DRAINAGE REPORT

For

98 Beacon Street, LLC

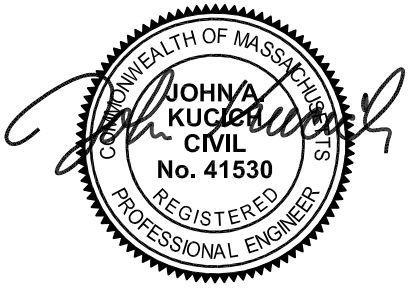
PROPOSED

98 Beacon Street, LLC

98 Beacon Street
Worcester, Massachusetts
Worcester County

Prepared by:

BOHLER ENGINEERING
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900 TEL.



John A. Kucich
Massachusetts P.E. Lic. #41530

BOHLER

February 15, 2024
#MAA220072.00

BOHLER

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the proposed redevelopment to convert the existing mill building at 98 Beacon Street in Worcester, Massachusetts to new residential units. The site, which contains approximately 1.61 acres of land, is developed with an existing mill building, grass and landscaped areas, and parking areas.

The proposed redevelopment project will include the construction of new paved parking areas, landscaping, storm water management components and associated utilities. This report addresses a comparative analysis of the pre- and post-development site runoff conditions. Additionally, this report provides calculations documenting the design of the proposed stormwater conveyance/management system as illustrated within the accompanying Site Development Plans prepared by Bohler. The project will also provide erosion and sedimentation controls during the demolition and construction periods, as well as long term stabilization of the site.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at two (2) "design points" where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in **Section II** below. A summary of the existing and proposed conditions peak runoff rates for the 2-, 10-, 25-, and 100-year storms can be found in **Table 1.1** below. In addition, the project has been designed to meet or exceed the Stormwater Management Standards as detailed herein.

Table 1.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP#1	0.81	0.78	**-0.03**	1.29	1.27	**-0.02**	1.59	1.57	**-0.02**	2.04	2.04	**0.00**
DP#2	2.91	2.28	**-0.63**	5.27	4.70	**-0.57**	6.75	5.72	**-1.03**	9.03	7.11	**-1.92**

**Flows are represented in cubic feet per second (cfs)*

II. EXISTING SITE CONDITIONS

Existing Site Description

The site consists of approximately 1.61 acres of land located at 98 Beacon Street in the City of Worcester, Massachusetts. The site is developed with an existing mill building, grass and landscaped areas, and parking areas.

On-Site Soil Information

Soils within the analyzed area consist of the following as classified by the Natural Resource Conservation Service (NRCS):

Table 2.1: Existing Soil Information

Soil Unit Symbol	Soil Name / Description	Hydrologic Soil Group (HSG)
602	Urban land	C

Based on soil testing conducted on site in July 2021, revealing the presence of substantial buried building debris and rubble, the Hydrologic Soil Group (HSG) has been assigned a "C" classification for the purposes of the hydrologic calculations in this report. Refer to **Appendix C** for additional information.

Existing Collection and Conveyance

The majority of the site drains from high points at Oread Street in a northeasterly direction towards Lagrange street and from high points along Beacon Street in a southeasterly towards Lagrange Street. The remaining northern portions of the site drain east towards lower points at Jackson Street. Runoff from the site is collected by the City's combined sewer and stormwater systems in Jackson Street and Lagrange Street. Slopes on the site range from 2%-50% with on-site elevations ranging from 524 adjacent to Oread Street to 488 at the easterly portion of the subject site along Lagrange Street.

Existing Watersheds and Design Point Information

For the purposes of this analysis, the pre- and post-development drainage conditions were analyzed at two (2) "design points" as described below where stormwater runoff currently drains to under existing conditions. The existing site was subdivided into two (2) separate sub catchments, as described below, to analyze existing and proposed flow rates at each design point. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Subcatchment EX-1 contains approximately 0.27 acres of land, consisting of rooftops, paved parking areas, compacted gravel areas, and grass. The curve number (CN) for this subarea is calculates as 96 with a time of concentration of 6.0 minutes. Runoff from this subcatchment flows southeast to existing catch basins and is directed to the closed drainage system in Jackson Street (DP#1).

Subcatchment EX-2 contains approximately 1.33 acres of land, consisting of rooftops, paved parking areas, and grass. The curve number (CN) for this subarea is calculates as 87 with a time of concentration of 6.3 minutes. Runoff from this subcatchment flows east towards Lagrange Street and into existing catch basins within Lagrange Street (DP#2).

