ATTACHMENT D

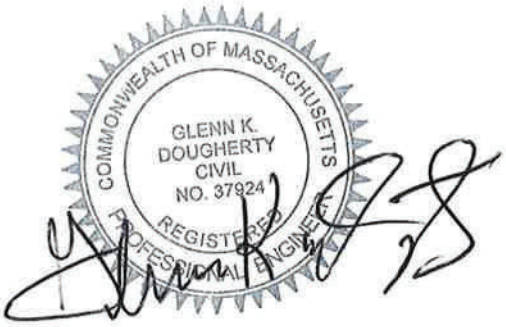
Stormwater Management Report

Stormwater Management Report

Proposed Medical Office Building
200 Libbey Industrial Parkway
Weymouth, Massachusetts

Submitted to:
Town of Weymouth
Conservation Commission

February 3, 2021



Prepared for:
FoxRock 200 Libbey, LLC
1200 Hancock Street, Suite 301
Quincy, Massachusetts 02169

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1.0 INTRODUCTION

This Stormwater Management Report, prepared in accordance with Massachusetts Department of Environmental Protection (MassDEP) Stormwater Standards, is submitted on behalf of the applicant, FoxRock 200 Libbey, LLC. The report summarizes the drainage analysis and Stormwater Management Plan for the proposed Medical Office Building (MOB) at 200 Libbey Industrial Parkway in Weymouth, Massachusetts. See **Figure 1**, USGS Locus Map.

The redevelopment of the 4.3-acre parcel at 200 Libbey Industrial Parkway [the "Site"] will replace an aging 2-story industrial building with a first class, 3-story MOB building of ±69,000 GSF [the "Project"]. The Project will raze the existing building and remove the existing site infrastructure. A new surface parking lot with 275 parking spaces will serve the Project. Previously disturbed areas located near Whitman's Pond will be restored with native landscape plantings and rain gardens as part of the stormwater management system. New trees, shrubs, perennial plantings, and grasses will be planted at the front of the Site along Libbey Industrial Parkway greatly improving the existing tired-looking planting strip. A new accessible walking path will be constructed near the pond for staff and patients to be able to enjoy the serene environment and rain gardens near the pond's edge. The Project will remove existing paving, structures, and walls that encroach within the fifty-foot wetland buffer, decreasing the existing lot impervious coverage area. New stormwater structures will be constructed to collect and release stormwater in compliance with DEP standards for a redevelopment site. The Project will be a significant improvement to the Site and provide important medical care services to the residents of Weymouth and the South Shore.

The Project meets the requirements of MassDEP Stormwater Standard No. 7 as a Redevelopment Project. The existing developed site has an impervious surface area of 3.12 acres, or 72.5% of the 4.3-acres site area. The proposed redeveloped site comprises 2.94 acres of impervious area, which is 68.3% of the site; thus, the Project provides a decrease of 0.18 acres in impervious area and clearly meets the definition of Redevelopment. This is important to understand because projects that fall under the Redevelopment Standard are permitted to meet certain Stormwater Standards only to the maximum extent practicable. In particular, Standard 3 for Recharge to Groundwater is a standard that can be met only to the maximum extent practicable. Due to the results of the on-site soils testing conducted December 28, 2020, where very high groundwater elevations, poorly-drained fine silty material, and evidence of fill material were encountered in all test pits, it is not practicable or feasible for the Project stormwater management system design to include infiltration/recharge systems. It's worth noting that by virtue of the decrease in impervious area, the Project actually does provide an increase in recharge to groundwater through the increased pervious landscaped areas; however, subsurface infiltration/recharge systems or surface infiltration basins are not part of this Project.

The four rain gardens located in the previously disturbed, impacted buffer zone adjacent to Whitman's Pond have been incorporated into the designed restoration area that includes walking paths and a pond-viewing deck as an aesthetic means to beautify the pond edge. Although the rain gardens serve to provide additional water quality treatment of runoff from pavement areas as well as outlet energy dissipation of discharged flows, they are not needed to meet the 80% minimum Total Suspended Solids (TSS) Removal Rate mandated in Standard 4 and have not been included in the TSS calculations to take credit for that Standard. The proposed stormwater management system, consisting of deep-sump hooded catch basins and water quality treatment units that collects and treats 100% of the site's paved areas, achieves greater than 80% TSS Removal Rate without taking credit for the rain gardens. The rain gardens are an added benefit to provide environmentally aesthetic plantings to restore the impacted buffer zone area to its natural state and to provide some additional stormwater quality and quantity controls.

The following sections describe the regulations pertinent to stormwater management and the specific components of the Stormwater Management Plan to be implemented at the Site. The MassDEP Stormwater Report Checklist is provided in **Appendix A**.

2.0 STORMWATER MANAGEMENT

2.1 METHOD OF CALCULATIONS

The hydrologic model created to analyze the hydrology of the site was developed using the Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service (SCS) Technical Release No. 20 (for unit hydrograph procedures) and Technical Release No. 55 (for Times of Concentration and Runoff Curve Numbers). The stormwater facilities were modeled using the Simultaneous Routing Method.

The hydrologic model was created and calculated with HydroCAD, Version 10.0 software, developed by Applied Microcomputer Systems. The runoff from the sub-drainage areas (HydroCAD subcatchments) is calculated based on rainfall and the watershed characteristics, and a runoff hydrograph (a runoff rate versus time curve) is developed. The stage-storage-discharge curve for a specific detention area (i.e., an infiltration basin) is used to compute an outflow hydrograph by hydraulically routing an inflow hydrograph through the detention facilities. This procedure calculates the relationship of the inflow hydrograph with the characteristics of the detention basin systems to determine the outflow, stage, and storage capacity of the detention systems for a given time during the specified storm event.

Pipe sizing calculations for the closed pipe drainage system were performed with StormCAD, a computer program developed by Haestad Methods, Inc., utilizing the Rational Method to determine the runoff. The Intensity Duration Frequency (IDF) Curves for the Site were used to obtain the rainfall intensity data for the hydraulic design standard 25-year storm event.

The existing watershed boundaries for the site were determined based on the topography of the site which was obtained through an on-the-ground survey performed by Dawood Engineering, Inc. (formerly SMC Surveying and Mapping Consultants of Braintree).

2.2 RAINFALL AMOUNTS

In accordance with the Massachusetts Department of Environmental Protection Stormwater Management Guidelines, the 2, 10, 25, and 100-year storm events were analyzed. Type III 24-hour storms were used for the stormwater runoff calculations.

The rainfall amounts summarized in Table 1 represent the most recent data from NOAA (National Oceanic and Atmospheric Administration) Atlas 14 for the Project area.

Table 1 Rainfall Amounts

Storm Event	24-Hour Rainfall Depth (inches)
2-year	3.37
10-year	5.16

Storm Event	24-Hour Rainfall Depth (inches)
25-year	6.28
100-year	8.00

2.3 SOIL CONDITIONS

Natural Resources Conservation Service (NRCS) Norfolk and Suffolk County Soil Survey indicates soils onsite that consist of "Map Unit Symbol 600: Pits, Sand and Gravel" with no Hydrologic Soil Group (HSG) indicated.

On-site soil testing was performed on December 28, 2020. Six test pits were located throughout the site, three on each side of the building, with excavation depths ranging from 2 feet to 5 feet. The tests were abandoned at these shallow depths due to high groundwater seeping into the pit causing the highly saturated fine silty soils to slump inward into the hole, collapsing the sidewalls and undermining the pavement surface. In all cases, the test pits revealed very fine silty sand material and very shallow depths of standing water ranging from 12 to 30 inches beneath the pavement surface. Estimated seasonal high groundwater depths ranged from 8 to 24 inches beneath pavement.

While witnessing the test pits, soil type, groundwater depths; noticing the 6 to 7-foot tall banks along the side lot lines, and referring to the NRCS Soil Survey data that defines the lot as "Pits, Sand and Gravel", it is evident that any decent coarse sand and gravel material that may have existed at one time several decades ago had been stripped down and exported from the site as part of the sand pit operations, leaving only the poorly-drained silty soil and high groundwater just beneath the surface.

In summary, the soil test results clearly indicate that stormwater infiltration is not suitable as a potential Best Management Practices design technique at this site for the proposed redevelopment project. Refer to **Figure 2**, Test-Pit Location Plan and **Appendix B** for the NRCS County Soils Map and test-pit logs.

2.4 GROUND COVER

The project site area is 4.30 acres; however, the overall hydrologic study area for the proposed redevelopment is 5.13 acres. Table 2, below, summarizes the ground cover distribution for the hydrologic study area for existing and proposed conditions. There is a decrease of approximately 0.18 acres (7,752 square-feet) in impervious area with the proposed redevelopment.

Table 1 Ground Cover Distribution

Ground Cover Type	Existing Conditions (acres)	Proposed Conditions (acres)
Pavement	2.47	2.74
Roof	0.98	0.53
Pervious	1.68	1.86
Total	5.13	5.13

2.5 EXISTING STORMWATER MANAGEMENT

The existing stormwater management system is essentially non-existent as there are no Best Management Practices (BMPs) providing water quality treatment measures or stormwater controls. There is no closed drainage system, no catch basins, no drain-pipe conveyance network. There is a detention basin located on-site in the southwest lot corner near Libbey and there are two old, plugged-up ineffective leaching basins in the front parking area near the southeast lot corner. As shown on **Figures 3**, Pre-Development Watershed Map, most of the runoff generated by the site discharges uncontrolled and untreated in a northerly direction to Whitman's Pond. Runoff from the smaller parking area in front of the building sheet flows to the catch basins located in Libbey Industrial Parkway, which is discharged to the existing on-site detention basin.

2.6 PROPOSED STORMWATER MANAGEMENT

The proposed project incorporates a stormwater management system that meets the guidelines in the 2008 MassDEP Stormwater Management Policy. Stormwater quality and quantity on the Site will be managed by implementing a series of best management practices (BMPs) that will include street sweeping, deep sump/hooded catch basins, water quality devices, and rain gardens. (Note: the rain gardens are not included in the TSS calculations and credit has not been taken, although additional water quality treatment is provided by them.) The proposed BMPs (sweeping + deep sump/hooded CB's + water quality devices) will remove a minimum 80 percent of total suspended solids from stormwater runoff, maintain the peak flow rates of stormwater runoff, and maintain the recharge rates to groundwater to the maximum extent practicable, as described in the MassDEP Stormwater Standards section of this report.

2.6.1 Site Hydraulics

The proposed drain-pipe network is composed of catch basins, manholes and water quality units that will collect runoff from the parking, building rooftop and landscaped areas within the Site and discharge to the on-site existing detention basin and proposed rain gardens.

The proposed storm drainage collection system has been designed for a 25-year storm frequency utilizing the Rational Method. StormCAD© was used to perform the hydraulic analysis for the storm drainage system. Refer to **Appendix E** for pipe sizing calculations.

The following criteria were used to design the pipe network:

- Pipes shall be sized to convey the 25-year storm event.
- All drainage pipes shall be either ductile iron (CLDI) pipe with cover over the pipe of less than 1.33 feet or high-density polyethylene (HDPE) with minimum cover of a minimum of 1.33 feet.
- Rainfall intensity of 8.78 inches per hour for a 5-minute duration for the 25-year storm frequency.
- Manning's coefficient (n) of 0.013 for CLDI and 0.012 for HDPE.
- Manholes shall be provided at all changes in direction or changes in pipe size.
- Maximum pipe velocity shall be 10 feet per second (fps).

3.0 MASSDEP STORMWATER STANDARDS

The ten (10) MassDEP Stormwater Management Standards provided in the Stormwater Management Policy and Massachusetts Wetlands Protection Act relate to the protection of wetlands and water bodies,

control of water quantity, recharge to groundwater, water quality and protection of critical areas, erosion/sedimentation control and stormwater maintenance.

The following section discusses compliance with the ten (10) MassDEP Stormwater Management Standards. The MassDEP Stormwater Report Checklist is provided in **Appendix A**.

3.1 STANDARD 1 – NO NEW UNTREATED DISCHARGES

There are no new point source discharges of untreated stormwater to or causing erosion in resource areas proposed as part of the Project. There are existing discharges of untreated stormwater from the site that has caused erosion at the edge of Whitman's Pond. That problem will be rectified with this proposed site redevelopment project.

The existing site runoff flow patterns have been closely replicated with the proposed grading and stormwater management design and all runoff generated by the Project is collected, conveyed and treated via network of deep-sump hooded catch basins, drain pipes and manholes, water quality treatment units and rain gardens prior to discharge to Whitman's Pond. Stormwater discharge velocities for the Project are mitigated by the rain gardens and rip-rap aprons at point source discharges. Outlet protection sizing calculation are provided in **Appendix F**.

The Project complies with Standard 1.

3.2 STANDARD 2 – PEAK RATE ATTENUATION

The Project's stormwater management system is designed so that post-development peak discharge rates do not exceed pre-development discharge rates for the 2-year, 10-year, 25-year, and 100-year 24-hour storm events.

To determine the peak rate of discharge for existing and proposed conditions, runoff hydrographs were generated for the design storm events using the NRCS TR-20 method. HydroCAD input/output data for pre-development and post-development conditions are provided in **Appendix C**. Table 3 summarizes the pre- and post-development peak runoff discharge rates determined in the hydrologic/hydraulic analyses performed for the Project Site. Point of Analysis 1R is the existing detention basin located on-site near Libbey; and Point of Analysis 2R is Whitman's Pond.

Table 2 Comparison of Peak Runoff Rates

Point of Analysis	2-Year Storm Event (cfs)*			10-Year Storm Event (cfs)*			25-Year Storm Event (cfs)*			100-Year Storm Event (cfs)*		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
1R	0.00	0.00	0.00	0.44	0.38	-0.06	2.04	1.85	-0.19	5.64	5.23	-0.41
2R	8.97	5.89	-3.08	16.12	9.02	-7.10	20.61	11.61	-9.00	27.48	15.41	-12.07

* cfs = cubic feet per second

The Project complies with Standard 2.

3.3 STANDARD 3 - RECHARGE TO GROUNDWATER

As a redevelopment project, Standard No. 3 needs to be met only to the maximum extent practicable. However, since the Project results in a net reduction of impervious surface there will be no loss of annual recharge to groundwater. Also, as discussed in Section 2.3 the Project site is not suitable for infiltration or recharge BMPs due to soil type and high groundwater elevations observed during soil testing.

The Project complies with Standard 3.

3.4 STANDARD 4 – WATER QUALITY

The incorporation of the following stormwater best management practices (BMPs) will achieve a cumulative Total Suspended Solids (TSS) removal rate greater than 80%. Refer to **Appendix D** for Water Quality Calculations and **Appendix E** for a copy of the Long-Term Pollution Prevention and Stormwater Operation & Maintenance Plan.

The Project complies with Standard 4.

3.4.1 Street Sweeping

The proposed design incorporates street sweeping as a BMP to control the amount of sediment that enters the stormwater management system. Street sweeping will be conducted on a quarterly basis. In accordance with MassDEP Standards a 5% TSS removal rate is credited for this BMP.

3.4.2 Deep Sump/Hooded Catch Basins

All proposed catch basins will be equipped with four-foot deep sumps and hoods, which will serve to trap sediment and floatables before entering the drain pipes. Catch basins will be inspected quarterly and, if necessary, cleaned when sediment reaches half full depth to ensure that the catch basins are working in their intended fashion and that they are free of debris. Sediments and hydrocarbons shall be properly handled and disposed of, in accordance with local, state, and federal requirements. In accordance with MassDEP Standards a 25% TSS removal rate is credited for this BMP.

3.4.3 Water Quality Units

The stormwater management system incorporates Barracuda® Stormwater Separator units prior to discharging into the existing detention basin and rain gardens. All units have been sized to treat the water quality flow rate derived from the first 1.0 inch of rainfall and will achieve TSS removal rates exceeding the minimum requirement of 80%.

3.4.4 Rain Gardens

The stormwater management system incorporates rain gardens prior to discharging into Whitman's Pond. Since not all rain gardens have capacity to treat the 1-inch water quality volume they are not included in the TSS calculations. Although rain gardens are not included in the TSS calculations they will provide additional treatment and slow down discharge velocities into Whitman's Pond.

3.5 STANDARD 5 – LAND USES WITH HIGHER POTENTIAL POLLUTAND LOADS

Standard 5 is applicable to the Project. The Project is considered a Land Use with Higher Potential for Pollutant Loads (LUHPPL) as defined in the Massachusetts Stormwater Handbook since it will generate greater than 1,000 vehicle trips per day. As a redevelopment project, Standard No. 5 needs to be met only to the maximum extent practicable. However, it should be noted that all runoff in contact with potential pollutants will be routed to deep sump/hooded catch basins and water quality units prior to discharge.

The Project complies with Standard 5.

3.6 STANDARD 6 - PROTECTION OF CRITICAL AREAS

Standard 6 is applicable to the Project. The Project site is located within the contributing watershed to Whitman's Pond, a public water supply. In addition, Whitman's Pond is considered a Cold-Water Fishery and is mapped as an Outstanding Resource Waters (ORW) and therefore considered a critical area. Stormwater discharges within a critical area require the use of a treatment train that provides 80% TSS removal prior to discharge and a least 44% TSS removal prior to discharge to an infiltration BMP. In addition, treatment BMPs must be designed to treat the required water quality volume, a volume equal to one-inch times the total impervious surfaces of the post-development site. As a redevelopment project, Standard No. 6 needs to be met only to the maximum extent practicable. However, it should be noted that all runoff in contact with potential pollutants will be routed to deep sump/hooded catch basins, water quality units, rain gardens or detention basins prior to discharge.

The Project complies with Standard 6.

3.7 STANDARD 7 - REDEVELOPMENT PROJECTS

Standard 7 is applicable to the Project. Redevelopment projects include development, rehabilitation, expansion, and phased projects on previously developed sites, provided the redevelopment results in no net increase in impervious area. As shown in Table 2 there is a decrease of approximately 0.18 acres (7,752 square-feet) in impervious area with the proposed redevelopment. The Project qualifies as a redevelopment project as there in no net increase in impervious area.

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

The Project complies with Standard 7.

3.8 STANDARD 8 – CONSTRUCTION PERIOD POLLUTION PREVENTION AND EROSION & SEDIMENTATION CONTROL

The Project will result in the disturbance of greater than one (1) acre of land and requires coverage under the U.S. EPA National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges from Construction Activities (CGP). In support of coverage, a project-specific Storm Water

Pollution Prevention Plan (SWPPP) will be provided under a separate cover and a Notice of Intent will be submitted to the EPA prior to commencement of construction activities.

The project complies with Standard 8.

3.9 STANDARD 9 – OPERATION AND MAINTENANCE PLAN

Refer to **Appendix E** for the Project's Long-Term Pollution Prevention and Stormwater Operation and Maintenance Plan.

The Project complies with Standard 9.

