seeding Inspection/Maintenance *

a) Frequently inspect seeded areas for failure and make necessary repairs and reseed immediately. Conduct or follow-up survey after one year and replace failed plants where necessary.

b) If vegetative cover is inadequate to prevent rill erosion, overseed and fertilize in accordance with soil test results.

c) If a stand has less than 40% cover, reevaluate choice of plant materials and quantities of lime and fertilizer. Re-establish the stand following seedbed preparation and seeding recommendations, omitting lime and fertilizer in the absence of soil test results. If the season prevents resowing, mulch or jute netting is an effective temporary cover.

d) Seeded areas should be fertilized during the second growing season. Lime and fertilize thereafter at periodic intervals, as needed. Organic fertilizer shall be utilized in areas within the 100-foot buffer zone to a wetland resource area.

Dust Control:

Dust control will be utilized throughout the entire construction process of the site. For example, keeping disturbed surfaces moist during windy periods will be an effective control measure, especially for construction access roads. The use of dust control will prevent the movement of soil to offsite areas. However, care must be taken to not create runoff from excessive use of water to control dust. The following are methods of Dust Control that may be used on-site:

- Vegetative Cover – The most practical method for disturbed areas not subject to traffic.
- Calcium Chloride – Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist but not so high as to cause water pollution or plant damage.
- Sprinkling – The site may be sprinkled until the surface is wet. Sprinkling will be effective for dust control on haul roads and other traffic routes.
- Stone – Stone will be used to stabilize construction roads; will also be effective for dust control.

The general contractor shall employ an on-site water vehicle for the control of dust as necessary.

Non-Stormwater Discharges:

The construction de-watering and all non-stormwater discharges will be directed into a sediment dirt bag (or equivalent inlet protection) or a sediment basin. Sediment material removed shall be disposed of in accordance with all applicable local, state, and federal regulations.

The developer and site general contractor will comply with the E.P.A.'s Final General Permit for Construction De-watering Discharges, (N.P.D.E.S., Section 402 and 40 C.F.R. 122.26(b) (14) (x).

Inspection/Maintenance:

Operator personnel must inspect the construction site at least once every 14 calendar days and within 24 hours of a storm event of ½-inch or greater. The applicant shall be responsible to secure the services of a design professional or similar professional (inspector) on an on-going basis throughout all phases of the project. Refer to the Inspection/Maintenance Requirements presented earlier in the "Structural and Stabilization Practices." The inspector should review the erosion and sediment controls with respect to the following:

- Whether or not the measure was installed/performed correctly.
- Whether or not there has been damage to the measure since it was installed or performed.

- What should be done to correct any problems with the measure.

The inspector should complete a Stormwater Management Construction Phase BMP Inspection Schedule and Evaluation Checklist for documenting the findings and should request the required maintenance or repair for the pollution prevention measures when the inspector finds that it is necessary for the measure to be effective. The inspector should notify the appropriate person to make the changes and submit copies of the form to the Middleton Public Works Department.

It is essential that the inspector document the inspection of the pollution prevention measures. These records will be used to request maintenance and repair and to prove that the inspection and maintenance were performed. The forms list each of the measures to be inspected on the site, the inspector's name, the date of the inspection, the condition of the measure/area inspected, maintenance or repair performed and any changes which should be made to the Operation and Maintenance Plan to control or eliminate unforeseen pollution of storm water.

APPENDIX F:

LONG TERM BEST MANAGEMENT PRACTICES O&M PLAN

Long Term Stormwater Best Management Practices
Operation and Maintenance Plan
for
Land Off Carleton Drive
Georgetown, Massachusetts

Issued: October 9, 2019
Revised: May 12, 2020

The following operation and maintenance plan has been provided to satisfy the requirements of Standard 9 of the Mass DEP Stormwater Management Handbook associated with development of the site and associated infrastructure. The success of the Stormwater Management Plan depends on the proper implementation, operation and maintenance of several management components. The following procedures shall be implemented to ensure success of the Stormwater Management Plan:

1. The contractor shall comply with the details of construction of the site as shown on the approved plans.
2. The catch basins, water quality units, infiltration basins, and subsurface infiltration units shall be inspected and maintained as indicated below.
3. Effective erosion control measurers during and after construction shall be maintained until a stable turf is established on all altered areas.
4. A Stormwater Management Maintenance Log is included at the end of this Appendix.

Basic Information

Stormwater Management System Owner:	G. Mello Waste Disposal Corp. 95 Tenney Street Georgetown, MA 01833 P: (978) 352-8581
Georgetown Public Works Department:	1 Library Street Georgetown, MA 01833 P: (978) 352-5704
Georgetown Planning Board:	1 Library Street Georgetown, MA 01833 P: (978) 352-5710

Erosion and Sedimentation Controls during Construction:

The site and drainage construction contractor shall be responsible for maintaining the stormwater system during construction. Routine maintenance of all items shall be performed to ensure adequate runoff and pollution control during construction.