Design Point #1 (DP#1) is the existing stormwater management system within Jackson Street. Under existing conditions, this design point receives stormwater flows from approximately 0.28 acres of land, designated as watershed “EX-1”. Refer to Table 2.1 below for additional detail.

Design Point #2 (DP#2) is the existing stormwater management system within Lagrange Street. Under existing conditions, this design point receives stormwater flows from approximately 1.33 acres of land, designated as watershed “EX-2”. Refer to Table 2.1 below for additional detail.

Table 2.2: Existing Sub-Catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)
EX-1	0.28±	Rooftops, paved parking, gravel, grass	96	6.0
EX-2	1.33±	Rooftops, paved parking, grass	87	6.3

Refer to **Table 1.1 and 6.1** for the existing conditions peak rates of runoff. Refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the existing drainage areas.

III. PROPOSED SITE CONDITIONS

Proposed Development Description

The proposed redevelopment project will include the construction of new paved parking areas, landscaping, storm water management components and associated utilities. The site, including the proposed parking areas, has been designed to drain to deep-sump, hooded catch basins. The catch basins will capture and convey a portion of the stormwater runoff, via an underground pipe system, to one (1) proposed underground detention basin. The remaining portion of the stormwater runoff from the parking areas will be captured and conveyed to the existing municipal system directly. Pretreatment of stormwater runoff will be provided by a combination of the deep-sump, hooded catch basins and one (1) proprietary treatment unit prior to discharge into the proposed underground detention basin.

Proposed Development Collection and Conveyance

Deep sump hooded catch basins are proposed to collect and route runoff from the paved parking areas to the proposed underground stormwater management basin prior to discharge to the existing municipal system or directly to the existing municipal system. Pipes have been designed for the 25-year storm using Rational Method. Pipe, inlet, and outlet protection sizing calculations are included in **Appendix F**.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meets, or exceeds, the standards set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards. Refer to **Section V** for additional information.

Proposed Watersheds and Design Point Information

The project has been designed to maintain existing drainage watersheds to the greatest extent possible, with the same design points described in **Section II** above. The site was subdivided into three (3) separate sub catchments for the proposed conditions as described below. The minimum time of concentration for all proposed areas is calculated as 6 minutes (0.1 hr).

Subcatchment P-1 contains approximately 0.28 acres of land, consisting of rooftops, paved parking areas, and grass. The curve number (CN) for this subarea is calculates as 94 with a time of concentration of 6.0 minutes. Runoff from this subcatchment is collected via on-site catch

basins and is conveyed to the existing catch basins directed to the closed drainage system within Jackson Street (DP#1).

Subcatchment P-2 contains approximately 0.39 acres of land, consisting of rooftops, paved parking areas, and grass. The curve number (CN) for this subarea is calculates as 94 with a time of concentration of 6.0 minutes. A portion of runoff from this subcatchment is collected via an on-site catch basin and is conveyed to the existing closed drainage system within Lagrange Street (DP#2). The remaining portions of runoff flow overland towards Lagrange Street (DP#2).

Subcatchment P-3 contains approximately 0.94 acres of land, consisting of rooftops, paved parking areas, and grass. The curve number (CN) for this subarea is calculates as 86 with a time of concentration of 6.0 minutes. Runoff from this subcatchment is collected via on-site catch basins and is directed to the proposed underground detention system (BMP-1). Overflow from the detention basin discharges to the closed drainage system in Lagrange Street (DP#2).

Under proposed conditions DP#1 receives stormwater flows from approximately 0.28 acres of land, designated as watershed “P-1”. Refer to Table 3.1 below for additional detail.

Under proposed conditions DP#2 receives stormwater flows from approximately 1.33 acres of land, designated as watershed “P-2” and “P-3”. Refer to Table 3.1 below for additional detail.

Table 3.1: Proposed Sub-catchment Summary

Sub-catchment Name	Total Area (acres)	Cover Description	Curve Number (CN)	Time of Concentration (Tc, minutes)	Hydrologic Routing
P-1	0.28±	Rooftops, paved parking, grass	94	6.0	DP#1
P-2	0.39±	Rooftops, paved parking, grass	94	6.0	DP#2
P-3	0.94±	Rooftops, paved parking, grass, basin bottom	86	6.0	BMP-1 / DP#2

Refer to **Table 1.1, and 6.1** for the calculated proposed conditions peak rates of runoff. For additional hydrologic information, refer to **Appendix D** and the Drainage Area Maps in the appendices of this report for a graphical representation of the proposed drainage areas.