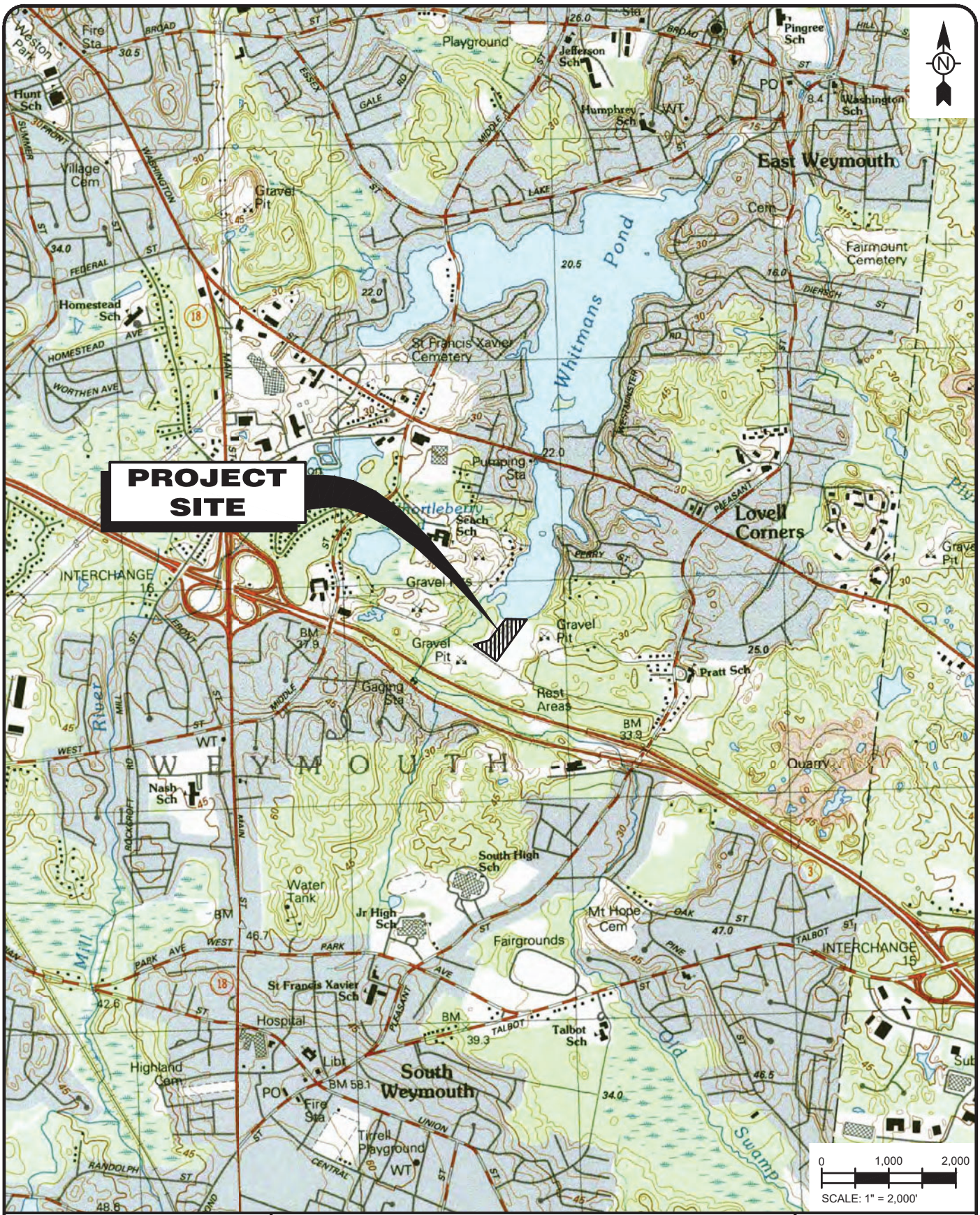
3.10 STANDARD 10 – PROHIBITION OF ILLICIT DISCHARGE

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. To the best of the owners and engineer's knowledge, no illicit discharges exist on Site and no illicit discharges will be incorporated as part of the Project into the stormwater management system. An Illicit Discharge Compliance Statement is provided in **Appendix F**.

The Project complies with Standard 10.

4.0 CONCLUSION

The stormwater management system addresses both the quantity and quality of stormwater runoff from the Site and conforms to the ten (10) standards outlined by the Massachusetts Department of Environmental Protection Stormwater Policy and the Town of Weymouth Stormwater Management Ordinance. The Project will be a significant improvement to the Site and provide important medical care services to the residents of Weymouth and the South Shore.



TETRA TECH

www.tetratech.com

20 Cabot Boulevard, Suite 305
Mansfield, MA 02048
Phone: (508) 786-2200 Fax: (508) 786-2201

FOXROCK 200 LIBBEY, LLC

200 Libbey Industrial Parkway
Weymouth, Massachusetts

USGS Locus Map

Project No.:	143-42892-20004
Date:	February 2021
Designed By:	SJW

Figure 1

Bar Measures 1 inch

1/28/2021 9:28:29 AM - P:\42892\143-42892-20004\CAD\SUPPORTFILES\USGS LOCUS MAP.DWG - WHITE, SARA

LEGEND:

TEST-PIT LOCATION

0 30' 60'

SCALE: 1" = 60'

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20 Cabot Boulevard, Suite 305
Mansfield, MA 02048
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FOXROCK 200 LIBBEY, LLC

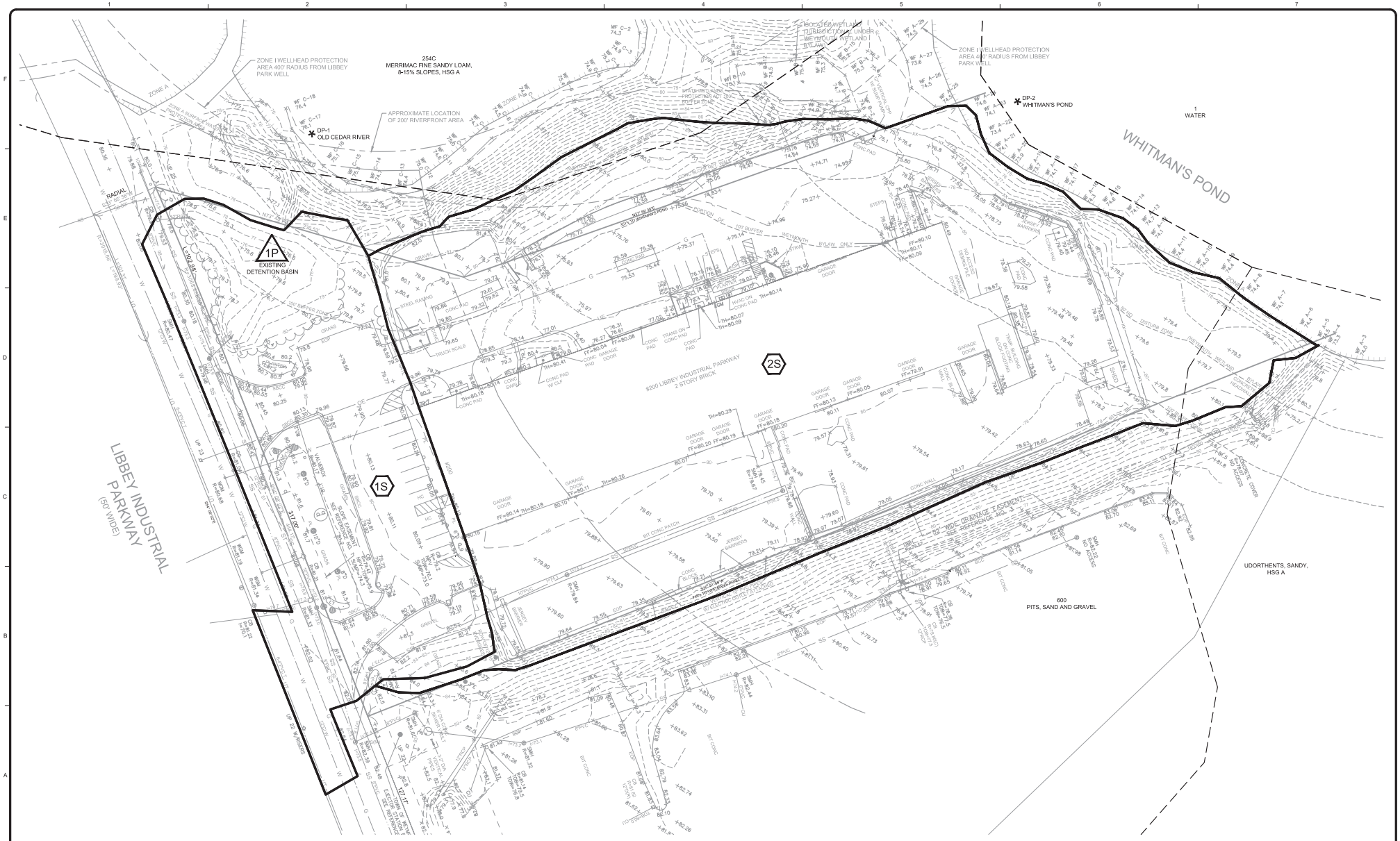
200 Libbey Industrial Parkway
Weymouth, Massachusetts

Test-Pit Location Plan

Project No.:	143-42892-20004
Date:	February 2021
Designed By:	SJW

Figure 2

Bar Measures 1 inch



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MARK	DATE	DESCRIPTION	BY
0	02-03-21	NOTICE OF INTENT	SJW

Client: FOXROCK 200 LIBBEY, LLC
Proj. Loc.: 200 Libbey Industrial Parkway, Weymouth, MA

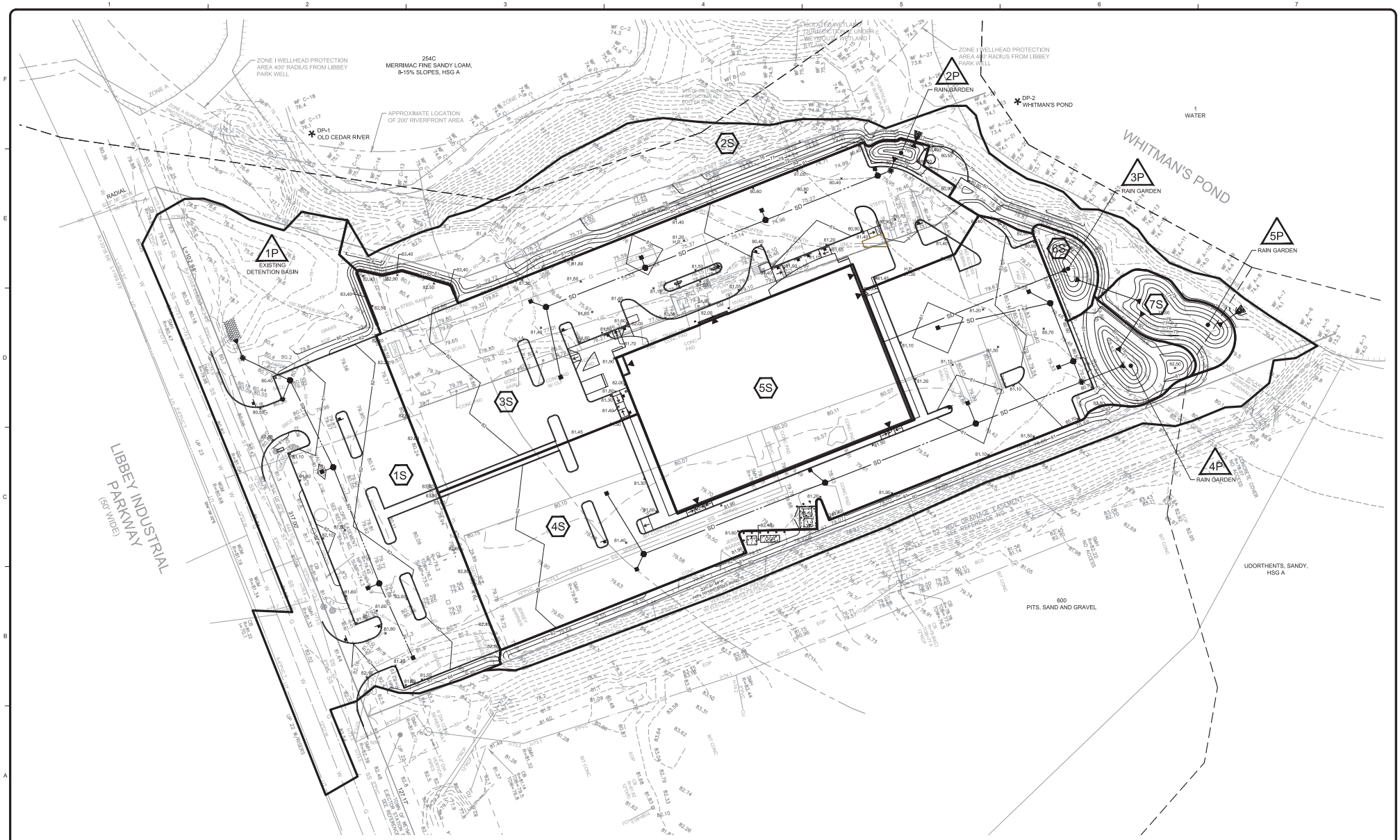
200 Libbey Industrial Parkway
Weymouth, Massachusetts

Pre-Development Watershed Map

Project No.:	143-42892-20004
Designed By:	SJW
Drawn By:	SJW
Checked By:	GKD

Fig. 3

Bar Measures 1 inch



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MARK	DATE	DESCRIPTION	BY
0	02-03-21	NOTICE OF INTENT	SJW

Client: FOXROCK 200 LIBBEY, LLC
Proj. Loc.: 200 Libbey Industrial Parkway, Weymouth, MA

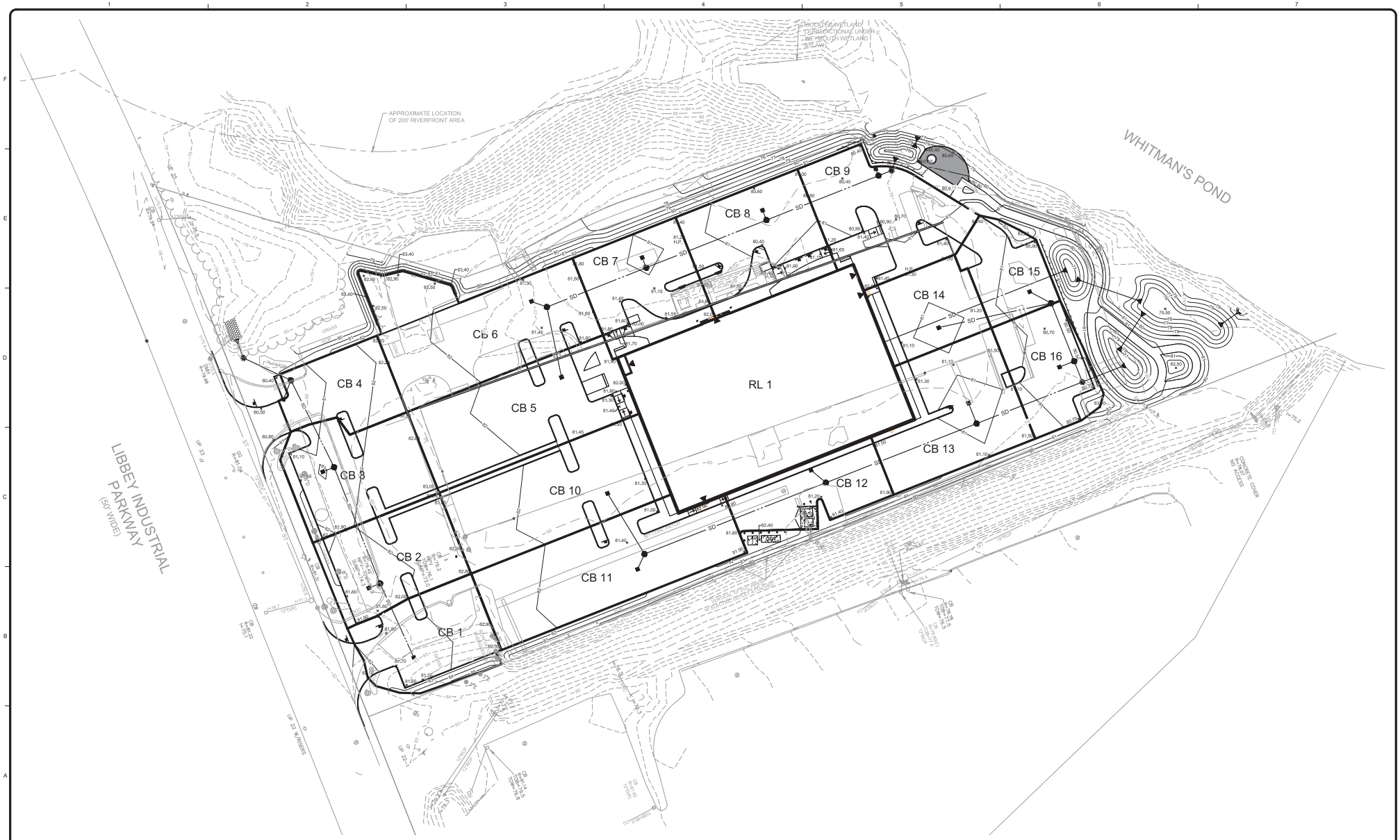
200 Libbey Industrial Parkway
Weymouth, Massachusetts

Post-Development Watershed Map

Project No.: 143-42892-20004
Designed By: SJW
Drawn By: SJW
Checked By: GKD

Fig. 4

Bar Measures 1 inch



LEGEND:

CATCHMENT BOUNDARY

0 15' 30' 60'

SCALE: 1" = 30'

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MARK	DATE	DESCRIPTION	BY
0	02-03-21	NOTICE OF INTENT	SJW

Client: FOXROCK 200 LIBBEY, LLC
Proj. Loc.: 200 Libbey Industrial Parkway, Weymouth, MA

200 Libbey Industrial Parkway
Weymouth, Massachusetts

Post-Development Catch Basin Catchment Areas

Fig. 5

Project No.:	143-42892-20004
Designed By:	SJW
Drawn By:	SJW
Checked By:	GKD

Bar Measures 1 inch

Appendix A

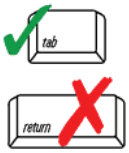
MassDEP Checklist for Stormwater Report

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

Signature and Date 2/03/2021

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☒ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

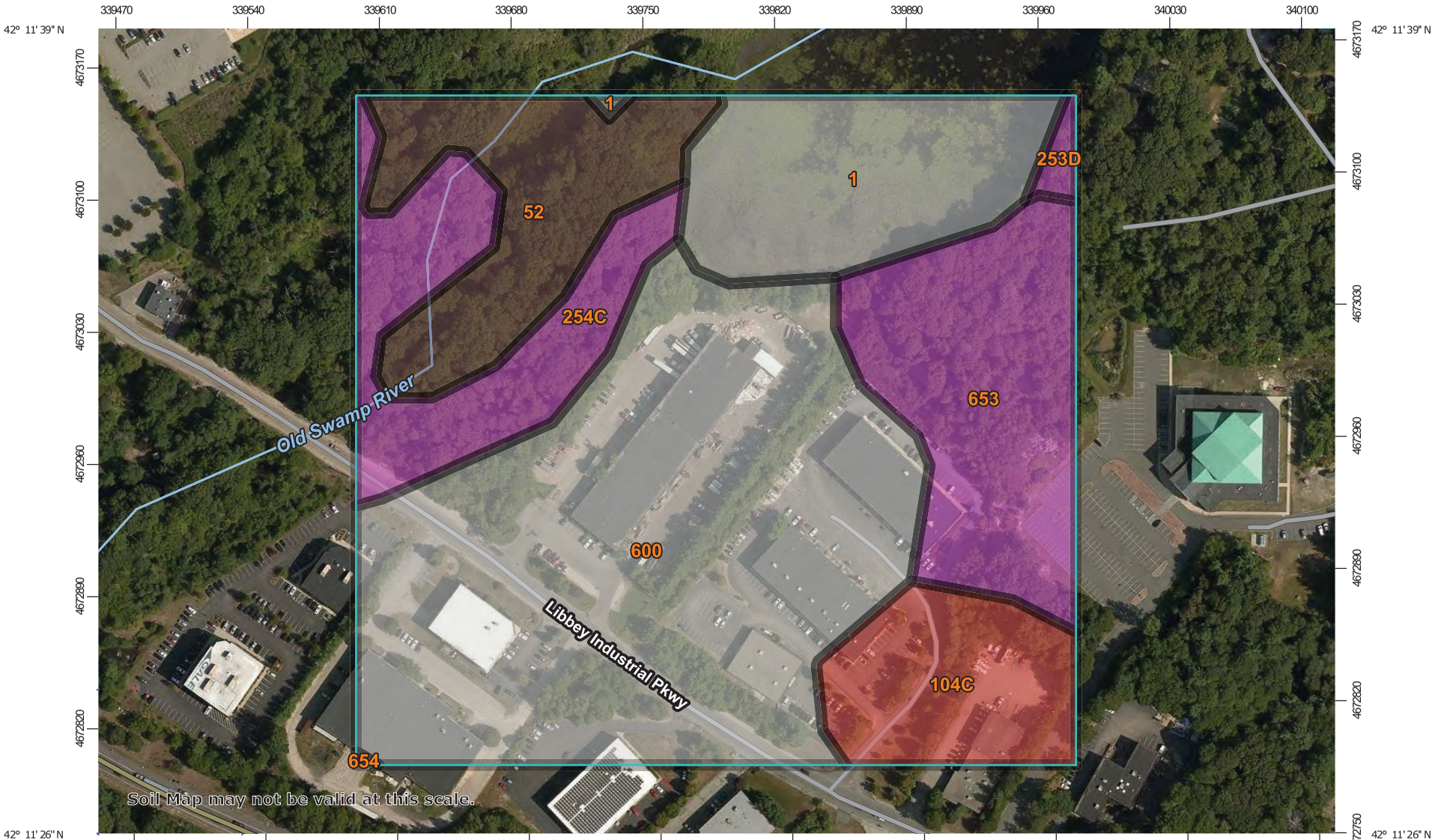
☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

Appendix B
Soils Information

Hydrologic Soil Group—Norfolk and Suffolk Counties, Massachusetts
(200 Libbey Industrial Parkway Weymouth, MA)



Map Scale: 1:3,010 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 40 80 160 240

Feet: 0 100 200 400 600

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

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts
Survey Area Data: Version 16, Jun 11, 2020

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

Date(s) aerial images were photographed: Aug 26, 2014—Sep 4, 2014

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		4.0	12.0%
52	Freetown muck, 0 to 1 percent slopes	B/D	3.7	11.1%
104C	Hollis-Rock outcrop-Charlton complex, 0 to 15 percent slopes	D	2.8	8.3%
253D	Hinckley loamy sand, 15 to 35 percent slopes	A	0.2	0.6%
254C	Merrimac fine sandy loam, 8 to 15 percent slopes	A	3.5	10.4%
600	Pits, sand and gravel		14.5	43.0%
653	Udorthents, sandy	A	4.9	14.6%
654	Udorthents, loamy	A	0.0	0.0%
Totals for Area of Interest			**33.7**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Evaluator: Sara J. White, SE3031

Commonwealth of Massachusetts
City/Town of Weymouth

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-1 (Hole #) | 12/28/20 (Date) | 8:15 am (Time) | 30°F, cloudy (Weather) | N42° 11' 32.31" (Latitude) | W70° 56' 29.06" (Longitude)

1. Land Use: parking lot (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | < 2 (Slope (%))

Description of Location: 200 Libbey Industrial Parkway

2. Soil Parent Material: sandy, loose till | N/A (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 380 feet | Drainage Way N/A feet | Wetlands 350+ feet
Property Line 10 feet | Drinking Water Well 400 feet | Other N/A feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 12" Depth Weeping from Pit | 30" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-3	PVMT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3-12	FILL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12-60	C	fine silty sand	10YR 6/2	12	faint	trace	5	15	single grain	loose noncoherent	weeping @ 12" +/-

Additional Notes:
saturated unstable pit sidewalls, undermining beneath pavement, slumping into pit. evidence of E.S.H.G.W. depth @12" to 18"; fine silty sand material and high groundwater not suitable for infiltration.