A proposed erosion control barrier will be placed as shown on the Grading & Utility Plan prior to the commencement of any clearing, grubbing, and earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. Silt sacks will also be placed in all new catch basins once constructed.

Operations and maintenance plans for the Stormwater Management construction phase and long term operation of the system have been attached to this report.

General Conditions

1. The developer shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's until such time as the project is completed and approved at which time the owner shall become the responsible party. The BMP maintenance shall be conducted as detailed in the following long-term pollution prevention plan and illustrated on the approved design plans: "Site Plan of Land in Georgetown, Massachusetts, Off Carleton Drive," prepared by The Morin-Cameron Group, Inc. dated October 9, 2019 as revised and approved by the Georgetown Planning Board.
2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Pollution Prevention Plan.
3. The owner shall:
    a. Maintain an Operation and Maintenance Log for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);
    b. Make the log available to the Georgetown Public Works Department and Planning Board upon request;
    c. Allow members and agents of the Georgetown Public Works Department and Planning Board to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.
4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule shall be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.

Long-Term Pollution Prevention Plan (LTPPP)

Vegetated Areas:

Immediately after construction, monitoring of the erosion control systems shall occur until establishment of natural vegetation. Afterwards, vegetated areas shall be maintained as such. Vegetation shall be replaced as necessary to ensure proper stabilization of the site.

Cost: Included with annual landscaping budget. Consult with local landscape contractors.

Paved Areas:

Sweepers shall sweep paved areas periodically during dry weather to remove excess sediments and to reduce the amount of sediments that the drainage system shall have to remove from the runoff. The sweeping shall be conducted primarily between March 15th and November 15th. Special attention should be made to sweeping paved surfaces in March and April before spring rains wash residual sand into the drainage system.

Cost: Consult with local landscaping companies for associated costs if necessary.

Salt used for de-icing on the roadway during winter months shall be limited as much as possible as this will reduce the need for removal and treatment. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

Deep Sump Hooded Catch Basins:

The catch basin grates shall be checked quarterly and following heavy rainfalls to verify that the inlet openings are not clogged by debris. Debris shall be removed from the grates and disposed of properly. Deep sump catch basins shall be inspected twice per year and cleaned as needed when accumulated sediments exceeds 2' from the bottom of the sump (approximately 1/2 of the sump capacity). Catch basins with hoods shall be inspected annually to check oil build-up and outlet obstructions. Material shall be removed from catch basins and disposed of in accordance with all applicable regulations

Cost: The Owner shall consult local vacuum cleaning contractors for detailed cost estimates.

Public Safety Concerns: Catch basins shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken or missing grates or frames shall be replaced immediately. At no time shall any person enter the basin structure unless measures have been taken to ensure safe access in accordance with OSHA enclosed space regulations.

CDS Water Quality Units:

The CDS Water Quality Units shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.9 inches of rainfall in a 24-hour period (5 year storm). Thereafter, the system shall be inspected twice per year in April and October. The units shall be cleaned per manufacturer's instructions included herein.

Cost: $50 - $100 per cleaning per unit as needed. The owner shall consult local vacuum cleaning contractors for detailed cost estimates.

Public Safety Concerns: The manhole covers shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken covers or frames shall be replaced immediately.

Infiltration Basins:

The infiltration basins shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.1 inches of rainfall in a 24 hour period (2 year storm). Thereafter, the basin shall be inspected twice per year, typically in the spring and fall. If erosion or loss of vegetation is observed in the basin, it shall be repaired immediately and new vegetation shall be established. Trash, leaves, branches, etc. shall be removed from facility.

The outlet structures shall be inspected annually for obstructions and structural integrity. The inspections shall be conducted by qualified personnel.

Cost: Consult with local landscaping companies for associated costs if necessary.

Sediment Forebay:

The forebay shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.9 inches of rainfall in a 24 hour period (5 year storm). Thereafter, the basin shall be inspected twice per year. All forebays shall be inspected on an annual basis, typically in the spring months, and sediment shall be removed when depth exceeds 6 inches.

Cost: Consult with local landscaping or pumping companies for associated costs if necessary.