IV. METHODOLOGY

Peak Flow Calculations

Methodology utilized to design the proposed stormwater management system includes compliance with the guidelines set forth in the latest edition of the Massachusetts DEP Stormwater Handbook. The pre- and post-development runoff rates being discharged from the site were computed using the HydroCAD computer program. The drainage area and outlet information were entered into the program, which routes storm flows based on NRCS TR-20 and TR-55 methods. The other components of the model were determined following standard NRCS procedures for Curve Numbers (CNs) and times of concentrations documented in the appendices of this report. The rainfall data utilized and listed below in table 4.1 below for stormwater calculations is based on NOAA. Refer to **Appendix F** for more information.

Table 4.1: NOAA Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.16	4.89	5.97	7.64

*Values derived from NOAA ATLAS on 1/29/2024

The proposed stormwater management as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year design storm events. Additionally, the proposed project meets, or exceeds, the MADEP Stormwater Management standards. Compliance with these standards is described further below.

V. STORMWATER MANAGEMENT STANDARDS

Standard #1: No New Untreated Discharges

The project has been designed so that proposed impervious areas shall be collected and passed through the proposed drainage system for treatment prior to discharge.

Standard #2: Peak Rate Attenuation

As outlined in **Table 1.1** and **Table 6.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at all design points.

Standard #3: Recharge

On-site soil testing was conducted by Bohler in July 2021 which shows that on-site soils consist of fill materials containing brick, concrete, pipes, and wood among other items. Based upon the on-site testing it was determined that existing soils are not suitable for infiltration purposes. Refer to Appendix C for copies of the soil observation logs.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins and proprietary water quality units. TSS removal calculations are included in **Appendix F** of this report. The project as proposed will involve the creation of 8,908 square feet of new impervious area. The water quality units have been sized following MassDEP's guidance for water quality flows. Refer to **Appendix F** of this report for calculations documenting required and provided water quality volumes.

Standard #5: Land Use with Higher Potential Pollutant Loads

Not Applicable for this project.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

The proposed project is classified as a redevelopment therefore the project has been designed to comply with the MassDEP Stormwater Handbook requirements to the greatest extent

practicable. The design meets all applicable standards for a new development with the exception of Standard #3, Groundwater Recharge, for the reason noted above.

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

The proposed project will provide construction period erosion and sedimentation controls as indicated within the site plan set provided for this project. This includes a proposed construction exit, protection for stormwater inlets, protection around temporary material stock piles and various other techniques as outlined on the erosion and sediment control sheets. Additionally, the project is required to file a Notice of Intent with the US EPA and implement a Stormwater Pollution Prevention Plan (SWPPP) during the construction period. The SWPPP will be prepared prior to the start of construction and will be implemented by the site contractor under the guidance and responsibility of the project's proponent.

Standard #9: Operation and Maintenance Plan (O&M Plan)

An Operation and Maintenance (O&M) Plan for this site has been prepared and is included in **Appendix G** of this report. The O&M Plan outlines procedures and time tables for the long term operation and maintenance of the proposed site stormwater management system, including initial inspections upon completion of construction, and periodic monitoring of the system components, in accordance with established practices and the manufacturer's recommendations. The O&M Plan includes a list of responsible parties and an estimated budget for inspections and maintenance.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensates, etc.) and will not contain any illicit discharges from prohibited sources. An Illicit Discharge Statement is included in **Appendix G** of this report.

VI. SUMMARY

In summary, the proposed stormwater management system illustrated on the drawings prepared by Bohler results in a reduction in peak rates of runoff from the subject site when compared to pre-development conditions for the 2-, 10-, 25- and 100-year storm frequencies. In addition, the proposed best management practices will result in an effective removal of total suspended solids from the post-development runoff. The pre-development versus post-development stormwater discharge comparisons are contained in **Table 6.1**:

Table 6.1: Design Point Peak Runoff Rate Summary

Point of Analysis	2-Year Storm			10-Year Storm			25-Year Storm			100-Year Storm		
	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ
DP#1	0.81	0.78	**-0.03**	1.29	1.27	**-0.02**	1.59	1.57	**-0.02**	2.04	2.04	**0.00**
DP#2	2.91	2.28	**-0.63**	5.27	4.70	**-0.57**	6.75	5.72	**-1.03**	9.03	7.11	**-1.92**

**Flows are represented in cubic feet per second (cfs)*

As outlined in the table above, the proposed stormwater management system as designed will provide a decrease in peak rates of runoff from the proposed facility for the 2-, 10-, 25- and 100-year storm events. Additionally, the project meets or exceeds the MADEP Stormwater Management Standards as described further herein.