Commonwealth of Massachusetts
City/Town of Weymouth

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-2 (Hole #) | 12/28/20 (Date) | 8:40 am (Time) | 30°F, cloudy (Weather) | N42° 11' 32.31" (Latitude) | W70° 56' 29.06" (Longitude:)

1. Land Use: parking lot (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | < 2 (Slope (%))

Description of Location: 200 Libbey Industrial Parkway

2. Soil Parent Material: sandy, loose till | N/A (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 250+ feet | Drainage Way N/A feet | Wetlands 250+ feet
Property Line 10 feet | Drinking Water Well 280 feet | Other N/A feet

4. Unsuitable Materials Present: ☒ Yes ☐ No If Yes: ☐ Disturbed Soil ☒ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 16" Depth Weeping from Pit | 28" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-3	PVMT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3-16	FILL	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16-44	C	fine silty sand	10YR 6/2	8	faint	trace	5	20	single grain	loose noncoherent	weeping @ 8" +/-

Additional Notes:
saturated unstable pit sidewalls, undermining beneath pavement, slumping into pit. trace evidence of E.S.H.G.W. depth @ 8" to 16"; fine silty sand material and high groundwater not suitable for infiltration.

Commonwealth of Massachusetts
City/Town of Weymouth

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-3 (Hole #) | 12/28/20 (Date) | 8:55 am (Time) | 34°F, cloudy (Weather) | N42° 11' 32.31" (Latitude) | W70° 56' 29.06" (Longitude:)

1. Land Use: parking lot (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.) | < 2 (Slope (%)

Description of Location: 200 Libbey Industrial Parkway

2. Soil Parent Material: sandy, loose till | N/A (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body 160+ feet | Drainage Way N/A feet | Wetlands 160+ feet
Property Line 10 feet | Drinking Water Well 280 feet | Other N/A feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 3" (top) Depth Weeping from Pit | 22" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-3	PVMT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3-36	C	v. fine silty sand	10YR6/2	12	faint	trace	0	5	single grain	loose noncoherent	weeping @ 3" +/-

Additional Notes:
saturated unstable pit sidewalls, undermining beneath pavement, slumping into pit. trace evidence of E.S.H.G.W. depth @ 12"; very fine silty sand material and high groundwater not suitable for infiltration.

Soil Evaluator: Sara J. White, SE3031

Commonwealth of Massachusetts
City/Town of Weymouth

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-4 (Hole #) | 12/28/20 (Date) | 9:30am (Time) | 40°F, cloudy (Weather) | N42° 11' 33.67" (Latitude) | W70° 56' 26.79" (Longitude:)

1. Land Use: parking lot (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | > 2 (Slope (%))

Description of Location: 200 Libbey Industrial Parkway

2. Soil Parent Material: sandy, loose till | N/A (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 200 feet | Drainage Way N/A feet | Wetlands 180 feet
Property Line 55 feet | Drinking Water Well 460 feet | Other N/A feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 6" Depth Weeping from Pit | 16" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-2	PVMT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-18	B	fine silty sand	10YR 3/6	12	faint	trace	5	0	single grain	loose noncoherent	weeping @ 6" +/-

Additional Notes:
saturated unstable pit sidewalls, undermining beneath pavement, slumping into pit. Trace evidence of E.S.H.G.W. depth @ 12", fine silty sand material and high groundwater not suitable for infiltration.

Commonwealth of Massachusetts
City/Town of Weymouth

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-5 (Hole #) | 12/28/20 (Date) | 9:15am (Time) | 40°F, cloudy (Weather) | N42° 11' 32.96" (Latitude) | W70° 56' 28.28" (Longitude)

1. Land Use: parking lot (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | > 2 (Slope (%))

Description of Location: 200 Libbey Industrial Parkway

2. Soil Parent Material: sandy, loose till | N/A (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 310 feet | Drainage Way N/A feet | Wetlands 115 feet
Property Line 10 feet | Drinking Water Well 440 feet | Other N/A feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 24" Depth Weeping from Pit | 38" Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-2	PVMT	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-24	Fill	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24-32	B	medium sand	10YR 5/1	24	5/10G	30	5	0	single grain	loose noncoherent	weeping @ 24"
32-40	C	fine silty sand	10YR 3/6	N/A	N/A	N/A	5	0	single grain	loose noncoherent	N/A

Additional Notes:
evidence of E.S.H.G.W. depth @ 24", gleyed soils observed, fine silty sand material and high groundwater not suitable for infiltration

Commonwealth of Massachusetts
City/Town of Weymouth

Form 11 - Soil Suitability Assessment for On-Site Sewage Disposal

C. On-Site Review (*minimum of two holes required at every proposed primary and reserve disposal area)*

Deep Observation Hole Number: TP-6 (Hole #) | 12/28/20 (Date) | 10:00am (Time) | 40°F, cloudy (Weather) | N42° 11' 32.31" (Latitude) | W70° 56' 29.06" (Longitude)

1. Land Use: parking lot/gravel area (e.g., woodland, agricultural field, vacant lot, etc.) | N/A (Vegetation) | N/A (Surface Stones (e.g., cobbles, stones, boulders, etc.)) | > 2 (Slope (%))

   Description of Location: 200 Libbey Industrial Parkway

2. Soil Parent Material: sandy, loose till | N/A (Landform) | BS (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body 400 feet | Drainage Way N/A feet | Wetlands 80 feet
   Property Line 10 feet | Drinking Water Well 460 feet | Other N/A feet

4. Unsuitable Materials Present: ☐ Yes ☒ No If Yes: ☐ Disturbed Soil ☐ Fill Material ☐ Weathered/Fractured Rock ☐ Bedrock

5. Groundwater Observed: ☒ Yes ☐ No If yes: 12" Depth Weeping from Pit | 63" Depth Standing Water in Hole

Soil Log

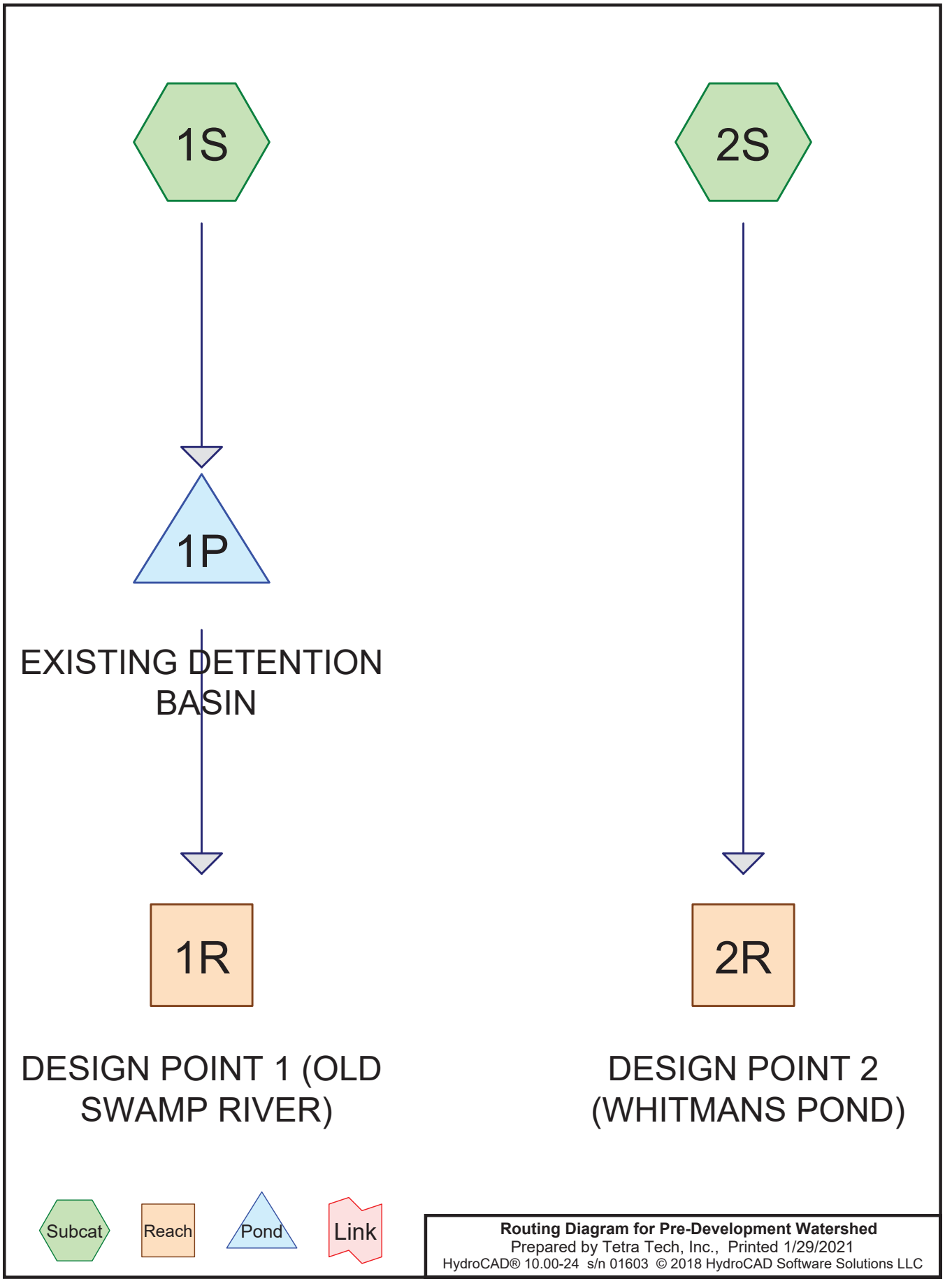
Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-16	A	loam	10YR 3/4	N/A	N/A	N/A	0	0	blocky	friable	weeping @ 12" +/-
16-24	B	fine silty sand	10YR 5/1	24	faint	trace	5	0	single grain	loose noncoherent	N/A
24-72	C	silty sand	10YR 3/6	N/A	N/A	N/A	10	0	single grain	friable	N/A

Additional Notes:
saturated unstable pit sidewalls and slumping into pit. Trace evidence of E.S.H.G.W. depth @ 24"; fine silty sand material and high groundwater not suitable for infiltration.

Appendix C

HydroCAD Report

Pre-Development HydroCAD Report



Routing Diagram for Pre-Development Watershed
Prepared by Tetra Tech, Inc., Printed 1/29/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.740	61	>75% Grass cover, Good, HSG B (1S, 2S)
0.230	96	Gravel surface, HSG B (1S, 2S)
2.470	98	Paved parking, HSG B (1S, 2S)
0.980	98	Roofs, HSG B (2S)
0.710	36	Woods, Fair, HSG A (1S, 2S)
5.130	**84**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=1.270 ac 51.97% Impervious Runoff Depth=1.47"
Tc=6.0 min CN=79 Runoff=2.16 cfs 0.155 af

Subcatchment 2S: Runoff Area=3.860 ac 72.28% Impervious Runoff Depth=1.98"
Tc=6.0 min CN=86 Runoff=8.97 cfs 0.638 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=8.97 cfs 0.638 af
Outflow=8.97 cfs 0.638 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.44' Storage=6,757 cf Inflow=2.16 cfs 0.155 af
Outflow=0.00 cfs 0.000 af

Total Runoff Area = 5.130 ac Runoff Volume = 0.793 af Average Runoff Depth = 1.86"
32.75% Pervious = 1.680 ac 67.25% Impervious = 3.450 ac

Summary for Subcatchment 1S:

Runoff = 2.16 cfs @ 12.09 hrs, Volume= 0.155 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.660	98	Paved parking, HSG B
0.100	96	Gravel surface, HSG B
0.300	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.270	79	Weighted Average
0.610		48.03% Pervious Area
0.660		51.97% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 8.97 cfs @ 12.09 hrs, Volume= 0.638 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
1.810	98	Paved parking, HSG B
0.980	98	Roofs, HSG B
0.130	96	Gravel surface, HSG B
0.440	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
3.860	86	Weighted Average
1.070		27.72% Pervious Area
2.790		72.28% Impervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 0.00" for 2 YEAR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.860 ac, 72.28% Impervious, Inflow Depth = 1.98" for 2 YEAR event
Inflow = 8.97 cfs @ 12.09 hrs, Volume= 0.638 af
Outflow = 8.97 cfs @ 12.09 hrs, Volume= 0.638 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 1.47" for 2 YEAR event
Inflow = 2.16 cfs @ 12.09 hrs, Volume= 0.155 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.44' @ 24.34 hrs Surf.Area= 5,535 sf Storage= 6,757 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.60' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=1.270 ac 51.97% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=79 Runoff=4.38 cfs 0.311 af

Subcatchment 2S: Runoff Area=3.860 ac 72.28% Impervious Runoff Depth=3.62"
Tc=6.0 min CN=86 Runoff=16.12 cfs 1.163 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=0.44 cfs 0.135 af
Outflow=0.44 cfs 0.135 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=16.12 cfs 1.163 af
Outflow=16.12 cfs 1.163 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.65' Storage=7,991 cf Inflow=4.38 cfs 0.311 af
Outflow=0.44 cfs 0.135 af

Total Runoff Area = 5.130 ac Runoff Volume = 1.474 af Average Runoff Depth = 3.45"
32.75% Pervious = 1.680 ac 67.25% Impervious = 3.450 ac

Summary for Subcatchment 1S:

Runoff = 4.38 cfs @ 12.09 hrs, Volume= 0.311 af, Depth= 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.660	98	Paved parking, HSG B
0.100	96	Gravel surface, HSG B
0.300	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.270	79	Weighted Average
0.610		48.03% Pervious Area
0.660		51.97% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 16.12 cfs @ 12.09 hrs, Volume= 1.163 af, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
1.810	98	Paved parking, HSG B
0.980	98	Roofs, HSG B
0.130	96	Gravel surface, HSG B
0.440	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
3.860	86	Weighted Average
1.070		27.72% Pervious Area
2.790		72.28% Impervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 1.27" for 10 YEAR event
Inflow = 0.44 cfs @ 12.98 hrs, Volume= 0.135 af
Outflow = 0.44 cfs @ 12.98 hrs, Volume= 0.135 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.860 ac, 72.28% Impervious, Inflow Depth = 3.62" for 10 YEAR event
Inflow = 16.12 cfs @ 12.09 hrs, Volume= 1.163 af
Outflow = 16.12 cfs @ 12.09 hrs, Volume= 1.163 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 2.94" for 10 YEAR event
Inflow = 4.38 cfs @ 12.09 hrs, Volume= 0.311 af
Outflow = 0.44 cfs @ 12.98 hrs, Volume= 0.135 af, Atten= 90%, Lag= 53.2 min
Primary = 0.44 cfs @ 12.98 hrs, Volume= 0.135 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.65' @ 12.98 hrs Surf.Area= 6,045 sf Storage= 7,991 cf

Plug-Flow detention time= 279.1 min calculated for 0.135 af (43% of inflow)
Center-of-Mass det. time= 159.2 min (982.3 - 823.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.43 cfs @ 12.98 hrs HW=78.65' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.43 cfs @ 0.60 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=1.270 ac 51.97% Impervious Runoff Depth=3.93"
Tc=6.0 min CN=79 Runoff=5.83 cfs 0.416 af

Subcatchment 2S: Runoff Area=3.860 ac 72.28% Impervious Runoff Depth=4.68"
Tc=6.0 min CN=86 Runoff=20.61 cfs 1.504 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=2.04 cfs 0.240 af
Outflow=2.04 cfs 0.240 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=20.61 cfs 1.504 af
Outflow=20.61 cfs 1.504 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.74' Storage=8,559 cf Inflow=5.83 cfs 0.416 af
Outflow=2.04 cfs 0.240 af

Total Runoff Area = 5.130 ac Runoff Volume = 1.920 af Average Runoff Depth = 4.49"
32.75% Pervious = 1.680 ac 67.25% Impervious = 3.450 ac

Summary for Subcatchment 1S:

Runoff = 5.83 cfs @ 12.09 hrs, Volume= 0.416 af, Depth= 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.660	98	Paved parking, HSG B
0.100	96	Gravel surface, HSG B
0.300	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.270	79	Weighted Average
0.610		48.03% Pervious Area
0.660		51.97% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 20.61 cfs @ 12.09 hrs, Volume= 1.504 af, Depth= 4.68"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
1.810	98	Paved parking, HSG B
0.980	98	Roofs, HSG B
0.130	96	Gravel surface, HSG B
0.440	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
3.860	86	Weighted Average
1.070		27.72% Pervious Area
2.790		72.28% Impervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 2.26" for 25 YEAR event
Inflow = 2.04 cfs @ 12.38 hrs, Volume= 0.240 af
Outflow = 2.04 cfs @ 12.38 hrs, Volume= 0.240 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.860 ac, 72.28% Impervious, Inflow Depth = 4.68" for 25 YEAR event
Inflow = 20.61 cfs @ 12.09 hrs, Volume= 1.504 af
Outflow = 20.61 cfs @ 12.09 hrs, Volume= 1.504 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 3.93" for 25 YEAR event
Inflow = 5.83 cfs @ 12.09 hrs, Volume= 0.416 af
Outflow = 2.04 cfs @ 12.38 hrs, Volume= 0.240 af, Atten= 65%, Lag= 17.3 min
Primary = 2.04 cfs @ 12.38 hrs, Volume= 0.240 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.74' @ 12.38 hrs Surf.Area= 6,266 sf Storage= 8,559 cf

Plug-Flow detention time= 208.1 min calculated for 0.240 af (58% of inflow)
Center-of-Mass det. time= 100.3 min (915.0 - 814.8)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.03 cfs @ 12.38 hrs HW=78.74' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 2.03 cfs @ 1.01 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Runoff Area=1.270 ac 51.97% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=79 Runoff=8.10 cfs 0.583 af