Subsurface Infiltration Concrete Galley Systems:

The subsurface infiltration concrete galley systems are equipped with inspection ports at the outlet chambers. Additional inspections should be scheduled during the first few months to make sure that the systems are functioning as intended. Silt, sand and sediment, if significant accumulation occurs, shall be removed annually. Material removed from the systems shall be disposed of in accordance with all applicable local, state, and federal regulations. In the case that water remains in the infiltration facilities for greater than three (3) days after a storm event, an inspection is warranted and maintenance or repairs should be addressed as necessary.

Cost: $500-$2,500 per cleaning depending on the volume of material/liquids that need to be removed.

Public Safety Concerns: The manhole covers shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken covers or frames shall be replaced immediately. At no time shall any person enter the subsurface structure unless measures have been taken to ensure safe access in accordance with OSHA enclosed space regulations.

Overall Site Grading:
After construction, and during the initial vegetation establishment period, the site should be inspected after every rainfall. Mowing, litter removal, and spot vegetation repair should be performed on a regular basis.

Debris & Litter:
All debris and litter shall be removed from the driveway/parking area as necessary to prevent migration into the drainage system.

Pesticides, Herbicides, and Fertilizers:
Pesticides and herbicides shall be used sparingly. Fertilizers shall be restricted to the use of organic fertilizers only. All fertilizers, herbicides, pesticides, sand and salt for deicing and the like shall be stored in dry area that is protected from weather.

Cost: Included in the routine landscaping maintenance schedule. The Owner shall consult local landscaping contractors for details.

Public Safety Concerns: Chemicals shall be stored in a secure area to prevent children from obtaining access to them. Any major spills shall be reported to municipal officials.

Prevention of Illicit Discharges:
Illicit discharges to the stormwater management system are not allowed. Illicit discharges are discharges that are not comprised entirely of stormwater. Pursuant to Mass DEP Stormwater Standards the following activities or facilities are not considered illicit discharges: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, DE chlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

To prevent illicit discharges to the stormwater management system the following policies should be implemented:

1. Provisions For Storing Materials And Waste Products Inside Or Under Cover
2. Vehicle Maintenance And Washing Controls
3. Requirements for Routine Inspections of the Stormwater Management System (i.e.: catch basins, outlet control structures & subsurface infiltration system.)
4. Spill Prevention and Response Plans.

APPENDIX G:

ILLICIT DISCHARGE

COMPLIANCE STATEMENT

Illicit Discharge Compliance Statement

I, Scott P. Cameron, P.E., hereby notify the Georgetown Planning Board that I have not witnessed, nor am aware of any existing illicit discharges at the site known as Land Off Carleton Drive in Georgetown, Massachusetts. I also hereby certify that the development of said property as illustrated on the final plans entitled "Site Plan of Land in Georgetown, Massachusetts, Off Carleton Drive," prepared by The Morin-Cameron Group, Inc. dated October 29, 2019 and as revised and approved by the Georgetown Planning Board and maintenance thereof in accordance with the "Construction Period Pollution Prevention Plan" and "Long-Term Pollution Prevention Plan" prepared by The Morin-Cameron Group, Inc dated October 29, 2019 and as revised and approved by the Georgetown Planning Board will not create any new illicit discharges. There is no warranty implied regarding future illicit discharges that may occur as a result of improper construction or maintenance of the stormwater management system or unforeseen accidents.

Name: Scott P. Cameron, P.E.

Company: The Morin-Cameron Group, Inc.

Title: Owner's Representative

Signature:

Date: 6-12-2020

APPENDIX H:

TSS REMOVAL

CALCULATIONS

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration Structure - 1P
Pretreatment Standard for Rapidly Draining Soil

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice*	**0.84**	**1.00**	**0.84**	**0.16**
	0.00	**0.16**	**0.00**	**0.16**
	0.00	**0.16**	**0.00**	**0.16**
	0.00	**0.16**	**0.00**	**0.16**
	0.00	**0.16**	**0.00**	**0.16**

Total TSS Removal = **84%**

*Refer to sheet found in this report titled: *CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD*
for Unit WQU-3 prepared by Contech

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration System - 1P With Pretreatment

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Subsurface Infiltration Structure	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration Structure - 2P
Pretreatment Standard for Rapidly Draining Soil

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice*	**0.81**	**1.00**	**0.81**	**0.19**
	0.00	**0.19**	**0.00**	**0.19**
	0.00	**0.19**	**0.00**	**0.19**
	0.00	**0.19**	**0.00**	**0.19**
	0.00	**0.19**	**0.00**	**0.19**

Total TSS Removal = **81%**

*Refer to sheet found in this report titled: *CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD*
for Unit WQU-1 prepared by Contech

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration System - 2P With Pretreatment

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Subsurface Infiltration Structure	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration Structure - 3P
Pretreatment Standard for Rapidly Draining Soil