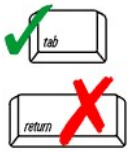
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

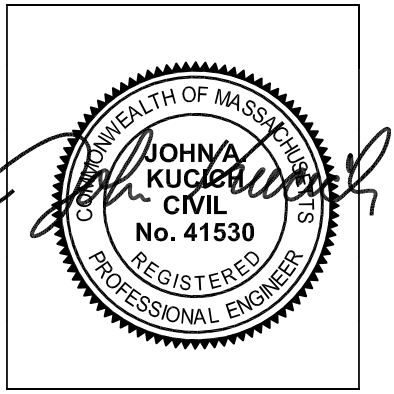
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



2/15/2024

Signature and Date

Checklist

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

☐ New development

☒ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☐ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☐ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☐ Other (describe): _____

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

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

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

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

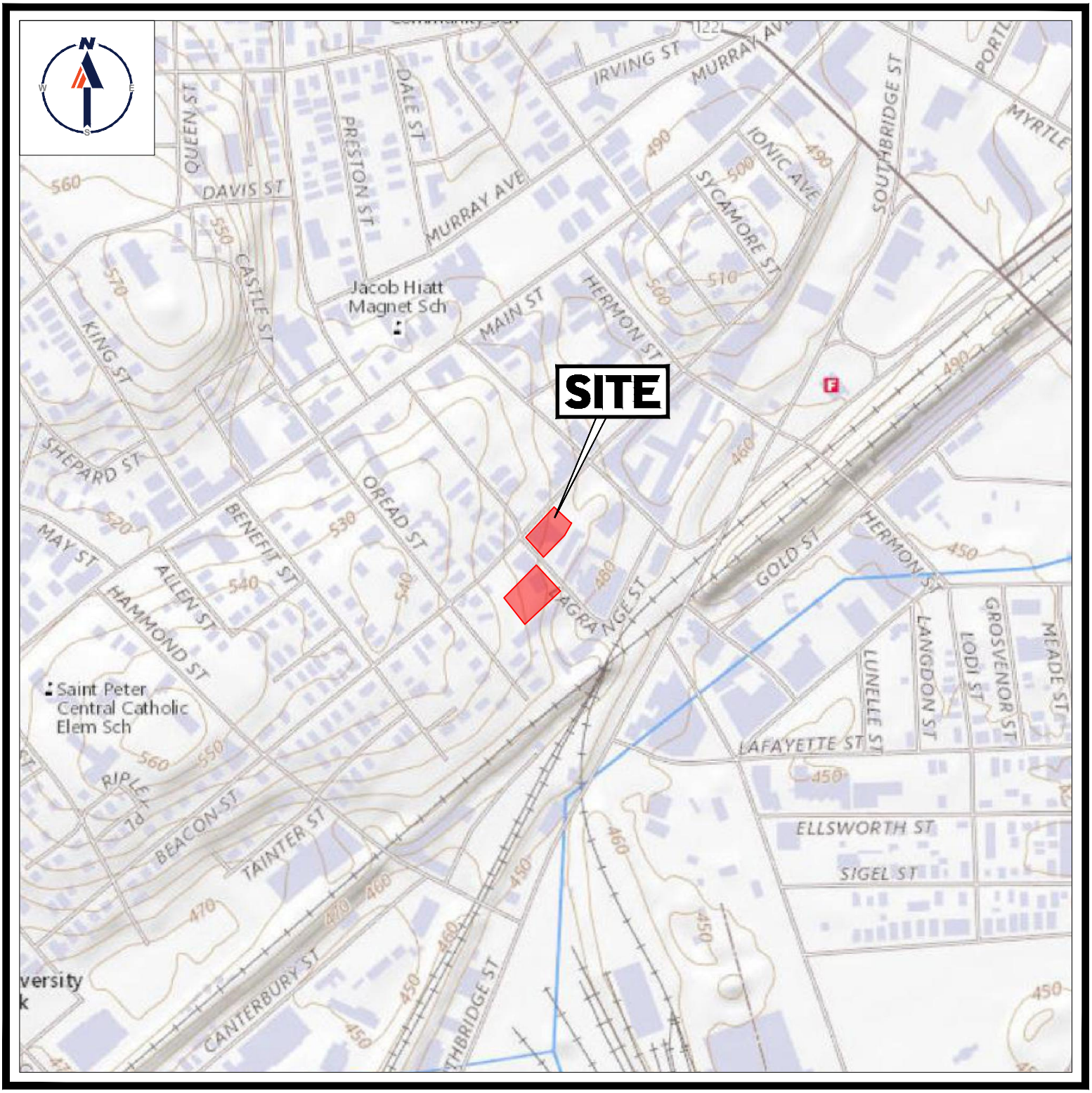
☐ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B: PROJECT LOCATION MAPS