Subcatchment 2S: Runoff Area=3.860 ac 72.28% Impervious Runoff Depth=6.33"
Tc=6.0 min CN=86 Runoff=27.48 cfs 2.037 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=5.64 cfs 0.406 af
Outflow=5.64 cfs 0.406 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=27.48 cfs 2.037 af
Outflow=27.48 cfs 2.037 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.88' Storage=9,452 cf Inflow=8.10 cfs 0.583 af
Outflow=5.64 cfs 0.406 af

Total Runoff Area = 5.130 ac Runoff Volume = 2.620 af Average Runoff Depth = 6.13"
32.75% Pervious = 1.680 ac 67.25% Impervious = 3.450 ac

Summary for Subcatchment 1S:

Runoff = 8.10 cfs @ 12.09 hrs, Volume= 0.583 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.660	98	Paved parking, HSG B
0.100	96	Gravel surface, HSG B
0.300	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.270	79	Weighted Average
0.610		48.03% Pervious Area
0.660		51.97% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 27.48 cfs @ 12.08 hrs, Volume= 2.037 af, Depth= 6.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
1.810	98	Paved parking, HSG B
0.980	98	Roofs, HSG B
0.130	96	Gravel surface, HSG B
0.440	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
3.860	86	Weighted Average
1.070		27.72% Pervious Area
2.790		72.28% Impervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 3.84" for 100 YEAR event
Inflow = 5.64 cfs @ 12.17 hrs, Volume= 0.406 af
Outflow = 5.64 cfs @ 12.17 hrs, Volume= 0.406 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.860 ac, 72.28% Impervious, Inflow Depth = 6.33" for 100 YEAR event
Inflow = 27.48 cfs @ 12.08 hrs, Volume= 2.037 af
Outflow = 27.48 cfs @ 12.08 hrs, Volume= 2.037 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.270 ac, 51.97% Impervious, Inflow Depth = 5.51" for 100 YEAR event
Inflow = 8.10 cfs @ 12.09 hrs, Volume= 0.583 af
Outflow = 5.64 cfs @ 12.17 hrs, Volume= 0.406 af, Atten= 30%, Lag= 4.9 min
Primary = 5.64 cfs @ 12.17 hrs, Volume= 0.406 af

Routing by Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.88' @ 12.17 hrs Surf.Area= 6,597 sf Storage= 9,452 cf

Plug-Flow detention time= 162.7 min calculated for 0.406 af (70% of inflow)
Center-of-Mass det. time= 69.1 min (874.3 - 805.2)

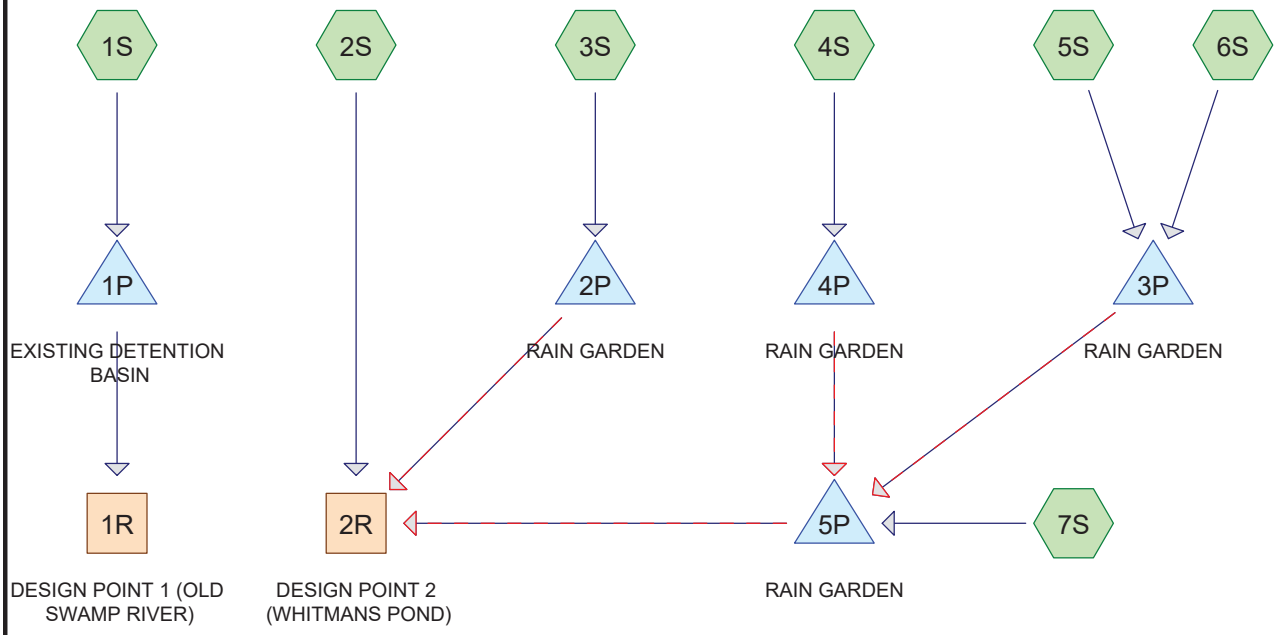
Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.62 cfs @ 12.17 hrs HW=78.88' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 5.62 cfs @ 1.43 fps)

Post-Development HydroCAD Report



Subcat Reach Pond Link

Routing Diagram for Post-Development Watershed
Prepared by Tetra Tech, Inc., Printed 1/29/2021

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.080	61	>75% Grass cover, Good, HSG B (1S, 2S, 3S, 4S, 6S, 7S)
0.070	96	Gravel surface, HSG B (2S, 4S, 6S)
2.740	98	Paved parking, HSG B (1S, 3S, 4S)
0.530	98	Roofs, HSG A (5S)
0.710	36	Woods, Fair, HSG A (1S, 2S)
5.130	**82**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Runoff Area=1.230 ac 60.98% Impervious Runoff Depth=1.47"
Tc=6.0 min CN=79 Runoff=2.09 cfs 0.150 af

Subcatchment 2S: Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=0.14"
Tc=6.0 min CN=49 Runoff=0.03 cfs 0.012 af

Subcatchment 3S: Runoff Area=1.030 ac 87.38% Impervious Runoff Depth=2.61"
Tc=6.0 min CN=93 Runoff=3.04 cfs 0.224 af

Subcatchment 4S: Runoff Area=1.190 ac 91.60% Impervious Runoff Depth=2.92"
Tc=6.0 min CN=96 Runoff=3.78 cfs 0.289 af

Subcatchment 5S: Runoff Area=0.530 ac 100.00% Impervious Runoff Depth=3.14"
Tc=6.0 min CN=98 Runoff=1.74 cfs 0.139 af

Subcatchment 6S: Runoff Area=0.050 ac 0.00% Impervious Runoff Depth=0.83"
Tc=6.0 min CN=68 Runoff=0.04 cfs 0.003 af

Subcatchment 7S: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=0.52"
Tc=6.0 min CN=61 Runoff=0.04 cfs 0.004 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=0.00 cfs 0.000 af
Outflow=0.00 cfs 0.000 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=5.89 cfs 0.652 af
Outflow=5.89 cfs 0.652 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.40' Storage=6,544 cf Inflow=2.09 cfs 0.150 af
Outflow=0.00 cfs 0.000 af

Pond 2P: RAIN GARDEN Peak Elev=78.52' Storage=648 cf Inflow=3.04 cfs 0.224 af
Primary=2.79 cfs 0.219 af Secondary=0.00 cfs 0.000 af Outflow=2.79 cfs 0.219 af

Pond 3P: RAIN GARDEN Peak Elev=78.28' Storage=325 cf Inflow=1.78 cfs 0.142 af
Primary=1.48 cfs 0.142 af Secondary=0.00 cfs 0.000 af Outflow=1.48 cfs 0.142 af

Pond 4P: RAIN GARDEN Peak Elev=78.72' Storage=582 cf Inflow=3.78 cfs 0.289 af
Primary=3.00 cfs 0.289 af Secondary=0.00 cfs 0.000 af Outflow=3.00 cfs 0.289 af

Pond 5P: RAIN GARDEN Peak Elev=78.22' Storage=2,454 cf Inflow=4.49 cfs 0.434 af
Primary=3.38 cfs 0.422 af Secondary=0.00 cfs 0.000 af Outflow=3.38 cfs 0.422 af

Total Runoff Area = 5.130 ac Runoff Volume = 0.821 af Average Runoff Depth = 1.92"
36.26% Pervious = 1.860 ac 63.74% Impervious = 3.270 ac

Summary for Subcatchment 1S:

Runoff = 2.09 cfs @ 12.09 hrs, Volume= 0.150 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.750	98	Paved parking, HSG B
0.270	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.230	79	Weighted Average
0.480		39.02% Pervious Area
0.750		60.98% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 0.03 cfs @ 12.46 hrs, Volume= 0.012 af, Depth= 0.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.020	96	Gravel surface, HSG B
0.490	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
1.010	49	Weighted Average
1.010		100.00% Pervious Area

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

Summary for Subcatchment 3S:

Runoff = 3.04 cfs @ 12.09 hrs, Volume= 0.224 af, Depth= 2.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.900	98	Paved parking, HSG B
0.130	61	>75% Grass cover, Good, HSG B
1.030	93	Weighted Average
0.130		12.62% Pervious Area
0.900		87.38% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 3.78 cfs @ 12.08 hrs, Volume= 0.289 af, Depth= 2.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
1.090	98	Paved parking, HSG B
0.040	96	Gravel surface, HSG B
0.060	61	>75% Grass cover, Good, HSG B
1.190	96	Weighted Average
0.100		8.40% Pervious Area
1.090		91.60% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 1.74 cfs @ 12.08 hrs, Volume= 0.139 af, Depth= 3.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.530	98	Roofs, HSG A
0.530		100.00% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.04 cfs @ 12.10 hrs, Volume= 0.003 af, Depth= 0.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.010	96	Gravel surface, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.050	68	Weighted Average
0.050		100.00% Pervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.04 cfs @ 12.12 hrs, Volume= 0.004 af, Depth= 0.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 YEAR Rainfall=3.37"

Area (ac)	CN	Description
0.090	61	>75% Grass cover, Good, HSG B
0.090		100.00% Pervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 0.00" for 2 YEAR event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.900 ac, 64.62% Impervious, Inflow Depth = 2.01" for 2 YEAR event
Inflow = 5.89 cfs @ 12.15 hrs, Volume= 0.652 af
Outflow = 5.89 cfs @ 12.15 hrs, Volume= 0.652 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 1.47" for 2 YEAR event
Inflow = 2.09 cfs @ 12.09 hrs, Volume= 0.150 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 78.40' @ 24.34 hrs Surf.Area= 5,443 sf Storage= 6,544 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=75.60' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: RAIN GARDEN

Inflow Area = 1.030 ac, 87.38% Impervious, Inflow Depth = 2.61" for 2 YEAR event
Inflow = 3.04 cfs @ 12.09 hrs, Volume= 0.224 af
Outflow = 2.79 cfs @ 12.12 hrs, Volume= 0.219 af, Atten= 8%, Lag= 2.1 min
Primary = 2.79 cfs @ 12.12 hrs, Volume= 0.219 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.52' @ 12.12 hrs Surf.Area= 521 sf Storage= 648 cf

Plug-Flow detention time= 27.7 min calculated for 0.219 af (98% of inflow)
Center-of-Mass det. time= 13.7 min (804.6 - 790.9)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	1,420 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	70	0	0
77.00	195	133	133
78.00	370	283	415
79.00	660	515	930
79.50	1,300	490	1,420

Device	Routing	Invert	Outlet Devices
#1	Primary	77.40'	**12.0" Round Culvert** L= 3.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.40' / 77.30' S= 0.0333 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Secondary	79.10'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=2.79 cfs @ 12.12 hrs HW=78.52' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Barrel Controls 2.79 cfs @ 3.96 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 3P: RAIN GARDEN

Inflow Area = 0.580 ac, 91.38% Impervious, Inflow Depth = 2.94" for 2 YEAR event
Inflow = 1.78 cfs @ 12.08 hrs, Volume= 0.142 af
Outflow = 1.48 cfs @ 12.09 hrs, Volume= 0.142 af, Atten= 17%, Lag= 0.6 min
Primary = 1.48 cfs @ 12.09 hrs, Volume= 0.142 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.28' @ 12.21 hrs Surf.Area= 393 sf Storage= 325 cf

Plug-Flow detention time= 7.4 min calculated for 0.142 af (100% of inflow)
Center-of-Mass det. time= 6.5 min (764.8 - 758.3)

Volume	Invert	Avail.Storage	Storage Description
#1	77.00'	3,355 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
77.00	130	0	0
78.00	320	225	225
79.00	580	450	675
80.00	900	740	1,415
81.00	1,320	1,110	2,525
81.50	2,000	830	3,355

Device	Routing	Invert	Outlet Devices
#1	Primary	77.05'	**12.0" Round Culvert** L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.05' / 76.80' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.31 cfs @ 12.09 hrs HW=78.14' TW=77.99' (Dynamic Tailwater)
1=Culvert (Outlet Controls 1.31 cfs @ 1.91 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=77.00' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: RAIN GARDEN

Inflow Area = 1.190 ac, 91.60% Impervious, Inflow Depth = 2.92" for 2 YEAR event
Inflow = 3.78 cfs @ 12.08 hrs, Volume= 0.289 af
Outflow = 3.00 cfs @ 12.11 hrs, Volume= 0.289 af, Atten= 20%, Lag= 1.8 min
Primary = 3.00 cfs @ 12.11 hrs, Volume= 0.289 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.72' @ 12.15 hrs Surf.Area= 550 sf Storage= 582 cf

Plug-Flow detention time= 6.0 min calculated for 0.289 af (100% of inflow)
Center-of-Mass det. time= 4.6 min (777.2 - 772.6)

Volume	Invert	Avail.Storage	Storage Description
#1	76.50'	5,140 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.50	0	0	0
77.00	120	30	30
78.00	340	230	260
79.00	630	485	745
80.00	990	810	1,555
81.00	3,000	1,995	3,550
81.50	3,360	1,590	5,140

Device	Routing	Invert	Outlet Devices
#1	Primary	76.95'	**12.0" Round Culvert** L= 33.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.95' / 76.78' S= 0.0052 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.91 cfs @ 12.11 hrs HW=78.66' TW=78.07' (Dynamic Tailwater)
1=Culvert (Inlet Controls 2.91 cfs @ 3.71 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.50' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 5P: RAIN GARDEN

Inflow Area = 1.860 ac, 87.10% Impervious, Inflow Depth = 2.80" for 2 YEAR event
Inflow = 4.49 cfs @ 12.10 hrs, Volume= 0.434 af
Outflow = 3.38 cfs @ 12.21 hrs, Volume= 0.422 af, Atten= 25%, Lag= 6.3 min
Primary = 3.38 cfs @ 12.21 hrs, Volume= 0.422 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.22' @ 12.21 hrs Surf.Area= 1,705 sf Storage= 2,454 cf

Plug-Flow detention time= 47.6 min calculated for 0.422 af (97% of inflow)
Center-of-Mass det. time= 29.5 min (803.8 - 774.3)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	5,231 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	560	0	0
77.00	1,030	795	795
78.00	1,570	1,300	2,095
79.00	2,185	1,878	3,973
79.50	2,850	1,259	5,231

Device	Routing	Invert	Outlet Devices
#1	Primary	76.75'	**12.0" Round Culvert** L= 18.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.75' / 76.65' S= 0.0056 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	79.10'	**70.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=3.38 cfs @ 12.21 hrs HW=78.22' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 3.38 cfs @ 4.30 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Runoff Area=1.230 ac 60.98% Impervious Runoff Depth=2.94"
Tc=6.0 min CN=79 Runoff=4.24 cfs 0.301 af

Subcatchment 2S: Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=0.70"
Tc=6.0 min CN=49 Runoff=0.51 cfs 0.059 af

Subcatchment 3S: Runoff Area=1.030 ac 87.38% Impervious Runoff Depth=4.36"
Tc=6.0 min CN=93 Runoff=4.93 cfs 0.374 af

Subcatchment 4S: Runoff Area=1.190 ac 91.60% Impervious Runoff Depth=4.69"
Tc=6.0 min CN=96 Runoff=5.92 cfs 0.465 af

Subcatchment 5S: Runoff Area=0.530 ac 100.00% Impervious Runoff Depth=4.92"
Tc=6.0 min CN=98 Runoff=2.68 cfs 0.217 af

Subcatchment 6S: Runoff Area=0.050 ac 0.00% Impervious Runoff Depth=1.99"
Tc=6.0 min CN=68 Runoff=0.11 cfs 0.008 af

Subcatchment 7S: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=1.47"
Tc=6.0 min CN=61 Runoff=0.14 cfs 0.011 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=0.38 cfs 0.125 af
Outflow=0.38 cfs 0.125 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=9.02 cfs 1.116 af
Outflow=9.02 cfs 1.116 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.65' Storage=7,967 cf Inflow=4.24 cfs 0.301 af
Outflow=0.38 cfs 0.125 af

Pond 2P: RAIN GARDEN Peak Elev=79.10' Storage=1,006 cf Inflow=4.93 cfs 0.374 af
Primary=4.15 cfs 0.369 af Secondary=0.02 cfs 0.000 af Outflow=4.17 cfs 0.369 af

Pond 3P: RAIN GARDEN Peak Elev=78.88' Storage=606 cf Inflow=2.79 cfs 0.226 af
Primary=2.07 cfs 0.226 af Secondary=0.00 cfs 0.000 af Outflow=2.07 cfs 0.226 af

Pond 4P: RAIN GARDEN Peak Elev=79.75' Storage=1,314 cf Inflow=5.92 cfs 0.465 af
Primary=4.09 cfs 0.465 af Secondary=0.00 cfs 0.000 af Outflow=4.09 cfs 0.465 af

Pond 5P: RAIN GARDEN Peak Elev=78.76' Storage=3,475 cf Inflow=6.26 cfs 0.701 af
Primary=4.65 cfs 0.689 af Secondary=0.00 cfs 0.000 af Outflow=4.65 cfs 0.689 af

Total Runoff Area = 5.130 ac Runoff Volume = 1.436 af Average Runoff Depth = 3.36"
36.26% Pervious = 1.860 ac 63.74% Impervious = 3.270 ac

Summary for Subcatchment 1S:

Runoff = 4.24 cfs @ 12.09 hrs, Volume= 0.301 af, Depth= 2.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.750	98	Paved parking, HSG B
0.270	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.230	79	Weighted Average
0.480		39.02% Pervious Area
0.750		60.98% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 0.51 cfs @ 12.12 hrs, Volume= 0.059 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.020	96	Gravel surface, HSG B
0.490	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
1.010	49	Weighted Average
1.010		100.00% Pervious Area

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

Summary for Subcatchment 3S:

Runoff = 4.93 cfs @ 12.08 hrs, Volume= 0.374 af, Depth= 4.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.900	98	Paved parking, HSG B
0.130	61	>75% Grass cover, Good, HSG B
1.030	93	Weighted Average
0.130		12.62% Pervious Area
0.900		87.38% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 5.92 cfs @ 12.08 hrs, Volume= 0.465 af, Depth= 4.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
1.090	98	Paved parking, HSG B
0.040	96	Gravel surface, HSG B
0.060	61	>75% Grass cover, Good, HSG B
1.190	96	Weighted Average
0.100		8.40% Pervious Area
1.090		91.60% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 2.68 cfs @ 12.08 hrs, Volume= 0.217 af, Depth= 4.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.530	98	Roofs, HSG A
0.530		100.00% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.11 cfs @ 12.09 hrs, Volume= 0.008 af, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.010	96	Gravel surface, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.050	68	Weighted Average
0.050		100.00% Pervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.14 cfs @ 12.10 hrs, Volume= 0.011 af, Depth= 1.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 YEAR Rainfall=5.16"