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice*	**0.82**	**1.00**	**0.82**	**0.18**
	0.00	**0.18**	**0.00**	**0.18**
	0.00	**0.18**	**0.00**	**0.18**
	0.00	**0.18**	**0.00**	**0.18**
	0.00	**0.18**	**0.00**	**0.18**

Total TSS Removal = **82%**

*Refer to sheet found in this report titled: *CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD*
for Unit WQU-2 prepared by Contech

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Subsurface Infiltration System - 3P With Pretreatment

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Subsurface Infiltration Structure	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Infiltration Basin - 4P
Pretreatment Standard for Rapidly Draining Soil

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Sediment Forebay	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

*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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Infiltration Basin - 4P With Pretreatment

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Infiltration Basin	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Infiltration Basin - 5P
Pretreatment Standard for Rapidly Draining Soil

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary Treatment Practice	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

THE MORIN-CAMERON GROUP, INC.
66 Elm Street,
Danvers, MA 01923
p | 978.777.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Infiltration Basin - 5P With Pretreatment

Name: Site Development Plans
Location: Off Carleton Drive
Georgetown, MA
County: Essex
Applicant: G. Mello Disposal Corp

Proj. No.: 3794
Date: 10/9/2019
Revised: 3/26/2020
Computed by: Daniel Powers, E.I.T.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation Worksheet

B BMP	C TSS Removal Rate	D Starting TSS Load	E Amount Removed (C*D)	F Remaining Load (D-E)
Infiltration Basin	**0.80**	**1.00**	**0.80**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**
	0.00	**0.20**	**0.00**	**0.20**

Total TSS Removal = **80%**

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

Project: Proposed Waste Transfer Station
Location: Georgetown, MA
Prepared For: Test Engineer

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

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

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

Compute Q Rate using the following equation:

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

where:

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

Structure Name	Impv. (acres)	A (miles^2)	t_c (min)	t_c (hr)	WQV (in)	qu (csm/in.)	Q (cfs)
WQU-1	0.77	0.0012031	6.0	0.100	1.00	774.00	0.93
WQU-2	0.62	0.0009688	6.0	0.100	1.00	774.00	0.75
WQU-3	0.43	0.0006719	6.0	0.100	1.00	774.00	0.52
WQU-4	0.19	0.0002969	6.0	0.100	1.00	774.00	0.23

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

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

PROPOSED WASTE TRANSFER STATION
GEORGETOWN, MA

Area	**0.77 ac**	Unit Site Designation	**WQU-1**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	9.8
0.04	9.6%	19.8%	0.03	0.03	9.2
0.06	9.4%	29.3%	0.04	0.04	8.9
0.08	7.7%	37.0%	0.06	0.06	7.2
0.10	8.6%	45.6%	0.07	0.07	7.9
0.12	6.3%	51.9%	0.08	0.08	5.8
0.14	4.7%	56.5%	0.10	0.10	4.2
0.16	4.6%	61.2%	0.11	0.11	4.2
0.18	3.5%	64.7%	0.12	0.12	3.1
0.20	4.3%	69.1%	0.14	0.14	3.8
0.25	8.0%	77.1%	0.17	0.17	6.8
0.30	5.6%	82.7%	0.21	0.21	4.6
0.35	4.4%	87.0%	0.24	0.24	3.5
0.40	2.5%	89.5%	0.28	0.28	2.0
0.45	2.5%	92.1%	0.31	0.31	1.9
0.50	1.4%	93.5%	0.35	0.35	1.0
0.75	5.0%	98.5%	0.52	0.52	3.1
1.00	1.0%	99.5%	0.69	0.69	0.5
1.50	0.0%	99.5%	1.04	1.00	0.0
2.00	0.0%	99.5%	1.39	1.00	0.0
3.00	0.5%	100.0%	2.08	1.00	0.1
					87.8
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.3%
				Predicted Net Annual Load Removal Efficiency =	**81.3%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

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

PROPOSED WASTE TRANSFER STATION GEORGETOWN, MA

Area	**0.62 ac**	Unit Site Designation	**WQU-2**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	9.8
0.04	9.6%	19.8%	0.02	0.02	9.2
0.06	9.4%	29.3%	0.03	0.03	9.0
0.08	7.7%	37.0%	0.04	0.04	7.3
0.10	8.6%	45.6%	0.06	0.06	8.0
0.12	6.3%	51.9%	0.07	0.07	5.8
0.14	4.7%	56.5%	0.08	0.08	4.3
0.16	4.6%	61.2%	0.09	0.09	4.2
0.18	3.5%	64.7%	0.10	0.10	3.2
0.20	4.3%	69.1%	0.11	0.11	3.9
0.25	8.0%	77.1%	0.14	0.14	7.0
0.30	5.6%	82.7%	0.17	0.17	4.8
0.35	4.4%	87.0%	0.20	0.20	3.7
0.40	2.5%	89.5%	0.22	0.22	2.1
0.45	2.5%	92.1%	0.25	0.25	2.0
0.50	1.4%	93.5%	0.28	0.28	1.1
0.75	5.0%	98.5%	0.42	0.42	3.5
1.00	1.0%	99.5%	0.56	0.56	0.6
1.50	0.0%	99.5%	0.84	0.84	0.0
2.00	0.0%	99.5%	1.12	1.00	0.0
3.00	0.5%	100.0%	1.67	1.00	0.1
					89.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.4%
				Predicted Net Annual Load Removal Efficiency =	**83.1%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

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

PROPOSED WASTE TRANSFER STATION
GEORGETOWN, MA

Area	**0.43 ac**	Unit Site Designation	**WQU-3**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.01	0.01	9.8
0.04	9.6%	19.8%	0.02	0.02	9.3
0.06	9.4%	29.3%	0.02	0.02	9.0
0.08	7.7%	37.0%	0.03	0.03	7.4
0.10	8.6%	45.6%	0.04	0.04	8.1
0.12	6.3%	51.9%	0.05	0.05	5.9
0.14	4.7%	56.5%	0.05	0.05	4.4
0.16	4.6%	61.2%	0.06	0.06	4.3
0.18	3.5%	64.7%	0.07	0.07	3.3
0.20	4.3%	69.1%	0.08	0.08	4.0
0.25	8.0%	77.1%	0.10	0.10	7.2
0.30	5.6%	82.7%	0.12	0.12	5.0
0.35	4.4%	87.0%	0.14	0.14	3.8
0.40	2.5%	89.5%	0.15	0.15	2.2
0.45	2.5%	92.1%	0.17	0.17	2.2
0.50	1.4%	93.5%	0.19	0.19	1.2
0.75	5.0%	98.5%	0.29	0.29	3.9
1.00	1.0%	99.5%	0.39	0.39	0.7
1.50	0.0%	99.5%	0.58	0.58	0.0
2.00	0.0%	99.5%	0.77	0.77	0.0
3.00	0.5%	100.0%	1.16	1.00	0.1
					91.8
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**85.4%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

CONTECH ENGINEERED SOLUTIONS

CDS TECHNOLOGIES

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

PROPOSED WASTE TRANSFER STATION GEORGETOWN, MA

Area	**0.19 ac**	Unit Site Designation	**WQU-4**
Weighted C	**0.9**	Rainfall Station #	**69**
t_c	**6 min**		
CDS Model	**1515-3**	CDS Treatment Capacity	**1.0 cfs**

Rainfall Intensity[1] (in/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	10.2%	10.2%	0.00	0.00	9.9
0.04	9.6%	19.8%	0.01	0.01	9.3
0.06	9.4%	29.3%	0.01	0.01	9.1
0.08	7.7%	37.0%	0.01	0.01	7.4
0.10	8.6%	45.6%	0.02	0.02	8.2
0.12	6.3%	51.9%	0.02	0.02	6.0
0.14	4.7%	56.5%	0.02	0.02	4.5
0.16	4.6%	61.2%	0.03	0.03	4.4
0.18	3.5%	64.7%	0.03	0.03	3.4
0.20	4.3%	69.1%	0.03	0.03	4.1
0.25	8.0%	77.1%	0.04	0.04	7.5
0.30	5.6%	82.7%	0.05	0.05	5.2
0.35	4.4%	87.0%	0.06	0.06	4.1
0.40	2.5%	89.5%	0.07	0.07	2.3
0.45	2.5%	92.1%	0.08	0.08	2.3
0.50	1.4%	93.5%	0.09	0.09	1.3
0.75	5.0%	98.5%	0.13	0.13	4.5
1.00	1.0%	99.5%	0.17	0.17	0.9
1.50	0.0%	99.5%	0.26	0.26	0.0
2.00	0.0%	99.5%	0.34	0.34	0.0
3.00	0.5%	100.0%	0.51	0.51	0.3
					94.8
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**88.4%**

1 - Based on 10 years of hourly precipitation data from NCDC Station 770, Boston WSFO AP, Suffolk County, MA
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

APPENDIX I:

SOIL SUITABILITY

ASSESSMENT REPORT

SOIL SUITABILITY ASSESSMENT REPORT

COMMONWEALTH OF MASSACHUSETTS

GEORGETOWN, MASSACHUSETTS

SOIL EVALUATION FOR NEW CONSTRUCTION OF ON-SITE SUBSURFACE SEWAGE DISPOSAL SYSTEM

SITE INFORMATION

Street Address: Carlton Drive Town: Georgetown State: Massachusetts Zip Code: 01833 County: Essex