Area (ac)	CN	Description
0.090	61	>75% Grass cover, Good, HSG B
0.090		100.00% Pervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 1.22" for 10 YEAR event
Inflow = 0.38 cfs @ 13.11 hrs, Volume= 0.125 af
Outflow = 0.38 cfs @ 13.11 hrs, Volume= 0.125 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.900 ac, 64.62% Impervious, Inflow Depth = 3.43" for 10 YEAR event
Inflow = 9.02 cfs @ 12.16 hrs, Volume= 1.116 af
Outflow = 9.02 cfs @ 12.16 hrs, Volume= 1.116 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 2.94" for 10 YEAR event
Inflow = 4.24 cfs @ 12.09 hrs, Volume= 0.301 af
Outflow = 0.38 cfs @ 13.11 hrs, Volume= 0.125 af, Atten= 91%, Lag= 61.2 min
Primary = 0.38 cfs @ 13.11 hrs, Volume= 0.125 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 78.65' @ 13.11 hrs Surf.Area= 6,035 sf Storage= 7,967 cf

Plug-Flow detention time= 292.1 min calculated for 0.125 af (41% of inflow)
Center-of-Mass det. time= 171.0 min (994.1 - 823.1)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=0.38 cfs @ 13.11 hrs HW=78.65' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.38 cfs @ 0.58 fps)

Summary for Pond 2P: RAIN GARDEN

Inflow Area = 1.030 ac, 87.38% Impervious, Inflow Depth = 4.36" for 10 YEAR event
Inflow = 4.93 cfs @ 12.08 hrs, Volume= 0.374 af
Outflow = 4.17 cfs @ 12.13 hrs, Volume= 0.369 af, Atten= 16%, Lag= 3.0 min
Primary = 4.15 cfs @ 12.13 hrs, Volume= 0.369 af
Secondary = 0.02 cfs @ 12.13 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.10' @ 12.13 hrs Surf.Area= 793 sf Storage= 1,006 cf

Plug-Flow detention time= 19.6 min calculated for 0.369 af (99% of inflow)
Center-of-Mass det. time= 10.9 min (788.2 - 777.3)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	1,420 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	70	0	0
77.00	195	133	133
78.00	370	283	415
79.00	660	515	930
79.50	1,300	490	1,420

Device	Routing	Invert	Outlet Devices
#1	Primary	77.40'	**12.0" Round Culvert** L= 3.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.40' / 77.30' S= 0.0333 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Secondary	79.10'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.15 cfs @ 12.13 hrs HW=79.10' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 4.15 cfs @ 5.28 fps)

Secondary OutFlow Max=0.01 cfs @ 12.13 hrs HW=79.10' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.13 fps)

Summary for Pond 3P: RAIN GARDEN

Inflow Area = 0.580 ac, 91.38% Impervious, Inflow Depth = 4.67" for 10 YEAR event
Inflow = 2.79 cfs @ 12.08 hrs, Volume= 0.226 af
Outflow = 2.07 cfs @ 12.10 hrs, Volume= 0.226 af, Atten= 26%, Lag= 1.3 min
Primary = 2.07 cfs @ 12.10 hrs, Volume= 0.226 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.88' @ 12.24 hrs Surf.Area= 548 sf Storage= 606 cf

Plug-Flow detention time= 6.8 min calculated for 0.226 af (100% of inflow)
Center-of-Mass det. time= 6.2 min (757.5 - 751.3)

Volume	Invert	Avail.Storage	Storage Description
#1	77.00'	3,355 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
77.00	130	0	0
78.00	320	225	225
79.00	580	450	675
80.00	900	740	1,415
81.00	1,320	1,110	2,525
81.50	2,000	830	3,355

Device	Routing	Invert	Outlet Devices
#1	Primary	77.05'	**12.0" Round Culvert** L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.05' / 76.80' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.91 cfs @ 12.10 hrs HW=78.70' TW=78.44' (Dynamic Tailwater)
1=Culvert (Outlet Controls 1.91 cfs @ 2.43 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=77.00' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: RAIN GARDEN

Inflow Area = 1.190 ac, 91.60% Impervious, Inflow Depth = 4.69" for 10 YEAR event
Inflow = 5.92 cfs @ 12.08 hrs, Volume= 0.465 af
Outflow = 4.09 cfs @ 12.13 hrs, Volume= 0.465 af, Atten= 31%, Lag= 2.9 min
Primary = 4.09 cfs @ 12.13 hrs, Volume= 0.465 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.75' @ 12.17 hrs Surf.Area= 898 sf Storage= 1,314 cf

Plug-Flow detention time= 5.3 min calculated for 0.465 af (100% of inflow)
Center-of-Mass det. time= 4.5 min (766.2 - 761.6)

Volume	Invert	Avail.Storage	Storage Description
#1	76.50'	5,140 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.50	0	0	0
77.00	120	30	30
78.00	340	230	260
79.00	630	485	745
80.00	990	810	1,555
81.00	3,000	1,995	3,550
81.50	3,360	1,590	5,140

Device	Routing	Invert	Outlet Devices
#1	Primary	76.95'	**12.0" Round Culvert** L= 33.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.95' / 76.78' S= 0.0052 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.02 cfs @ 12.13 hrs HW=79.68' TW=78.55' (Dynamic Tailwater)
1=Culvert (Inlet Controls 4.02 cfs @ 5.11 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.50' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 5P: RAIN GARDEN

Inflow Area = 1.860 ac, 87.10% Impervious, Inflow Depth = 4.52" for 10 YEAR event
Inflow = 6.26 cfs @ 12.12 hrs, Volume= 0.701 af
Outflow = 4.65 cfs @ 12.26 hrs, Volume= 0.689 af, Atten= 26%, Lag= 8.8 min
Primary = 4.65 cfs @ 12.26 hrs, Volume= 0.689 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 78.76' @ 12.26 hrs Surf.Area= 2,040 sf Storage= 3,475 cf

Plug-Flow detention time= 35.8 min calculated for 0.689 af (98% of inflow)
Center-of-Mass det. time= 24.0 min (789.0 - 765.0)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	5,231 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	560	0	0
77.00	1,030	795	795
78.00	1,570	1,300	2,095
79.00	2,185	1,878	3,973
79.50	2,850	1,259	5,231

Device	Routing	Invert	Outlet Devices
#1	Primary	76.75'	**12.0" Round Culvert** L= 18.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.75' / 76.65' S= 0.0056 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	79.10'	**70.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.65 cfs @ 12.26 hrs HW=78.76' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 4.65 cfs @ 5.92 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.00' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Runoff Area=1.230 ac 60.98% Impervious Runoff Depth=3.93"
Tc=6.0 min CN=79 Runoff=5.65 cfs 0.403 af

Subcatchment 2S: Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=1.21"
Tc=6.0 min CN=49 Runoff=1.13 cfs 0.102 af

Subcatchment 3S: Runoff Area=1.030 ac 87.38% Impervious Runoff Depth=5.46"
Tc=6.0 min CN=93 Runoff=6.10 cfs 0.469 af

Subcatchment 4S: Runoff Area=1.190 ac 91.60% Impervious Runoff Depth=5.81"
Tc=6.0 min CN=96 Runoff=7.25 cfs 0.576 af

Subcatchment 5S: Runoff Area=0.530 ac 100.00% Impervious Runoff Depth=6.04"
Tc=6.0 min CN=98 Runoff=3.26 cfs 0.267 af

Subcatchment 6S: Runoff Area=0.050 ac 0.00% Impervious Runoff Depth=2.84"
Tc=6.0 min CN=68 Runoff=0.17 cfs 0.012 af

Subcatchment 7S: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=2.20"
Tc=6.0 min CN=61 Runoff=0.22 cfs 0.016 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=1.85 cfs 0.226 af
Outflow=1.85 cfs 0.226 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=11.61 cfs 1.422 af
Outflow=11.61 cfs 1.422 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.73' Storage=8,505 cf Inflow=5.65 cfs 0.403 af
Outflow=1.85 cfs 0.226 af

Pond 2P: RAIN GARDEN Peak Elev=79.17' Storage=1,060 cf Inflow=6.10 cfs 0.469 af
Primary=4.26 cfs 0.453 af Secondary=1.83 cfs 0.010 af Outflow=6.09 cfs 0.463 af

Pond 3P: RAIN GARDEN Peak Elev=79.24' Storage=824 cf Inflow=3.43 cfs 0.279 af
Primary=2.44 cfs 0.279 af Secondary=0.00 cfs 0.000 af Outflow=2.44 cfs 0.279 af

Pond 4P: RAIN GARDEN Peak Elev=80.29' Storage=1,925 cf Inflow=7.25 cfs 0.576 af
Primary=4.57 cfs 0.575 af Secondary=0.00 cfs 0.000 af Outflow=4.57 cfs 0.575 af

Pond 5P: RAIN GARDEN Peak Elev=79.11' Storage=4,210 cf Inflow=7.21 cfs 0.870 af
Primary=5.15 cfs 0.857 af Secondary=0.07 cfs 0.000 af Outflow=5.22 cfs 0.857 af

Total Runoff Area = 5.130 ac Runoff Volume = 1.844 af Average Runoff Depth = 4.31"
36.26% Pervious = 1.860 ac 63.74% Impervious = 3.270 ac

Summary for Subcatchment 1S:

Runoff = 5.65 cfs @ 12.09 hrs, Volume= 0.403 af, Depth= 3.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.750	98	Paved parking, HSG B
0.270	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.230	79	Weighted Average
0.480		39.02% Pervious Area
0.750		60.98% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 1.13 cfs @ 12.11 hrs, Volume= 0.102 af, Depth= 1.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.020	96	Gravel surface, HSG B
0.490	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
1.010	49	Weighted Average
1.010		100.00% Pervious Area

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

Summary for Subcatchment 3S:

Runoff = 6.10 cfs @ 12.08 hrs, Volume= 0.469 af, Depth= 5.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.900	98	Paved parking, HSG B
0.130	61	>75% Grass cover, Good, HSG B
1.030	93	Weighted Average
0.130		12.62% Pervious Area
0.900		87.38% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 7.25 cfs @ 12.08 hrs, Volume= 0.576 af, Depth= 5.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
1.090	98	Paved parking, HSG B
0.040	96	Gravel surface, HSG B
0.060	61	>75% Grass cover, Good, HSG B
1.190	96	Weighted Average
0.100		8.40% Pervious Area
1.090		91.60% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 3.26 cfs @ 12.08 hrs, Volume= 0.267 af, Depth= 6.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.530	98	Roofs, HSG A
0.530		100.00% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.17 cfs @ 12.09 hrs, Volume= 0.012 af, Depth= 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.010	96	Gravel surface, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.050	68	Weighted Average
0.050		100.00% Pervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.22 cfs @ 12.09 hrs, Volume= 0.016 af, Depth= 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 YEAR Rainfall=6.28"

Area (ac)	CN	Description
0.090	61	>75% Grass cover, Good, HSG B
0.090		100.00% Pervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 2.21" for 25 YEAR event
Inflow = 1.85 cfs @ 12.40 hrs, Volume= 0.226 af
Outflow = 1.85 cfs @ 12.40 hrs, Volume= 0.226 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.900 ac, 64.62% Impervious, Inflow Depth = 4.38" for 25 YEAR event
Inflow = 11.61 cfs @ 12.10 hrs, Volume= 1.422 af
Outflow = 11.61 cfs @ 12.10 hrs, Volume= 1.422 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 3.93" for 25 YEAR event
Inflow = 5.65 cfs @ 12.09 hrs, Volume= 0.403 af
Outflow = 1.85 cfs @ 12.40 hrs, Volume= 0.226 af, Atten= 67%, Lag= 18.8 min
Primary = 1.85 cfs @ 12.40 hrs, Volume= 0.226 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 78.73' @ 12.40 hrs Surf.Area= 6,245 sf Storage= 8,505 cf

Plug-Flow detention time= 214.7 min calculated for 0.226 af (56% of inflow)
Center-of-Mass det. time= 105.8 min (920.6 - 814.8)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=1.85 cfs @ 12.40 hrs HW=78.73' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.85 cfs @ 0.98 fps)

Summary for Pond 2P: RAIN GARDEN

Inflow Area = 1.030 ac, 87.38% Impervious, Inflow Depth = 5.46" for 25 YEAR event
Inflow = 6.10 cfs @ 12.08 hrs, Volume= 0.469 af
Outflow = 6.09 cfs @ 12.09 hrs, Volume= 0.463 af, Atten= 0%, Lag= 0.6 min
Primary = 4.26 cfs @ 12.09 hrs, Volume= 0.453 af
Secondary = 1.83 cfs @ 12.09 hrs, Volume= 0.010 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.17' @ 12.09 hrs Surf.Area= 877 sf Storage= 1,060 cf

Plug-Flow detention time= 16.8 min calculated for 0.463 af (99% of inflow)
Center-of-Mass det. time= 9.7 min (781.4 - 771.7)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	1,420 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	70	0	0
77.00	195	133	133
78.00	370	283	415
79.00	660	515	930
79.50	1,300	490	1,420

Device	Routing	Invert	Outlet Devices
#1	Primary	77.40'	**12.0" Round Culvert** L= 3.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.40' / 77.30' S= 0.0333 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Secondary	79.10'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.26 cfs @ 12.09 hrs HW=79.17' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 4.26 cfs @ 5.42 fps)

Secondary OutFlow Max=1.80 cfs @ 12.09 hrs HW=79.17' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 1.80 cfs @ 0.65 fps)

Summary for Pond 3P: RAIN GARDEN

Inflow Area = 0.580 ac, 91.38% Impervious, Inflow Depth = 5.77" for 25 YEAR event
Inflow = 3.43 cfs @ 12.08 hrs, Volume= 0.279 af
Outflow = 2.44 cfs @ 12.11 hrs, Volume= 0.279 af, Atten= 29%, Lag= 1.5 min
Primary = 2.44 cfs @ 12.11 hrs, Volume= 0.279 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.24' @ 12.28 hrs Surf.Area= 657 sf Storage= 824 cf

Plug-Flow detention time= 6.7 min calculated for 0.278 af (100% of inflow)
Center-of-Mass det. time= 6.4 min (754.9 - 748.6)

Volume	Invert	Avail.Storage	Storage Description
#1	77.00'	3,355 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
77.00	130	0	0
78.00	320	225	225
79.00	580	450	675
80.00	900	740	1,415
81.00	1,320	1,110	2,525
81.50	2,000	830	3,355

Device	Routing	Invert	Outlet Devices
#1	Primary	77.05'	**12.0" Round Culvert** L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.05' / 76.80' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.30 cfs @ 12.11 hrs HW=79.05' TW=78.68' (Dynamic Tailwater)
1=Culvert (Outlet Controls 2.30 cfs @ 2.93 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=77.00' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: RAIN GARDEN

Inflow Area = 1.190 ac, 91.60% Impervious, Inflow Depth = 5.81" for 25 YEAR event
Inflow = 7.25 cfs @ 12.08 hrs, Volume= 0.576 af
Outflow = 4.57 cfs @ 12.13 hrs, Volume= 0.575 af, Atten= 37%, Lag= 2.7 min
Primary = 4.57 cfs @ 12.13 hrs, Volume= 0.575 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 80.29' @ 12.18 hrs Surf.Area= 1,571 sf Storage= 1,925 cf

Plug-Flow detention time= 5.5 min calculated for 0.575 af (100% of inflow)
Center-of-Mass det. time= 4.8 min (762.1 - 757.2)

Volume	Invert	Avail.Storage	Storage Description
#1	76.50'	5,140 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.50	0	0	0
77.00	120	30	30
78.00	340	230	260
79.00	630	485	745
80.00	990	810	1,555
81.00	3,000	1,995	3,550
81.50	3,360	1,590	5,140

Device	Routing	Invert	Outlet Devices
#1	Primary	76.95'	**12.0" Round Culvert** L= 33.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.95' / 76.78' S= 0.0052 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.49 cfs @ 12.13 hrs HW=80.18' TW=78.77' (Dynamic Tailwater)
1=Culvert (Inlet Controls 4.49 cfs @ 5.72 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.50' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 5P: RAIN GARDEN

Inflow Area = 1.860 ac, 87.10% Impervious, Inflow Depth = 5.61" for 25 YEAR event
Inflow = 7.21 cfs @ 12.12 hrs, Volume= 0.870 af
Outflow = 5.22 cfs @ 12.31 hrs, Volume= 0.857 af, Atten= 28%, Lag= 11.4 min
Primary = 5.15 cfs @ 12.31 hrs, Volume= 0.857 af
Secondary = 0.07 cfs @ 12.31 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.11' @ 12.31 hrs Surf.Area= 2,325 sf Storage= 4,210 cf

Plug-Flow detention time= 31.8 min calculated for 0.857 af (99% of inflow)
Center-of-Mass det. time= 22.1 min (783.7 - 761.6)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	5,231 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	560	0	0
77.00	1,030	795	795
78.00	1,570	1,300	2,095
79.00	2,185	1,878	3,973
79.50	2,850	1,259	5,231

Device	Routing	Invert	Outlet Devices
#1	Primary	76.75'	**12.0" Round Culvert** L= 18.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.75' / 76.65' S= 0.0056 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	79.10'	**70.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.15 cfs @ 12.31 hrs HW=79.11' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 5.15 cfs @ 6.56 fps)

Secondary OutFlow Max=0.07 cfs @ 12.31 hrs HW=79.11' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.07 cfs @ 0.19 fps)

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Runoff Area=1.230 ac 60.98% Impervious Runoff Depth=5.51"
Tc=6.0 min CN=79 Runoff=7.84 cfs 0.565 af

Subcatchment 2S: Runoff Area=1.010 ac 0.00% Impervious Runoff Depth=2.15"
Tc=6.0 min CN=49 Runoff=2.30 cfs 0.181 af

Subcatchment 3S: Runoff Area=1.030 ac 87.38% Impervious Runoff Depth=7.16"
Tc=6.0 min CN=93 Runoff=7.89 cfs 0.615 af

Subcatchment 4S: Runoff Area=1.190 ac 91.60% Impervious Runoff Depth=7.52"
Tc=6.0 min CN=96 Runoff=9.28 cfs 0.746 af

Subcatchment 5S: Runoff Area=0.530 ac 100.00% Impervious Runoff Depth=7.76"
Tc=6.0 min CN=98 Runoff=4.16 cfs 0.343 af

Subcatchment 6S: Runoff Area=0.050 ac 0.00% Impervious Runoff Depth=4.24"
Tc=6.0 min CN=68 Runoff=0.25 cfs 0.018 af

Subcatchment 7S: Runoff Area=0.090 ac 0.00% Impervious Runoff Depth=3.44"
Tc=6.0 min CN=61 Runoff=0.36 cfs 0.026 af

Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER) Inflow=5.23 cfs 0.388 af
Outflow=5.23 cfs 0.388 af

Reach 2R: DESIGN POINT 2 (WHITMANS POND) Inflow=15.41 cfs 1.909 af
Outflow=15.41 cfs 1.909 af

Pond 1P: EXISTING DETENTION BASIN Peak Elev=78.87' Storage=9,363 cf Inflow=7.84 cfs 0.565 af
Outflow=5.23 cfs 0.388 af

Pond 2P: RAIN GARDEN Peak Elev=79.21' Storage=1,095 cf Inflow=7.89 cfs 0.615 af
Primary=4.33 cfs 0.576 af Secondary=3.55 cfs 0.033 af Outflow=7.87 cfs 0.610 af

Pond 3P: RAIN GARDEN Peak Elev=79.73' Storage=1,186 cf Inflow=4.41 cfs 0.360 af
Primary=2.94 cfs 0.360 af Secondary=0.00 cfs 0.000 af Outflow=2.94 cfs 0.360 af

Pond 4P: RAIN GARDEN Peak Elev=80.85' Storage=3,136 cf Inflow=9.28 cfs 0.746 af
Primary=4.92 cfs 0.745 af Secondary=0.00 cfs 0.000 af Outflow=4.92 cfs 0.745 af

Pond 5P: RAIN GARDEN Peak Elev=79.16' Storage=4,339 cf Inflow=8.17 cfs 1.131 af
Primary=5.23 cfs 1.068 af Secondary=2.74 cfs 0.051 af Outflow=7.97 cfs 1.119 af

Total Runoff Area = 5.130 ac Runoff Volume = 2.492 af Average Runoff Depth = 5.83"
36.26% Pervious = 1.860 ac 63.74% Impervious = 3.270 ac

Summary for Subcatchment 1S:

Runoff = 7.84 cfs @ 12.09 hrs, Volume= 0.565 af, Depth= 5.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.750	98	Paved parking, HSG B
0.270	61	>75% Grass cover, Good, HSG B
0.210	36	Woods, Fair, HSG A
1.230	79	Weighted Average
0.480		39.02% Pervious Area
0.750		60.98% Impervious Area

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

Summary for Subcatchment 2S:

Runoff = 2.30 cfs @ 12.10 hrs, Volume= 0.181 af, Depth= 2.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.020	96	Gravel surface, HSG B
0.490	61	>75% Grass cover, Good, HSG B
0.500	36	Woods, Fair, HSG A
1.010	49	Weighted Average
1.010		100.00% Pervious Area

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

Summary for Subcatchment 3S:

Runoff = 7.89 cfs @ 12.08 hrs, Volume= 0.615 af, Depth= 7.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.900	98	Paved parking, HSG B
0.130	61	>75% Grass cover, Good, HSG B
1.030	93	Weighted Average
0.130		12.62% Pervious Area
0.900		87.38% Impervious Area

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

Summary for Subcatchment 4S:

Runoff = 9.28 cfs @ 12.08 hrs, Volume= 0.746 af, Depth= 7.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
1.090	98	Paved parking, HSG B
0.040	96	Gravel surface, HSG B
0.060	61	>75% Grass cover, Good, HSG B
1.190	96	Weighted Average
0.100		8.40% Pervious Area
1.090		91.60% Impervious Area

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

Summary for Subcatchment 5S:

Runoff = 4.16 cfs @ 12.08 hrs, Volume= 0.343 af, Depth= 7.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.530	98	Roofs, HSG A
0.530		100.00% Impervious Area

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

Summary for Subcatchment 6S:

Runoff = 0.25 cfs @ 12.09 hrs, Volume= 0.018 af, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.010	96	Gravel surface, HSG B
0.040	61	>75% Grass cover, Good, HSG B
0.050	68	Weighted Average
0.050		100.00% Pervious Area

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

Summary for Subcatchment 7S:

Runoff = 0.36 cfs @ 12.09 hrs, Volume= 0.026 af, Depth= 3.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 YEAR Rainfall=8.00"

Area (ac)	CN	Description
0.090	61	>75% Grass cover, Good, HSG B
0.090		100.00% Pervious Area

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

Summary for Reach 1R: DESIGN POINT 1 (OLD SWAMP RIVER)

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 3.79" for 100 YEAR event
Inflow = 5.23 cfs @ 12.17 hrs, Volume= 0.388 af
Outflow = 5.23 cfs @ 12.17 hrs, Volume= 0.388 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach 2R: DESIGN POINT 2 (WHITMANS POND)

Inflow Area = 3.900 ac, 64.62% Impervious, Inflow Depth = 5.87" for 100 YEAR event
Inflow = 15.41 cfs @ 12.16 hrs, Volume= 1.909 af
Outflow = 15.41 cfs @ 12.16 hrs, Volume= 1.909 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: EXISTING DETENTION BASIN

Inflow Area = 1.230 ac, 60.98% Impervious, Inflow Depth = 5.51" for 100 YEAR event
Inflow = 7.84 cfs @ 12.09 hrs, Volume= 0.565 af
Outflow = 5.23 cfs @ 12.17 hrs, Volume= 0.388 af, Atten= 33%, Lag= 5.3 min
Primary = 5.23 cfs @ 12.17 hrs, Volume= 0.388 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Peak Elev= 78.87' @ 12.17 hrs Surf.Area= 6,565 sf Storage= 9,363 cf

Plug-Flow detention time= 166.7 min calculated for 0.388 af (69% of inflow)
Center-of-Mass det. time= 71.7 min (877.0 - 805.2)

Volume	Invert	Avail.Storage	Storage Description
#1	75.60'	10,249 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
75.60	0	0	0
76.00	170	34	34
77.00	2,200	1,185	1,219
78.00	4,490	3,345	4,564
79.00	6,880	5,685	10,249

Device	Routing	Invert	Outlet Devices
#1	Primary	78.60'	**14.0' long x 20.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.22 cfs @ 12.17 hrs HW=78.87' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 5.22 cfs @ 1.39 fps)

Summary for Pond 2P: RAIN GARDEN

Inflow Area = 1.030 ac, 87.38% Impervious, Inflow Depth = 7.16" for 100 YEAR event
Inflow = 7.89 cfs @ 12.08 hrs, Volume= 0.615 af
Outflow = 7.87 cfs @ 12.09 hrs, Volume= 0.610 af, Atten= 0%, Lag= 0.3 min
Primary = 4.33 cfs @ 12.09 hrs, Volume= 0.576 af
Secondary = 3.55 cfs @ 12.09 hrs, Volume= 0.033 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.21' @ 12.09 hrs Surf.Area= 927 sf Storage= 1,095 cf

Plug-Flow detention time= 13.9 min calculated for 0.610 af (99% of inflow)
Center-of-Mass det. time= 8.4 min (773.8 - 765.4)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	1,420 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	70	0	0
77.00	195	133	133
78.00	370	283	415
79.00	660	515	930
79.50	1,300	490	1,420

Device	Routing	Invert	Outlet Devices
#1	Primary	77.40'	**12.0" Round Culvert** L= 3.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.40' / 77.30' S= 0.0333 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#2	Secondary	79.10'	**40.0' long x 10.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=4.33 cfs @ 12.09 hrs HW=79.21' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 4.33 cfs @ 5.51 fps)

Secondary OutFlow Max=3.54 cfs @ 12.09 hrs HW=79.21' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 3.54 cfs @ 0.82 fps)

Summary for Pond 3P: RAIN GARDEN

Inflow Area = 0.580 ac, 91.38% Impervious, Inflow Depth = 7.46" for 100 YEAR event
Inflow = 4.41 cfs @ 12.08 hrs, Volume= 0.360 af
Outflow = 2.94 cfs @ 12.12 hrs, Volume= 0.360 af, Atten= 33%, Lag= 2.0 min
Primary = 2.94 cfs @ 12.12 hrs, Volume= 0.360 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.73' @ 12.18 hrs Surf.Area= 815 sf Storage= 1,186 cf

Plug-Flow detention time= 6.5 min calculated for 0.360 af (100% of inflow)
Center-of-Mass det. time= 6.2 min (751.7 - 745.5)

Volume	Invert	Avail.Storage	Storage Description
#1	77.00'	3,355 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
77.00	130	0	0
78.00	320	225	225
79.00	580	450	675
80.00	900	740	1,415
81.00	1,320	1,110	2,525
81.50	2,000	830	3,355

Device	Routing	Invert	Outlet Devices
#1	Primary	77.05'	**12.0" Round Culvert** L= 50.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 77.05' / 76.80' S= 0.0050 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=2.81 cfs @ 12.12 hrs HW=79.58' TW=79.01' (Dynamic Tailwater)
1=Culvert (Outlet Controls 2.81 cfs @ 3.58 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=77.00' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 4P: RAIN GARDEN

Inflow Area = 1.190 ac, 91.60% Impervious, Inflow Depth = 7.52" for 100 YEAR event
Inflow = 9.28 cfs @ 12.08 hrs, Volume= 0.746 af
Outflow = 4.92 cfs @ 12.21 hrs, Volume= 0.745 af, Atten= 47%, Lag= 7.7 min
Primary = 4.92 cfs @ 12.21 hrs, Volume= 0.745 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 80.85' @ 12.21 hrs Surf.Area= 2,708 sf Storage= 3,136 cf

Plug-Flow detention time= 5.8 min calculated for 0.745 af (100% of inflow)
Center-of-Mass det. time= 5.3 min (757.7 - 752.4)

Volume	Invert	Avail.Storage	Storage Description
#1	76.50'	5,140 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.50	0	0	0
77.00	120	30	30
78.00	340	230	260
79.00	630	485	745
80.00	990	810	1,555
81.00	3,000	1,995	3,550
81.50	3,360	1,590	5,140

Device	Routing	Invert	Outlet Devices
#1	Primary	76.95'	**12.0" Round Culvert** L= 33.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.95' / 76.78' S= 0.0052 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	81.10'	**40.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=4.92 cfs @ 12.21 hrs HW=80.85' TW=79.16' (Dynamic Tailwater)
1=Culvert (Inlet Controls 4.92 cfs @ 6.27 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=76.50' TW=76.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 5P: RAIN GARDEN

Inflow Area = 1.860 ac, 87.10% Impervious, Inflow Depth = 7.30" for 100 YEAR event
Inflow = 8.17 cfs @ 12.12 hrs, Volume= 1.131 af
Outflow = 7.97 cfs @ 12.19 hrs, Volume= 1.119 af, Atten= 2%, Lag= 4.4 min
Primary = 5.23 cfs @ 12.19 hrs, Volume= 1.068 af
Secondary = 2.74 cfs @ 12.19 hrs, Volume= 0.051 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 79.16' @ 12.19 hrs Surf.Area= 2,397 sf Storage= 4,339 cf

Plug-Flow detention time= 26.8 min calculated for 1.118 af (99% of inflow)
Center-of-Mass det. time= 19.4 min (777.2 - 757.8)

Volume	Invert	Avail.Storage	Storage Description
#1	76.00'	5,231 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
76.00	560	0	0
77.00	1,030	795	795
78.00	1,570	1,300	2,095
79.00	2,185	1,878	3,973
79.50	2,850	1,259	5,231

Device	Routing	Invert	Outlet Devices
#1	Primary	76.75'	**12.0" Round Culvert** L= 18.0' CPP, end-section conforming to fill, Ke= 0.500 Inlet / Outlet Invert= 76.75' / 76.65' S= 0.0056 '/' Cc= 0.900 n= 0.012, Flow Area= 0.79 sf
#2	Secondary	79.10'	**70.0' long x 15.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=5.23 cfs @ 12.19 hrs HW=79.16' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 5.23 cfs @ 6.65 fps)

Secondary OutFlow Max=2.74 cfs @ 12.19 hrs HW=79.16' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 2.74 cfs @ 0.65 fps)

Appendix D

Water Quality Calculations

TETRA TECH

200 Libbey Industrial Parkway
Quincy, MA

TSS Removal Efficiency Calculations

TSS Removal Calculation Worksheet

BMP	C	D	E	F
	TSS Removal Rate	Starting TSS Load[1]	Amount Removed (C*D)	Remaining Load (D-E)
Street Sweeping - 5%	0.05	1.00	0.05	0.95
Deep Sump and Hooded Catch Basin	0.25	0.95	0.24	0.71
Proprietary Treatment Practice	0.80	0.71	0.57	0.14
	0.00	0.14	0.00	0.14
	0.00	0.14	0.00	0.14

Total TSS Removal = **86%**

Notes:
1.) Equals remaining load from previous BMP (E) which enters the BMP.
2.) Although rain gardens are not included in the TSS calculations they will provide additional TSS removal.

BARRACUDA WQU

PROJECT NAME	CITY	STATE
Libby	Weymouth	MA

PREPARED FOR

TetraTech

CALCULATIONS BASED ON:

MASSACHUSETTS DEPT. OF ENVIRONMENTAL PROTECTION WETLANDS PROGRAM/ US Dept of Agriculture Natural Resource Conservation Service TR-55 Manual
Standard Method to convert required water quality volume to a discharge rate for sizing flow based Manufactured Proprietary Stormwater Treatment Practices
Stormwater Standard No. 4 requires the full WQV be captured and treated to remove 80% of the average annual post-construction TSS (Total Suspended Solids) load

Compute Q Rate using the following equation:
Q= (qu) (A) (WQV)

Where:
Q= flow rate associated with the 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	Imperv. (acres)	A (miles^2)	Tc (min)	Tc (hr)	WQV (in)	qu (csm/in.)	Q (cfs)	Barracuda Unit
WQU 1	0.48	0.00075	5.0	0.08	1	725	0.54	S3
WQU 2	0.9	0.00141	5.0	0.08	1	725	1.02	S4
WQU 3	1.09	0.0017	5.0	0.08	1	725	1.23	S4

Proposed Device Is sized so that the required site WQF is less than the treatment flow at
which the device acheives at least 80% TSS removal. Supporting information attached.

BOGGS ENVIRONMENTAL CONSULTANTS

Middletown, MD & Morgantown, WV

Administrative Office:
200 W Main Street
Middletown, Maryland 21769
Office (301) 694-5687
Fax (301) 694-9799

BaySaver Technologies, LLC
1030 Deer Hollow Drive
Mount Airy, MD 21771
(301) 679-0640; dfigola@ads-pipe.com

April 8, 2019

ATTENTION: Daniel Figola, General Manager
REFERENCE: Third Party Review of Testing Procedures for Barracuda™ Separator at the Mid Atlantic Storm Water Research Center, 1207 Park Ridge Drive, Mount Airy, MD 21771

SUMMARY

Boggs Environmental Consultants, Inc. (BEC) was hired by Advanced Drainage Systems (ADS) in August of 2017, to serve as independent third-party oversight of the BaySaver Barracuda S4 Separator test unit for removal of sediment with equivalent particle size distribution to the industry standard OK-110. The BaySaver Barracuda S4 is a storm water treatment device with a Maximum Treatment Flow Rate (MTFR) of approximately 1.08 cubic feet per second (cfs) that removes suspended solids from storm water runoff, with an average removal efficiency of 80% at the MTFR and a feed concentration of 300 mg/L. The device is an insert that can be installed in either Polypropylene plastic pipe or concrete vault, and consists of a cone (vortex separator) and baffles ("teeth").

SCALED RESULTS

Testing flow rates for the BaySaver Barracuda S4 Separator ranged from 0.31 to 1.61 cfs, with a feed OK-110 concentration of 300 mg/L. Based upon New Jersey scaling methodology, the table below represents treatment and device information for the S3, S4, S5, S6, and S8 units.

Table 1: MTFR's and Sizing for BaySaver Barracuda Models

Model[1]	Man-hole Diam-eter[1] (ft)	OK110 80% TSS Maximum Treatment Flow Rate (cfs)	Treat-ment Area (ft^2)	Hydraulic Loading rate (gpm/ft^2)	Chamber Depth (ft)	Wet Volume (ft^3)	50% Maximum Sediment Storage[2] (ft^3)
Barracuda S3	3	0.61	7.07	38.6	4.83	28.3	5.89
Barracuda S4	4	1.08	12.57	38.6	6.83	75.4	10.47
Barracuda S5	5	1.69	19.63	38.6	6.83	117.8	16.36
Barracuda S6	6	2.43	28.27	38.6	6.83	169.7	23.56
Barracuda S8	8	4.32	50.27	38.6	11.03	512.7	41.89

Notes:
1. In some areas, Barracuda units are available in additional diameters. Units not listed here are sized not to exceed 38.6 gpm/ft^2 of effective treatment during the peak water quality flow.
2. 50% Sediment Storage Capacity is equal to manhole diameter x 10 inches of sediment depth. Each Barracuda unit has a 20 inches deep sediment sump.

Should you have any questions, contact our office at your earliest convenience.

Sincerely,
BOGGS ENVIRONMENTAL CONSULTANTS, INC.
William R. Warfel
Principal Environmental Scientist

Appendix E

Long-Term Pollution Prevention and Stormwater Operation and Maintenance Plan

Long-Term Pollution Prevention and Stormwater Operation & Maintenance Plan

Proposed Medical Office Building
200 Libbey Industrial Parkway
Weymouth, Massachusetts

Submitted to:
Town of Weymouth
Conservation Commission

February 3, 2021

Prepared for:
FoxRock 200 Libbey, LLC
1200 Hancock Street, Suite 301
Quincy, Massachusetts 02169

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1.0 INTRODUCTION

The Long-Term Pollution Prevention (LTPP) and Stormwater Operation and Maintenance (O&M) Plan, filed with the Town of Weymouth, shall be implemented at the Medical Office Building located at 200 Libbey Industrial Parkway to ensure long-term functioning of the stormwater management system (System), and to provide suitable practices for source control of pollutants.

The System has been designed in accordance with the ten (10) MassDEP Stormwater Management Standards provided in the Stormwater Management Policy and Massachusetts Wetlands Protection Act, which relate to the protection of wetlands and water bodies, control of water quantity, recharge to groundwater, water quality and protection of critical areas, erosion/sedimentation control and stormwater maintenance. Preventative maintenance of the System is essential in the protection of these interests.

1.1 RESPONSIBILITY

The Owner possesses the primary responsibility for overseeing and implementing the LTPP and Stormwater O&M Plan. When necessary the Owner shall designate responsibility to a professional engineer or other technical professional with expertise and experience with stormwater management facilities for the proper operation and maintenance of the System. In case of transfer of property ownership, future property owners shall be notified of the presence of the stormwater management system and the requirements for proper implementation of the LTPP and Stormwater O&M Plan.

The ongoing responsibility is the Owner, its successors and assigns. Adequate maintenance is defined in this document as good working condition.

Responsibility for Operations and Maintenance

Daniel Snyder, Property/Facility Manager
FoxRock Properties LLC
(781) 733-4510
dsnyder@foxrockproperties.com

Responsible Party Signature: _____ Date: _____

1.2 TRAINING

The Owner will coordinate an annual in-house training session with the property manager and maintenance staff to discuss the LTPP and Stormwater O&M Plan. Annual training will include the following:

- Discuss the Stormwater Operations and Maintenance Plan
    - Explain the general operations of the stormwater management system and its Best Management Practices (BMP's).
    - Identify potential sources of stormwater pollution and measures/methods of reducing or eliminating that pollution.
    - Emphasize good housekeeping measures.

- Discuss the Spill Prevention and Response Plan
  - Explain the process in the event of a spill.
  - Identify potential sources of spills and the procedures for clean-up and/or reporting and notification.
  - Complete a yearly inventory of Materials Safety Data Sheets of all tenants and confirm that no potentially harmful chemicals are in use.

1.3 REFERENCES

The LTPP and Stormwater O&M Plan references the following documents:

Site Plans:
Plans titled "200 Industrial Parkway, Weymouth Massachusetts Site Development Plans," dated February 3, 2021 (or as amended), prepared by Tetra Tech, Inc.

Stormwater Management Report:
Report titled "Stormwater Management Report," 200 Industrial Parkway, Weymouth Massachusetts" dated February 3, 2021 (or as amended), prepared by Tetra Tech, Inc.

1.4 PUBLIC SAFETY FEATURES

The following measures have been incorporated into the stormwater management system to promote the safety of the public:

- Drain manholes and catch basins have been provided with heavy duty covers and/or grates and designed to withstand H20 loading.
- Treatment of stormwater runoff from paved surfaces has been designed to remove 80% TSS.
- Reduction in peak rates of runoff from the site under post-development conditions.
- Development and implementation of an Operations and Maintenance Plan to promote the proper functioning of the stormwater management system.
- Development and implementation of good housekeeping practices identifying potential pollution sources and suitable practices to control them from impacting the environment and/or the public's health and safety.

2.0 PRACTICES FOR LONG-TERM POLLUTION PREVENTION

The Owner/Operator shall employ the use of good housekeeping practices by adhering to the maintenance schedules and procedures described in this Report. In general, the Project is not expected to generate significant amounts of hazardous waste nor will there be any outdoor storage of petroleum products or chemicals.

2.1 GOOD HOUSEKEEPING MEASURES

The Owner or designated responsible party shall implement the following good housekeeping measures to ensure long-term pollution prevention and provide suitable practices for source control of pollutants.

2.1.1 Storage of Materials and Waste

The storage of hazardous materials and waste is not anticipated at this site.

2.1.2 Vehicle Washing Controls

The washing of vehicles is not anticipated at this site. In the event that vehicle washing is conducted at the site, it will be performed in a location where runoff can be collected in the closed stormwater collection system and directed to a stormwater quality unit. Runoff resulting from vehicle washing will not be directly discharged to a wetland.

2.1.3 Routine Inspection and Maintenance of Stormwater BMPs

Conduct inspection and maintenance of the stormwater BMPs in accordance with the Stormwater O&M Plan discussed in Section 3.0.

2.1.4 Spill Prevention and Response Plans

There is limited risk of a large spill requiring action at this site. Spills requiring action will most likely be associated with motor vehicle activity. The following good housekeeping practices shall be followed to reduce the risk of spills or other accidental exposure of hazardous materials to the stormwater management system:

- Store quantities of materials only required for the facility and not more.
- Store materials indoors or under cover in appropriate labeled containers.
- Follow manufactures recommendations for proper use and disposal of material.