Land Use: Undeveloped/ commercial Latitude: ~42º 42' 46.2" N Longitude: ~70º 57' 49.1" W Elevation: 80' to 85' AMSL

PUBLISHED SOIL DATA AND MAP UNIT DESCRIPTION

Physiographic Division: Appalachian Highlands Physio. Province: New England Physio. Section: Seaboard lowland section

Soil survey area: Essex County, Massachusetts, Northern Part Series name: 256A– Deerfield LFS, 00-03% slopes

Order: Entisol Suborder: Psamments Family: Mixed, mesic Aquic Udipsamments

Soil moisture regime: Udic Soil temperature regime: Mesic Runoff class: Negligible

Soil hydric or upland: Upland Average depth to water table: > 80" Depth to restrictive feature: > 80"

Frequency of flooding: None Frequency of ponding: None Available water capacity: Moderate (~6.5")

Drainage Class: Moderately well drained Hydrologic Soil Group: A Ksat: High to very high (1.42 – 99.00 in/hr)

WETLAND AREA & USGS WELL MEASUREMENTS

National Wetland Inventory Map: NA Wetlands Conservancy Program: NA Bordering vegetative wetland: NA

Current Water Resource Condition (USGS*):* Well Site # 424520070562401- MA-NIW 27 Newbury, MA

Well depth: 19.8 feet Land altitude: 55.00 feet above NGVD29 Latitude: ~42º45'19.3" N Longitude: ~70º56'22.1"

Most recent data value: 10.30' on 10/15/19 (depth to water level in feet below land surface) Range: Normal

SURFICIAL GEOLOGY:

Surficial geology map: Qcs: Collapsed stratified drift deposits - Yellow-brown to gray-brown poorly-sorted, crudely stratified, sandy cobble gravel. Occurs as imperfectly formed kame terraces and irregular hills.

Geologic parent material: Sandy proglacial outwash Geomorphic component: Outwash plain

Slope aspect: Northerly Landform position (2D): Plain Landform position (3D): Tread

Slope gradient: ~01 - 03 % Down slope shape: Convex Across slope shape: Convex Slope complexity: Simple

Bedrock outcropping in vicinity: None observed Glacial erratics in vicinity: None observed

Bedrock Type: Nashoba Formation – Boxford Member: Thin bedded to massive amphibolite & minor biotite gneiss

TP19-1 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 09:00 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-1

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00" → 30"	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
30" → 120"	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	68" (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 68"; apparent water observed at 72"; no bedrock refusal at test hole depth.

Depth to bedrock: 120" Seasonal High Groundwater Table: 68" Apparent water: 72"

TP19-1 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 72" (below land surface) Depth to stabilized apparent water: 72" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 68" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 68" inches below grade

Observed depth to stabilized phreatic water: 72" inches below grade

Observed water weeping from side of deep hole: 72" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.00 feet

Depth of naturally occurring pervious material in TP19-1 Upper boundary: 00"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-2 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 09:44 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-2

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00” → 25”	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
25” → 121”	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	68” (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 68”; apparent water observed at 73”; no bedrock refusal at test hole depth.

Depth to bedrock: 121” Seasonal High Groundwater Table: 68” Apparent water: 73”

TP19-2 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 73" (below land surface) Depth to stabilized apparent water: 73" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 68" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 68" inches below grade

Observed depth to stabilized phreatic water: 73" inches below grade

Observed water weeping from side of deep hole: 73" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.08 feet

Depth of naturally occurring pervious material in TP19-2 Upper boundary: 00"
Lower boundary: 121"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-3 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 10:18 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^{+} feet Drainage way: 50^{+} feet Drinking water well: 100^{+} feet Abutting septic system: 50^{+} feet

Wetlands: 100^{+} feet Public water supply reservoir: 400^{+} feet Tributary to reservoir: 200^{+} feet

SOIL PROFILE ► TP19-3

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00” → 31”	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
31” → 122”	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	69” (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 69”; apparent water observed at 73”; no bedrock refusal at test hole depth.

Depth to bedrock: 122” Seasonal High Groundwater Table: 69” Apparent water: 73”

TP19-3 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 73" (below land surface) Depth to stabilized apparent water: 73" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 69" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 69" inches below grade

Observed depth to stabilized phreatic water: 73" inches below grade

Observed water weeping from side of deep hole: 73" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.16 feet

Depth of naturally occurring pervious material in TP19-3 Upper boundary: 00"
Lower boundary: 122"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-4 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 10:48 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-4

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00” → 25”	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
25” → 121”	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	68” (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 68”; apparent water observed at 74”; no bedrock refusal at test hole depth.

Depth to bedrock: 121” Seasonal High Groundwater Table: 68” Apparent water: 74”

TP19-4 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 74" (below land surface) Depth to stabilized apparent water: 74" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 68" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 68" inches below grade

Observed depth to stabilized phreatic water: 74" inches below grade

Observed water weeping from side of deep hole: 74" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 10.08 feet

Depth of naturally occurring pervious material in TP19-4 Upper boundary: 00"
Lower boundary: 121"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-5 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 11:11 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-5

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00” → 37”	C^	Sandy Loam Mixture	2.5Y 3/1 very dark gray	none observed	Fill material. Loose, structurless; mixed fine-to-medium grained mineral content; non-deleterious material; brick, concrete, organics and stone mixed within matrix; abrupt wavy boundary
37” → 120”	2C	Sand gravelly	2.5Y 5/3 light olive brown	65” (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 65”; apparent water observed at 74”; no bedrock refusal at test hole depth.

Depth to bedrock: 120” Seasonal High Groundwater Table: 65” Apparent water: 74”

TP19-5 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 74" (below land surface) Depth to stabilized apparent water: 74" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 65" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 68" inches below grade

Observed depth to stabilized phreatic water: 74" inches below grade

Observed water weeping from side of deep hole: 74" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 6.92 feet

Depth of naturally occurring pervious material in TP19-5 Upper boundary: 37"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-6 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 11:48 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-6

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00" → 02"	A_p	Sandy Loam Fine grained	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium granular structure; slightly cohesive; fine grained mineral content; dry matrix; non-sticky; non-plastic; common fine roots; free of clasts; clear smooth boundary.
02" → 40"	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
40" → 120"	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	64" (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 64"; apparent water observed at 75"; no bedrock refusal at test hole depth.

Depth to bedrock: 120" Seasonal High Groundwater Table: 64" Apparent water: 75"

TP19-6 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 75" (below land surface) Depth to stabilized apparent water: 75" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 64" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 64" inches below grade

Observed depth to stabilized phreatic water: 75" inches below grade

Observed water weeping from side of deep hole: 75" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.83 feet

Depth of naturally occurring pervious material in TP19-6 Upper boundary: 02"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-7 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 12:21 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-7

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00" → 04"	A_p	Sandy Loam Fine grained	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium granular structure; slightly cohesive; fine grained mineral content; dry matrix; non-sticky; non-plastic; common fine roots; free of clasts; clear smooth boundary.
04" → 29"	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
29" → 120"	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	65" (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 65"; apparent water observed at 75"; no bedrock refusal at test hole depth.

Depth to bedrock: 120" Seasonal High Groundwater Table: 65" Apparent water: 75"

TP19-7 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 75" (below land surface) Depth to stabilized apparent water: 75" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 65" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 65" inches below grade

Observed depth to stabilized phreatic water: 75" inches below grade

Observed water weeping from side of deep hole: 75" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.66 feet

Depth of naturally occurring pervious material in TP19-7 Upper boundary: 04"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-8 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 12:51 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-8

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00" → 07"	A_p	Sandy Loam Fine grained	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium granular structure; slightly cohesive; fine grained mineral content; dry matrix; non-sticky; non-plastic; common fine roots; free of clasts; clear smooth boundary.
07" → 36"	$_2C_1$	Sand	2.5Y 6/4 light yellowish brown	none observed	Loose, structurless; mixed fine-to-medium grained mineral content; crudely stratified; damp matrix; free of aggregate; non-sticky; non-plastic; abrupt wavy boundary.
36" → 120"	$_2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	66" (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 66"; apparent water observed at 72"; no bedrock refusal at test hole depth.

Depth to bedrock: 120" Seasonal High Groundwater Table: 66" Apparent water: 72"

TP19-8 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 72" (below land surface) Depth to stabilized apparent water: 72" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 66" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 66" inches below grade

Observed depth to stabilized phreatic water: 72" inches below grade

Observed water weeping from side of deep hole: 72" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 9.42 feet

Depth of naturally occurring pervious material in TP19-8 Upper boundary: 07"
Lower boundary: 120"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

TP19-9 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

Date: October 15, 2019 Time: 12:51 Weather: Clear and sunny, ~60-65°F, calm.