A spill of greater than 10 gallons of oil or a spill of any quantity that has reached a surface water, into a sewer, storm drain, ditch, or culvert leading to a surface water, shall be immediately reported to one or more municipal, state, or federal authority. In the event of a hazardous waste spill on-site the following protocol should be followed.

- If it is safe to do so, employees (or on-site property manager) detecting an oil spill should immediately stop the release and use available materials to prevent the spread of oil, particularly trying to discharge to catch basins.
- If there is a potentially flammable, toxic, or explosive condition, evacuate the vicinity of the spill.
- If is believed that a reportable or dangerous condition exists, immediately call your local Fire Department to notify them of the release.

If it's believed that a reportable condition exists, immediately call the Massachusetts Department of Environmental Protection (DEP) to notify them of the release. Call the DEP Emergency Response Section toll free statewide number, 1-888-304-1133. Be prepared to provide the following information to the DEP and the Fire Department:

- Identity of the caller
- Contact phone number
- Location of the spill
- Type of product spilled
- Approximate quantity or product spilled

- Extent of actual and/or potential water pollution
- Date and time of spill
- Cause of spill

Contact a Licensed Site Professional (LSP) to assist in further handling of the material(s) and DEP.

2.1.5 Maintenance of Landscaped Areas

Routine mowing shall be conducted on a consistent basis with grass cut to adequate height to maintain a healthy vegetative cover. Bare areas, areas of sparse growth, and signs of erosion shall be addressed in accordance with the Stormwater O&M Plan discussed in Section 3.0.

2.1.6 Storage and Use of Fertilizers, Herbicides, and Pesticides

No fertilizers, herbicides, and pesticides will be stored at the site. The use of herbicides and pesticides is prohibited. Use of fertilizers will be limited to the maximum extent feasible and only slow-release organic low-phosphorous fertilizers will be used in any landscaped areas to limit the amount of nutrients that could enter the stormwater system and adjacent wetlands and pond.

2.1.7 Solid Waste Management:

Solid waste management systems shall be inspected and maintained in accordance with all local, state, and federal solid waste management regulations.

2.1.8 Winter Maintenance

The Owner will contract with a professional snow removal/winter conditions management contractor to treat the paved parking and walking areas within the project site for safe access during winter conditions. Each storm brings a specific treatment regime based on the temperature and precipitation type/amount. Drainage structures must be cleared and not blocked by snow, ice, debris or trash during winter months. The contractor is responsible to minimize de-icing applications while ensuring safe vehicle and pedestrian access throughout the site. Reduced use of road salt to the extent feasible helps limit the amount of dissolved pollutants in runoff and minimizes the potential impact of deicing chemicals on natural resources.

Snow piles shall be located adjacent to or on pervious surfaces in upland areas. A designated snow storage area is shown on the Site Plan. In no case shall snow be disposed of or stored in resource areas (i.e. wetlands, floodplains, streams or other water bodies). If necessary stockpiled snow will be removed from the site and disposed of at an off-site location in accordance with all local, state and federal regulations.

2.1.9 Prevention of Illicit Discharges

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. No chemicals, trash, or other materials shall be dumped into or otherwise allowed to enter the stormwater management system. Only stormwater and the following non-stormwater discharges may enter the storm drainage system: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources. To the best of the owner's and engineer's knowledge there are no known or proposed illicit connections associated with the Project, however if a potential illicit discharge is detected it shall be investigated to determine the nature and source of the discharge, and if required action shall be taken to eliminate the illicit discharge.

2.1.10 Emergency Contacts

Name: Weymouth Fire Department
Address: 636 Broad Street
City, State: Weymouth, MA 02189
Contact: Keith Stark, Fire Chief
Telephone: 911 or 781-337-5151

Name: Weymouth Police Department
Address: 140 Winter Street
City, State: Weymouth, MA 02188
Contact: Richard C. Grimes, Police Chief
Telephone: 911 or 781-335-1212

Name: Weymouth Conservation Commission
Address: Weymouth Town Hall, 75 Middle Street
City, State: Weymouth, MA 02189
Contact: Mary Ellen Schloss, Conservation Administrator
Telephone: 781-340-5007

Name: Weymouth Board of Health
Address: Weymouth Town Hall, 75 Middle Street
City, State: Weymouth, MA 02189
Telephone: 781-335-2000

Name: MassDEP Southeast Regional Office
Address: 20 Riverside Drive
City, State: Lakeville, MA 02347
Telephone: 508-946-2700
Emergency: 888-304-1133 (24-hour statewide number to report a spill of oil or hazardous material)

3.0 STORMWATER OPERATIONS AND MAINTENANCE PROGRAM

The Owner or designated responsible party shall conduct the Stormwater O&M Program set forth in this document, ensure that inspections and record keeping are timely and accurate, and that cleaning and maintenance are performed in accordance with the recommended frequency for each System component. The Owner or designated responsible party shall also maintain all System components to function as they were designed to. Estimated annual cost of the Maintenance Program is $6,000 to $8,000.

3.1 DOCUMENTATION

Inspection and Maintenance Log Forms shall include the date on which each inspection or maintenance task was performed, date and the amount of the last storm event in excess of 0.25 inches of rain in a 24-hour period, a description of the inspection findings or maintenance completed, and the name of the inspector or maintenance personnel performing the task. Inspection findings shall include items such as physical conditions of the System components, depth of sediment in structures, evidence of overtopping or

debris blockage, and maintenance required for each System component. If a maintenance task requires the clean-out of any sediments or debris, the location where the sediment and debris was disposed after removal will be indicated. O&M Logs will be kept on file at the maintenance office for a minimum of three years and copies will be available to the Town of Weymouth upon request. A sample Operation and Maintenance Log form is included in **Attachment 1.**

3.2 STORMWATER MANAGEMENT ACCESS

The proposed on-site stormwater management system consists of catch basins, manholes, water quality structures, drain-pipes and rain garden systems. The Owner and their successors authorize the Town of Weymouth Conservation Commission to enter the premises to inspect the stormwater management system.

Regarding access to each catch basin, drain manhole and other drainage structure on site, The Owner will accept a condition of approval that allows appropriate Town of Weymouth staff (i.e. Town Engineer, DPW Director, Conservation Commission agent) to enter the site with prior Owner notification to review any or all parts of the stormwater management system.

3.3 INSPECTION AND MAINTENANCE FREQUENCY

The following areas, facilities, and measures will be inspected by the Owner and maintained as specified below. Identified deficiencies will be corrected. Accumulated sediments and debris will be properly handled and disposed of off-site, in accordance with local, state, and federal guidelines and regulations. Refer to the Site Plans for the components of the stormwater management system. A sample Operation and Maintenance Log form is included in **Attachment 1.**

3.3.1 Street Sweeping

Accumulations of sand and debris will be cleared from parking lots and site access drives through street sweeping to control the amount of sediment that enters the drainage system. Street sweeping will be conducted quarterly. Street sweeping will also occur after winter snowmelt when road sand and other sediments have accumulated.

3.3.2 Vegetated Areas

Inspect slopes and embankments early in the growing season to identify active or potential erosion problems. Replant bare areas or areas with sparse growth. Where rill erosion is evident, armor the area with an appropriate lining or divert the erosive flows to on-site areas able to withstand the concentrated flows.

3.3.3 Catch Basins

Catch basins will be inspected quarterly and cleaned when sediment reaches ½ full depth from the invert of the pipe to ensure that the catch basins are working in their intended fashion and that they are free of debris. If the basin outlet is designed with a hood/tee to trap floatable materials, check to ensure watertight seal is working. Sediments and hydrocarbons will be properly handled and disposed of off-site, in accordance with local, state, and federal guidelines and regulations. The method of sediment removal will

be by vacuum and disposal must be documented. Any structural damage to the catch basins or to castings must be repaired upon discovery.

3.3.4 Drain Manholes

Drain manholes will be inspected on a quarterly basis. Collection of accumulated sediment and hydrocarbons will be accomplished by means of vacuum pumping. Disposal of accumulated sediment and hydrocarbons will be performed in accordance with applicable local, state and federal regulations. Any structural damage to drain manholes or to castings must be repaired upon discovery.

3.3.5 Water Quality Units

The stormwater management system incorporates BaySaver Barracuda™ Stormwater Separator units prior to discharging into the detention basin and rain gardens. All water quality units will be inspected twice a year. BaySaver has defined the appropriate inspection and maintenance procedures. Refer to **Attachment 2** of the O&M Plan for the procedure.

3.3.6 Storm Drain Piping

The storm drain piping system functions as the collection system of runoff from the roof leaders and catch basins and discharges into the detention basin and rain gardens. Typical observations that would indicate that the storm drain piping system is not functioning properly are: puddles around the catch basin grates after a storm event and no visible discharge of runoff into the detention basins during a storm event. The storm drain piping system will be inspected quarterly and cleaned as necessary. Sediments and hydrocarbons will be properly handled and disposed of off-site, in accordance with local, state and federal guidelines and regulations.

3.3.7 Flared End Outlets

Flared end outlets and rip rap are provided at pipe outfalls to dissipate runoff velocities and prevent erosion. Rip rap works by absorbing and deflecting the energy of moving water or runoff before it reaches the outfall. Typical observations that would indicate that the flared end outlets are not functioning properly are: sediment/trash accumulation around the outlet, erosion, vegetation growth through the rip rap, and dislodged rip rap. Many times, because of the repeated impact/force of water, the rip rap can shift and settle. Structural damage can occur at any time to flared end structures or to rip rap rundowns. This could eventually lead to loss of hydraulic performance. Flared end outlets and rip rap will be inspected quarterly or as necessary to ensure that they are working in their intended fashion and that they are free of debris. Remove any obstructions to flow; remove accumulated sediments and debris at the outlet and within the conduit and to repair any erosion damage.

3.3.8 Rain Gardens

Rain gardens will be inspected on a monthly basis to ensure they are functioning properly. Litter and debris will be removed, and eroded areas will be repaired a as necessary. Removal and replacement of dead vegetation will be twice per year (spring and fall). Sediments and hydrocarbons will be properly handled and disposed of off-site, in accordance with local, state and federal guidelines and regulations.

Attachment 1

Inspection and Maintenance Record Log

Operation and Maintenance Record Log
200 Libbey Industrial Parkway, Weymouth, MA

Inspector's Name: _____

Date:_____

Maintenance:

- ☐ Routine
- ☐ Response to Rainfall Event _____ inches
- ☐ Other _____

Stormwater Structure/BMP	Inspection Frequency	Description of Inspection Findings	Depth of Sediment	Description of Maintenance Completed
Vegetated Areas	Annual Inspections			
	Maintenance as Required			
Deep Sump/ Hooded Catch Basins	Quarterly Inspections			
	Maintenance as Required			
Drain Manholes	Quarterly Inspections			
	Maintenance as Required			
Water Quality Units	Semi-Annual Inspections			
	Maintenance as Required			
Storm Drain Piping	Quarterly Inspections			
	Maintenance as Required			

** This is a rolling log in which the responsible party records all operation and maintenance activities for the past three years.

Stormwater Structure/BMP	Inspection Frequency	Description of Inspection Findings	Depth of Sediment	Description of Maintenance Completed
Flared End Sections	Quarterly Inspections			
	Maintenance as Required			
Rain Gardens	Monthly Inspections			
	Maintenance as Required			

Location where the sediment and debris was disposed after removal:

_____

_____

_____

_____

_____

** This is a rolling log in which the responsible party records all operation and maintenance activities for the past three years.

Attachment 2

BaySaver Barracuda™ Maintenance Guide

Maintenance Guide

BaySaver Barracuda™

July 2017

One of the advantages of the BaySaver Barracuda is the ease of maintenance. Like any system that collects pollutants, the BaySaver Barracuda must be maintained for continued effectiveness. Maintenance is a simple procedure performed using a vacuum truck or similar equipment. The systems were designed to minimize the volume of water removed during routine maintenance, reducing disposal costs.

Contractors can access the pollutants stored in the manhole through the manhole cover. This allows them to gain vacuum hose access to the bottom of the manhole to remove sediment and trash. There is no confined space entry necessary for inspection or maintenance.

The entire maintenance procedure typically takes from 2 to 4 hours, depending on the size of the system, the captured material, and the capacity of the vacuum truck.

Local regulations may apply to the maintenance procedure. Safe and legal disposal of pollutants is the responsibility of the maintenance contractor. Maintenance should be performed only by a qualified contractor.

Inspection and Cleaning Cycle

Periodic inspection is needed to determine the need for and frequency of maintenance. You should begin inspecting as soon as construction is complete and thereafter on an annual basis. Typically, the system needs to be cleaned every 1-3 years.

Excessive oils, fuels or sediments may reduce the maintenance cycle. Periodic inspection is important.

Determining When to Clean

To determine the sediment depth, the maintenance contractor should lower a stadia rod into the manhole until it contacts the top of the captured sediment and mark that spot on the rod. Then push the probe through to the bottom of the sump and mark that spot to determine sediment depth.

Maintenance should occur when the sediment has reached the levels indicated in the Storage Capacity Chart.

BaySaver Barracuda Storage Capacities

Model	Manhole Diameter	Treatment Chamber Capacity	Standard Sediment Capacity (20” depth)	NJDEP Sediment Capacity (50% of standard depth)
S3	36”	212 gallons	0.44 cubic yards	0.22 cubic yards
S4	48”	564 gallons	0.78 cubic yards	0.39 cubic yards
S5	60”	881 gallons	1.21 cubic yards	0.61 cubic yards
S6	72”	1269 gallons	1.75 cubic yards	0.88 cubic yards
S8	96”	3835 gallons	3.10 cubic yards	1.55 cubic yards
S10	120”	7496 gallons	4.85 cubic yards	2.43 cubic yards

Maintenance Instructions

1. Remove the manhole cover to provide access to the pollutant storage. Pollutants are stored in the sump, below the bowl assembly visible from the surface. You’ll access this area through the 10” diameter access cylinder.

2. Use a vacuum truck or other similar equipment to remove all water, debris, oils and sediment. See figure 1.
3. Use a high pressure hose to clean the manhole of all the remaining sediment and debris. Then, use the vacuum truck to remove the water.
4. Fill the cleaned manhole with water until the level reaches the invert of the outlet pipe.
5. Replace the manhole cover.
6. Dispose of the polluted water, oils, sediment and trash at an approved facility.
   - Local regulations prohibit the discharge of solid material into the sanitary system. Check with the local sewer authority for authority to discharge the liquid.
   - Some localities treat the pollutants as leachate. Check with local regulators about disposal requirements.
   - Additional local regulations may apply to the maintenance procedure.

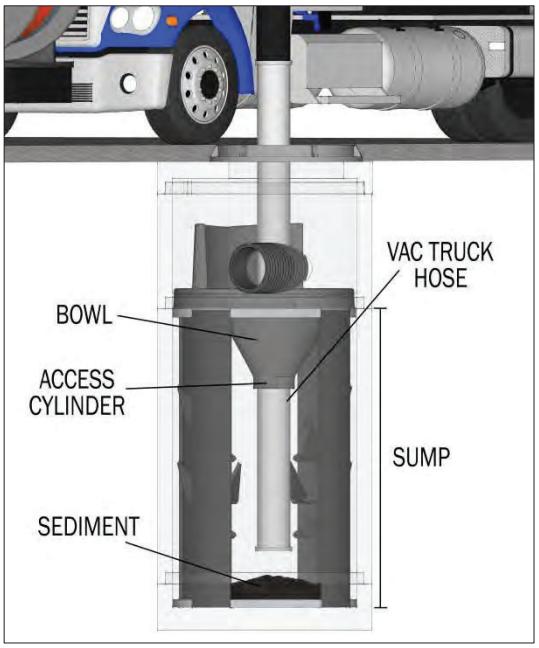


Figure 1

Appendix F

Supporting Documentation

TETRA TECH

ILLICIT DISCHARGE COMPLIANCE STATEMENT

Owner Name: FoxRock 200 Libbey, LLC

Site Address: 200 Libbey Industrial Parkway, Weymouth, Massachusetts

Date: February 3, 2021

This statement is provided in accordance with the provisions of Massachusetts Stormwater Management Standards (the Standards), Standard 10, and the Massachusetts Stormwater Handbook.

To the best of the Owners and Engineers knowledge, no illicit discharges exist on the Project Site and no illicit discharges are proposed as part of the Project. The facility's Operation & Maintenance Plans are designed to prevent non-stormwater discharge to on-site stormwater Best Management Practices. Any illicit discharges identified during or after construction will be immediately disconnected in accordance with the Standards.

Signed:

Glenn K. Dougherty, P.E.
Senior Project Manager

Tetra Tech
20 Cabot Boulevard, Suite 305, Mansfield, MA 02048
Tel 508.786.2200 Fax 508.786.2201 tetratech.com

TETRA TECH

200 Libbey Industrial Parkway
Weymouth, MA

StormCAD Report

Label	Upstream Structure	Upstream Rim Elevation (ft)	Downstream Structure	Downstream Rim Elevation (ft)	Upstream Invert (ft)	Downstream Invert (ft)	Length (ft)	Slope (ft/ft)	Diameter (in)	Manning's n	Velocity (ft/s)	Flow (cfs)	Capacity (Full Flow) (cfs)	Upstream Cover (ft)	Downstream Cover (ft)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)
CO-1	CB-1	81.40	DMH-1	80.90	78.00	77.72	56	0.005	12	0.012	1.25	0.98	2.73	2.40	2.18	79.27	79.23
CO-2	CB-2	81.40	DMH-1	80.90	77.75	77.72	5	0.006	12	0.012	1.42	1.12	2.99	2.65	2.18	79.24	79.23
CO-3	DMH-1	80.90	DMH-2	81.10	77.72	77.40	88	0.004	12	0.012	2.55	2.01	2.33	2.18	2.70	79.23	79.00
CO-4	CB-3	80.90	DMH-2	81.10	77.50	77.40	5	0.020	12	0.012	1.53	1.20	5.46	2.40	2.70	79.00	79.00
CO-5	DMH-2	81.10	DMH-3	80.70	77.40	77.06	68	0.005	15	0.012	2.48	3.05	4.95	2.45	2.39	79.00	78.87
CO-6	CB-4	80.30	DMH-3	80.70	77.26	77.06	11	0.018	12	0.012	1.07	0.84	5.20	2.04	2.64	78.87	78.87
CO-7	DMH-3	80.70	WQU-1	80.20	77.06	76.89	34	0.005	15	0.012	3.03	3.71	4.95	2.39	2.06	78.87	78.77
CO-8	WQU-1	80.20	FE-1	78.05	76.89	76.80	15	0.006	15	0.012	2.99	3.67	5.42	2.06	0.00	78.77	78.73
CO-9	CB-5	81.00	DMH-4	81.30	79.15	78.90	50	0.005	12	0.013	3.48	1.79	2.52	0.85	1.40	80.10	79.98
CO-10	CB-6	81.20	DMH-4	81.30	78.94	78.90	8	0.005	12	0.013	2.34	1.84	2.52	1.26	1.40	80.00	79.98
CO-11	DMH-4	81.30	DMH-5	80.95	78.90	78.53	74	0.005	15	0.012	4.39	3.58	4.95	1.15	1.17	79.98	79.82
CO-12	CB-7	80.80	DMH-5	80.95	78.55	78.53	4	0.005	12	0.012	1.52	1.19	2.73	1.25	1.42	79.83	79.82
CO-13	DMH-5	80.95	DMH-6	80.50	78.53	78.07	91	0.005	15	0.012	3.81	4.68	4.98	1.17	1.18	79.82	79.42
CO-14	CB-8	80.40	DMH-6	80.50	78.09	78.07	4	0.005	12	0.012	1.74	1.37	2.73	1.31	1.43	79.42	79.42
CO-15	DMH-6	80.50	DMH-7	80.05	78.07	77.64	85	0.005	18	0.012	4.99	5.87	8.09	0.93	0.91	79.42	79.22
CO-16	CB-9	80.00	DMH-7	80.05	77.68	77.64	2	0.020	12	0.012	1.67	1.31	5.46	1.32	1.41	79.22	79.22
CO-17	DMH-7	80.05	WQU-2	80.15	77.64	77.61	6	0.005	18	0.012	3.95	6.98	8.05	0.91	1.04	79.22	79.20
CO-18	WQU-2	80.15	FE-2	79.00	77.61	77.50	8	0.014	18	0.012	3.94	6.97	13.34	1.04	0.00	79.20	79.17
CO-19	RL-1	82.00	FE-5	78.00	79.10	77.00	140	0.015	12	0.012	5.67	4.46	4.73	1.90	0.00	82.16	80.29
CO-20	CB-10	81.00	DMH-8	81.30	79.15	78.89	50	0.005	12	0.013	2.28	1.79	2.57	0.85	1.41	80.60	80.47
CO-21	CB-11	81.20	DMH-8	81.30	78.94	78.89	8	0.006	12	0.013	2.70	2.12	2.82	1.26	1.41	80.50	80.47
CO-22	DMH-8	81.30	DMH-9	81.15	78.89	78.21	138	0.005	15	0.012	3.12	3.82	4.91	1.16	1.69	80.47	80.06
CO-23	CB-12	81.00	DMH-9	81.15	78.26	78.21	10	0.005	12	0.012	1.18	0.92	2.73	1.74	1.94	80.06	80.06
CO-25	DMH-9	81.15	DMH-10	80.85	78.21	77.64	114	0.005	15	0.012	3.68	4.52	4.95	1.69	1.96	80.06	79.58
CO-26	CB-13	80.70	DMH-10	80.85	77.70	77.64	12	0.005	12	0.012	1.95	1.53	2.73	2.00	2.21	79.60	79.58
CO-27	DMH-10	80.85	WQU-3	80.50	77.64	77.24	80	0.005	18	0.012	3.26	5.76	8.05	1.71	1.76	79.58	79.38
CO-28	CB-14	80.80	DMH-11	80.60	77.92	77.51	82	0.005	12	0.012	0.98	0.77	2.73	1.88	2.09	79.49	79.46
CO-29	CB-15	80.60	DMH-11	80.60	77.58	77.51	14	0.005	12	0.012	0.89	0.70	2.73	2.02	2.09	79.47	79.46
CO-30	DMH-11	80.60	DMH-12	80.40	77.51	77.30	42	0.005	12	0.012	1.72	1.35	2.73	2.09	2.10	79.46	79.41
CO-31	CB-16	80.30	DMH-12	80.40	77.34	77.30	8	0.005	12	0.012	1.09	0.86	2.73	1.96	2.10	79.41	79.41
CO-32	DMH-12	80.40	WQU-3	80.50	77.30	77.24	12	0.005	12	0.012	2.65	2.08	2.73	2.10	2.26	79.41	79.38
CO-33	WQU-3	80.50	FE-8	78.50	77.24	77.00	30	0.008	18	0.012	4.34	7.66	10.18	1.76	0.00	79.38	79.24

Notes:
1.) Pipes sized for the 25-year storm event.