Landscape: Upland Landform: Outwash Plain Position on landscape: Tread Slope aspect: Northerly

Slope (%): 0 – 1 % Slope complexity: Simple Land Cover: Shrubs, sapling trees, stripped land

Property line: 10^+ feet Drainage way: 50^+ feet Drinking water well: 100^+ feet Abutting septic system: 50^+ feet

Wetlands: 100^+ feet Public water supply reservoir: 400^+ feet Tributary to reservoir: 200^+ feet

SOIL PROFILE ► TP19-9

Depth below land surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA/ NRCS)	Soil Color (Munsell)	Redoxomorphic Features/ ESHGWT	Consistence, grade, size, structure, grain size, soil moisture state, roots, horizon boundary, clasts, stratification, artifacts, restrictive features, etc.
00” → 14”	C^	Sandy Loam Mixture	2.5Y 3/1 very dark gray	none observed	Fill material. Loose, structurless; mixed fine-to-medium grained mineral content; non-deleterious material; brick, concrete, organics and stone mixed within matrix; abrupt wavy boundary
14” → 22”	A_b	Sandy Loam Fine grained	10YR 3/2 very dark grayish brown	none observed	Very friable; moderate-grade fine-to-medium granular structure; slightly cohesive; fine grained mineral content; dry matrix; non-sticky; non-plastic; common fine roots; free of clasts; clear smooth boundary.
22” → 34”	BC	Loamy Sand Fine to medium grained	10YR 5/4 yellowish brown	none observed	Very friable; weak-grade, fine, sub-angular blocky structure; somewhat cohesive; mixed medium to mostly fine-grained mineral content; dry matrix; non-sticky; non-plastic; few fine roots and few medium to coarse roots; approximately 05% sub-angular to sub-rounded gravel content of mixed lithology; diffuse wavy boundary.
34” → 122”	$2C_2$	Sand gravelly	2.5Y 5/3 light olive brown	69” (c,2,d) 5YR 5/8 10YR 7/1	Loose, structurless; mixed fine-to-coarse grained mineral content; stratified; damp matrix; ~15 - 20% sub-angular to sub-rounded gravel content and ~10 - 15% sub-angular to sub-rounded cobble content of mixed lithology; non-sticky; non-plastic; redoximorphic high and low chroma colors dispersed within matrix below 69”; apparent water observed at 78”; no bedrock refusal at test hole depth.

Depth to bedrock: 122” Seasonal High Groundwater Table: 69” Apparent water: 78”

TP19-9 DEEP OBSERVATION HOLE

Land off Carlton Drive, Georgetown, Massachusetts

DEPTH TO PHREATIC GROUNDWATER TABLE:

Apparent water seeping from pit face: 78" (below land surface) Depth to stabilized apparent water: 78" (below land surface)

Soil moisture state: Damp

ESTIMATED SEASONAL HIGH GROUNDWATER TABLE:

Depth of Estimated Seasonal High Groundwater Table: 69" (below land surface)

Kind: Iron concentrations; noncemented iron masses - coatings on sand grains

Location: In $2C_2$ matrix surrounding redox depletions Shape: Irregular/ spherical

Hardness: Soft Boundary: Clear Abundance: Common Size: Medium Contrast: Distinct

Concentration color: 5YR 5/8 red Reduction color: 10YR 7/1 light gray Moisture state: Damp

DETERMINATION OF HIGH GROUNDWATER ELEVATION

Observed depth to redoximorphic features: 68" inches below grade

Observed depth to stabilized phreatic water: 78" inches below grade

Observed water weeping from side of deep hole: 78" inches below grade

DEPTH OF NATURALLY OCCURRING PERVIOUS MATERIAL: ► 8.33 feet

Depth of naturally occurring pervious material in TP19-9 Upper boundary: 22"
Lower boundary: 122"

Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.017.

Alexander F. Parker *License #1848* June 1998

Evaluator & license number Certification Date of Certification

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing

SOIL SUITABILITY PERCOLATION TEST

COMMONWEALTH OF MASSACHUSETTS

GEORGETOWN, MASSACHUSETTS

Land off Carlton Drive, Georgetown, Massachusetts

Percolation Test	Percolation Test-1 TP19-1	Percolation Test-2 TP19-4
Depth of test:	Depth to shelf: 04” 22” Depth of hole: 18”	Depth to shelf: 05” 23” Depth of hole: 18”
Start presoak:	09:17	09:50
End presoak:	09:41	10:05
Time at 12”→	09:41	10:05
Time at 9”→	09:35	10:08
Time at 6”→	09:41	10:11
Total time 9” to 6”→	6 minutes	3 minutes
Rate (minutes per inch)	2.0 MPI CLASS I SOIL LTAR 0.74	1.0 MPI CLASS I SOIL LTAR 0.74

Alexander F. Parker *#1848*

Massachusetts Soil Evaluator & Certification number

Mrs. Deborah Rogers, Georgetown Board of Health Director 10/15/19

Georgetown Town Witness Date of soil testing