200 Libbey Industrial Parkway
Weymouth, MA

Proposed Catchment Areas

Inlet	Impervious		Pervious		Composite Runoff Coefficient	Total Area (acres)
	Area (acres)	Runoff Coefficient	Area (acres)	Runoff Coefficient		
CB 1	0.11	0.95	0.04	0.15	0.74	0.15
CB 2	0.13	0.95	0.02	0.15	0.84	0.15
CB 3	0.14	0.95	0.02	0.15	0.85	0.16
CB 4	0.10	0.95	0.00	0.15	0.95	0.10
CB 5	0.21	0.95	0.02	0.15	0.88	0.23
CB 6	0.21	0.95	0.05	0.15	0.80	0.26
CB 7	0.14	0.95	0.01	0.15	0.90	0.15
CB 8	0.16	0.95	0.02	0.15	0.86	0.18
CB 9	0.17	0.95	0.02	0.15	0.87	0.19
CB 10	0.21	0.95	0.02	0.15	0.88	0.23
CB 11	0.25	0.95	0.01	0.15	0.92	0.26
CB 12	0.11	0.95	0.00	0.15	0.95	0.11
CB 13	0.18	0.95	0.01	0.15	0.91	0.19
CB 14	0.09	0.95	0.01	0.15	0.87	0.10
CB 15	0.08	0.95	0.02	0.15	0.79	0.10
CB 16	0.10	0.95	0.01	0.15	0.88	0.11
RL 1	0.53	0.95	0.00	0.15	0.95	0.53

Notes:
1.) Runoff coefficients are from the 2006 Massachusetts Highway Department Project Development & Design Guide Exhibit 8-9.

NOAA Atlas 14, Volume 10, Version 3
Location name: East Weymouth, Massachusetts, USA*
Latitude: 42.1925°, Longitude: -70.9407°
Elevation: 70.61 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.303** (0.236-0.384)	**0.376** (0.293-0.477)	**0.496** (0.385-0.631)	**0.595** (0.460-0.762)	**0.732** (0.549-0.986)	**0.834** (0.613-1.15)	**0.943** (0.676-1.36)	**1.07** (0.722-1.57)	**1.27** (0.824-1.93)	**1.44** (0.912-2.23)
10-min	**0.429** (0.335-0.544)	**0.533** (0.415-0.676)	**0.703** (0.546-0.894)	**0.843** (0.651-1.08)	**1.04** (0.777-1.40)	**1.18** (0.869-1.63)	**1.34** (0.958-1.92)	**1.52** (1.02-2.22)	**1.80** (1.17-2.73)	**2.04** (1.29-3.15)
15-min	**0.505** (0.394-0.640)	**0.627** (0.489-0.795)	**0.827** (0.642-1.05)	**0.992** (0.766-1.27)	**1.22** (0.914-1.64)	**1.39** (1.02-1.92)	**1.57** (1.13-2.26)	**1.79** (1.20-2.61)	**2.12** (1.37-3.21)	**2.40** (1.52-3.71)
30-min	**0.700** (0.546-0.886)	**0.870** (0.677-1.10)	**1.15** (0.892-1.46)	**1.38** (1.06-1.76)	**1.70** (1.27-2.28)	**1.93** (1.42-2.66)	**2.18** (1.57-3.15)	**2.49** (1.67-3.64)	**2.95** (1.91-4.47)	**3.35** (2.12-5.17)
60-min	**0.894** (0.697-1.13)	**1.11** (0.866-1.41)	**1.47** (1.14-1.87)	**1.76** (1.36-2.26)	**2.17** (1.63-2.92)	**2.47** (1.82-3.41)	**2.80** (2.01-4.03)	**3.19** (2.14-4.66)	**3.78** (2.45-5.73)	**4.29** (2.72-6.63)
2-hr	**1.13** (0.889-1.43)	**1.43** (1.12-1.80)	**1.92** (1.50-2.42)	**2.32** (1.80-2.95)	**2.87** (2.17-3.85)	**3.28** (2.43-4.50)	**3.73** (2.69-5.34)	**4.27** (2.88-6.18)	**5.11** (3.32-7.66)	**5.83** (3.70-8.91)
3-hr	**1.32** (1.03-1.65)	**1.66** (1.31-2.08)	**2.23** (1.74-2.80)	**2.69** (2.10-3.41)	**3.34** (2.52-4.45)	**3.81** (2.83-5.21)	**4.33** (3.14-6.18)	**4.97** (3.36-7.15)	**5.95** (3.87-8.86)	**6.79** (4.32-10.3)
6-hr	**1.73** (1.37-2.15)	**2.15** (1.70-2.68)	**2.84** (2.24-3.55)	**3.42** (2.68-4.30)	**4.21** (3.20-5.56)	**4.79** (3.57-6.49)	**5.43** (3.95-7.66)	**6.20** (4.21-8.83)	**7.39** (4.82-10.9)	**8.40** (5.36-12.6)
12-hr	**2.27** (1.80-2.80)	**2.76** (2.19-3.42)	**3.57** (2.83-4.43)	**4.24** (3.34-5.30)	**5.17** (3.94-6.76)	**5.85** (4.38-7.83)	**6.59** (4.80-9.18)	**7.48** (5.10-10.5)	**8.82** (5.78-12.9)	**9.96** (6.37-14.8)
24-hr	**2.77** (2.21-3.40)	**3.37** (2.69-4.14)	**4.35** (3.46-5.36)	**5.16** (4.08-6.40)	**6.28** (4.82-8.15)	**7.11** (5.34-9.43)	**8.00** (5.86-11.1)	**9.08** (6.22-12.7)	**10.7** (7.04-15.4)	**12.1** (7.77-17.8)
2-day	**3.14** (2.53-3.83)	**3.89** (3.12-4.74)	**5.11** (4.09-6.25)	**6.12** (4.87-7.53)	**7.51** (5.80-9.70)	**8.54** (6.47-11.3)	**9.66** (7.13-13.3)	**11.0** (7.58-15.3)	**13.2** (8.68-18.8)	**15.0** (9.66-21.8)
3-day	**3.44** (2.77-4.17)	**4.24** (3.42-5.15)	**5.55** (4.46-6.77)	**6.65** (5.31-8.14)	**8.15** (6.31-10.5)	**9.25** (7.02-12.2)	**10.5** (7.74-14.3)	**12.0** (8.22-16.4)	**14.3** (9.42-20.2)	**16.3** (10.5-23.4)
4-day	**3.72** (3.01-4.50)	**4.55** (3.68-5.51)	**5.90** (4.75-7.18)	**7.03** (5.63-8.59)	**8.58** (6.65-11.0)	**9.72** (7.39-12.7)	**11.0** (8.12-14.9)	**12.5** (8.62-17.1)	**14.9** (9.84-21.0)	**16.9** (10.9-24.3)
7-day	**4.50** (3.66-5.42)	**5.36** (4.35-6.46)	**6.77** (5.48-8.18)	**7.94** (6.38-9.64)	**9.54** (7.43-12.1)	**10.7** (8.18-13.9)	**12.0** (8.91-16.2)	**13.6** (9.40-18.4)	**16.0** (10.6-22.3)	**18.0** (11.7-25.7)
10-day	**5.22** (4.26-6.27)	**6.11** (4.97-7.34)	**7.55** (6.13-9.10)	**8.75** (7.06-10.6)	**10.4** (8.11-13.1)	**11.6** (8.88-15.0)	**12.9** (9.59-17.2)	**14.5** (10.1-19.6)	**16.9** (11.2-23.4)	**18.9** (12.2-26.7)
20-day	**7.31** (6.00-8.72)	**8.28** (6.78-9.88)	**9.86** (8.05-11.8)	**11.2** (9.06-13.4)	**13.0** (10.1-16.1)	**14.3** (10.9-18.1)	**15.8** (11.6-20.5)	**17.3** (12.1-23.0)	**19.4** (13.0-26.6)	**21.1** (13.7-29.5)
30-day	**9.04** (7.44-10.7)	**10.1** (8.28-12.0)	**11.8** (9.63-14.0)	**13.2** (10.7-15.7)	**15.1** (11.8-18.6)	**16.6** (12.7-20.7)	**18.1** (13.3-23.2)	**19.6** (13.7-25.9)	**21.5** (14.4-29.3)	**23.0** (15.0-32.0)
45-day	**11.2** (9.25-13.2)	**12.3** (10.2-14.6)	**14.1** (11.6-16.7)	**15.6** (12.7-18.6)	**17.7** (13.9-21.6)	**19.3** (14.7-23.9)	**20.9** (15.3-26.5)	**22.3** (15.7-29.3)	**24.2** (16.3-32.7)	**25.5** (16.6-35.1)
60-day	**13.0** (10.8-15.4)	**14.2** (11.7-16.7)	**16.1** (13.2-19.0)	**17.7** (14.4-21.0)	**19.8** (15.6-24.1)	**21.5** (16.5-26.6)	**23.2** (17.0-29.2)	**24.6** (17.3-32.2)	**26.4** (17.8-35.5)	**27.5** (18.0-37.7)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

NOAA Atlas 14, Volume 10, Version 3
Location name: East Weymouth, Massachusetts, USA*
Latitude: 42.1925°, Longitude: -70.9407°
Elevation: 70.61 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	3.64 (2.83-4.61)	4.51 (3.52-5.72)	5.95 (4.62-7.57)	7.14 (5.52-9.14)	8.78 (6.59-11.8)	10.0 (7.36-13.8)	11.3 (8.11-16.3)	12.9 (8.66-18.8)	15.3 (9.89-23.1)	17.3 (10.9-26.7)
10-min	2.57 (2.01-3.26)	3.20 (2.49-4.06)	4.22 (3.28-5.36)	5.06 (3.91-6.47)	6.22 (4.66-8.38)	7.09 (5.21-9.78)	8.02 (5.75-11.5)	9.13 (6.14-13.3)	10.8 (7.00-16.4)	12.2 (7.75-18.9)
15-min	2.02 (1.58-2.56)	2.51 (1.96-3.18)	3.31 (2.57-4.20)	3.97 (3.06-5.08)	4.88 (3.66-6.58)	5.56 (4.09-7.66)	6.28 (4.51-9.06)	7.16 (4.82-10.5)	8.48 (5.49-12.8)	9.60 (6.08-14.8)
30-min	1.40 (1.09-1.77)	1.74 (1.35-2.20)	2.30 (1.78-2.92)	2.76 (2.13-3.53)	3.39 (2.54-4.57)	3.86 (2.84-5.33)	4.37 (3.13-6.30)	4.98 (3.35-7.27)	5.90 (3.82-8.94)	6.69 (4.24-10.3)
60-min	0.894 (0.697-1.13)	1.11 (0.866-1.41)	1.47 (1.14-1.87)	1.76 (1.36-2.26)	2.17 (1.63-2.92)	2.47 (1.82-3.41)	2.80 (2.01-4.03)	3.19 (2.14-4.66)	3.78 (2.45-5.73)	4.29 (2.72-6.63)
2-hr	0.567 (0.444-0.714)	0.716 (0.560-0.901)	0.958 (0.748-1.21)	1.16 (0.900-1.47)	1.44 (1.08-1.92)	1.64 (1.21-2.25)	1.86 (1.35-2.67)	2.14 (1.44-3.09)	2.55 (1.66-3.83)	2.91 (1.85-4.46)
3-hr	0.438 (0.345-0.549)	0.553 (0.435-0.693)	0.741 (0.580-0.932)	0.897 (0.698-1.14)	1.11 (0.840-1.48)	1.27 (0.943-1.74)	1.44 (1.05-2.06)	1.65 (1.12-2.38)	1.98 (1.29-2.95)	2.26 (1.44-3.44)
6-hr	0.288 (0.228-0.359)	0.359 (0.284-0.447)	0.475 (0.374-0.594)	0.571 (0.447-0.717)	0.703 (0.534-0.929)	0.800 (0.597-1.08)	0.906 (0.659-1.28)	1.04 (0.703-1.48)	1.23 (0.805-1.82)	1.40 (0.895-2.11)
12-hr	0.188 (0.150-0.232)	0.229 (0.182-0.283)	0.296 (0.235-0.368)	0.352 (0.277-0.439)	0.429 (0.327-0.561)	0.486 (0.363-0.650)	0.547 (0.398-0.762)	0.621 (0.423-0.875)	0.732 (0.480-1.07)	0.826 (0.529-1.23)
24-hr	0.115 (0.092-0.141)	0.140 (0.112-0.172)	0.181 (0.144-0.223)	0.215 (0.170-0.266)	0.262 (0.201-0.340)	0.296 (0.223-0.393)	0.334 (0.244-0.461)	0.378 (0.259-0.528)	0.446 (0.293-0.643)	0.504 (0.324-0.740)
2-day	0.065 (0.053-0.080)	0.081 (0.065-0.099)	0.106 (0.085-0.130)	0.127 (0.101-0.157)	0.157 (0.121-0.202)	0.178 (0.135-0.235)	0.201 (0.148-0.277)	0.230 (0.158-0.318)	0.274 (0.181-0.391)	0.312 (0.201-0.454)
3-day	0.048 (0.039-0.058)	0.059 (0.047-0.072)	0.077 (0.062-0.094)	0.092 (0.074-0.113)	0.113 (0.088-0.145)	0.129 (0.098-0.169)	0.145 (0.107-0.199)	0.166 (0.114-0.228)	0.198 (0.131-0.281)	0.226 (0.146-0.326)
4-day	0.039 (0.031-0.047)	0.047 (0.038-0.057)	0.061 (0.050-0.075)	0.073 (0.059-0.089)	0.089 (0.069-0.114)	0.101 (0.077-0.132)	0.114 (0.085-0.155)	0.130 (0.090-0.178)	0.155 (0.102-0.219)	0.176 (0.114-0.253)
7-day	0.027 (0.022-0.032)	0.032 (0.026-0.038)	0.040 (0.033-0.049)	0.047 (0.038-0.057)	0.057 (0.044-0.072)	0.064 (0.049-0.083)	0.072 (0.053-0.096)	0.081 (0.056-0.110)	0.095 (0.063-0.133)	0.107 (0.070-0.153)
10-day	0.022 (0.018-0.026)	0.025 (0.021-0.031)	0.031 (0.026-0.038)	0.036 (0.029-0.044)	0.043 (0.034-0.055)	0.048 (0.037-0.062)	0.054 (0.040-0.072)	0.060 (0.042-0.081)	0.070 (0.047-0.098)	0.079 (0.051-0.111)
20-day	0.015 (0.012-0.018)	0.017 (0.014-0.021)	0.021 (0.017-0.025)	0.023 (0.019-0.028)	0.027 (0.021-0.034)	0.030 (0.023-0.038)	0.033 (0.024-0.043)	0.036 (0.025-0.048)	0.040 (0.027-0.056)	0.044 (0.029-0.061)
30-day	0.013 (0.010-0.015)	0.014 (0.011-0.017)	0.016 (0.013-0.019)	0.018 (0.015-0.022)	0.021 (0.016-0.026)	0.023 (0.018-0.029)	0.025 (0.018-0.032)	0.027 (0.019-0.036)	0.030 (0.020-0.041)	0.032 (0.021-0.044)
45-day	0.010 (0.009-0.012)	0.011 (0.009-0.013)	0.013 (0.011-0.016)	0.014 (0.012-0.017)	0.016 (0.013-0.020)	0.018 (0.014-0.022)	0.019 (0.014-0.025)	0.021 (0.015-0.027)	0.022 (0.015-0.030)	0.024 (0.015-0.032)
60-day	0.009 (0.007-0.011)	0.010 (0.008-0.012)	0.011 (0.009-0.013)	0.012 (0.010-0.015)	0.014 (0.011-0.017)	0.015 (0.011-0.018)	0.016 (0.012-0.020)	0.017 (0.012-0.022)	0.018 (0.012-0.025)	0.019 (0.013-0.026)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical

200 Libbey Industrial Parkway
Weymouth, MA

Outlet Protection Sizing

Outfall	Q^2 (cfs)	Pipe Diameter (inches)	D (ft)	TW (ft)	Velocity (ft/sec)	D_{50} (ft)	Apron Length (ft)	Apron Depth (ft)	Apron W1 (ft)	Apron W2 (ft)
Flared End 4	4.26	12	1.0	0.4	5.4	0.3	4.0	1.5	3.0	5.7
Flared End 12	5.15	12	1.0	0.4	6.6	0.4	4.0	1.5	3.0	5.7

Equations to determine length of apron are as follows:

$$D_{50} = 0.2\,D\left(\frac{Q}{\sqrt{g}D^{2.5}}\right)^{4/3}\left(\frac{D}{TW}\right)$$ (Equation 10.4, HEC 14, July 2006)

D_{50} = median stone diameter (ft)
Q = design discharge (cfs)
D = pipe diameter (ft)
TW = tailwater depth (ft), if TW<0.4D use TW=0.4D
g = acceleration due to gravity (32.2 ft/s^2)

Apron length and depth equations vary based on D_{50} size.

Class 1: D_{50} = 5 in (Table 10.1, HEC 14, July 2006)
Apron Length L = 4*D
Apron Depth = 3.5*D_{50}

Equations to determine widths of apron are as follows:

Apron Width (W1) at pipe outlet, W = 3D
Apron Width (W2) at end of apron, W = 3D +(2/3)L

Notes:

1.) Source: U.S. Federal Highway Administration, 2006, Hydraulic Design of Energy Dissipators for Culverts and Cannels, Hydraulic Engineering Circular No. 14 (HEC-14).
2.) Peak discharge taken from HydroCAD Report for the 25-year storm event.