- *USGS MAP*
- *FEMA FIRMETTE*



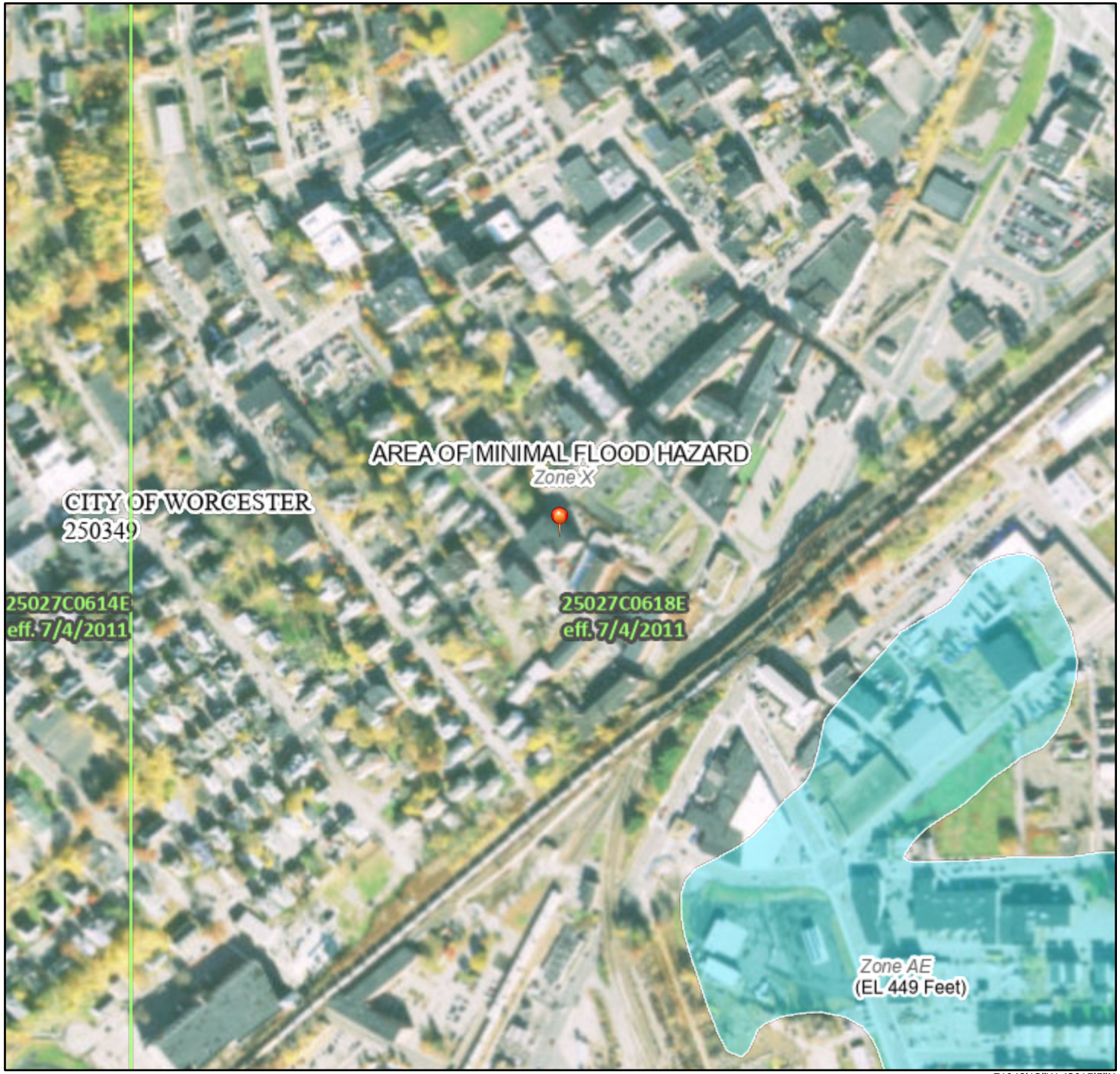
USGS MAP

SCALE: 1" = 500'
SOURCE: USGS WORCESTER NORTH QUADRANGLE

National Flood Hazard Layer FIRMette

FEMA

71°48'49"W 42°15'31"N



71°48'12"W 42°15'5"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

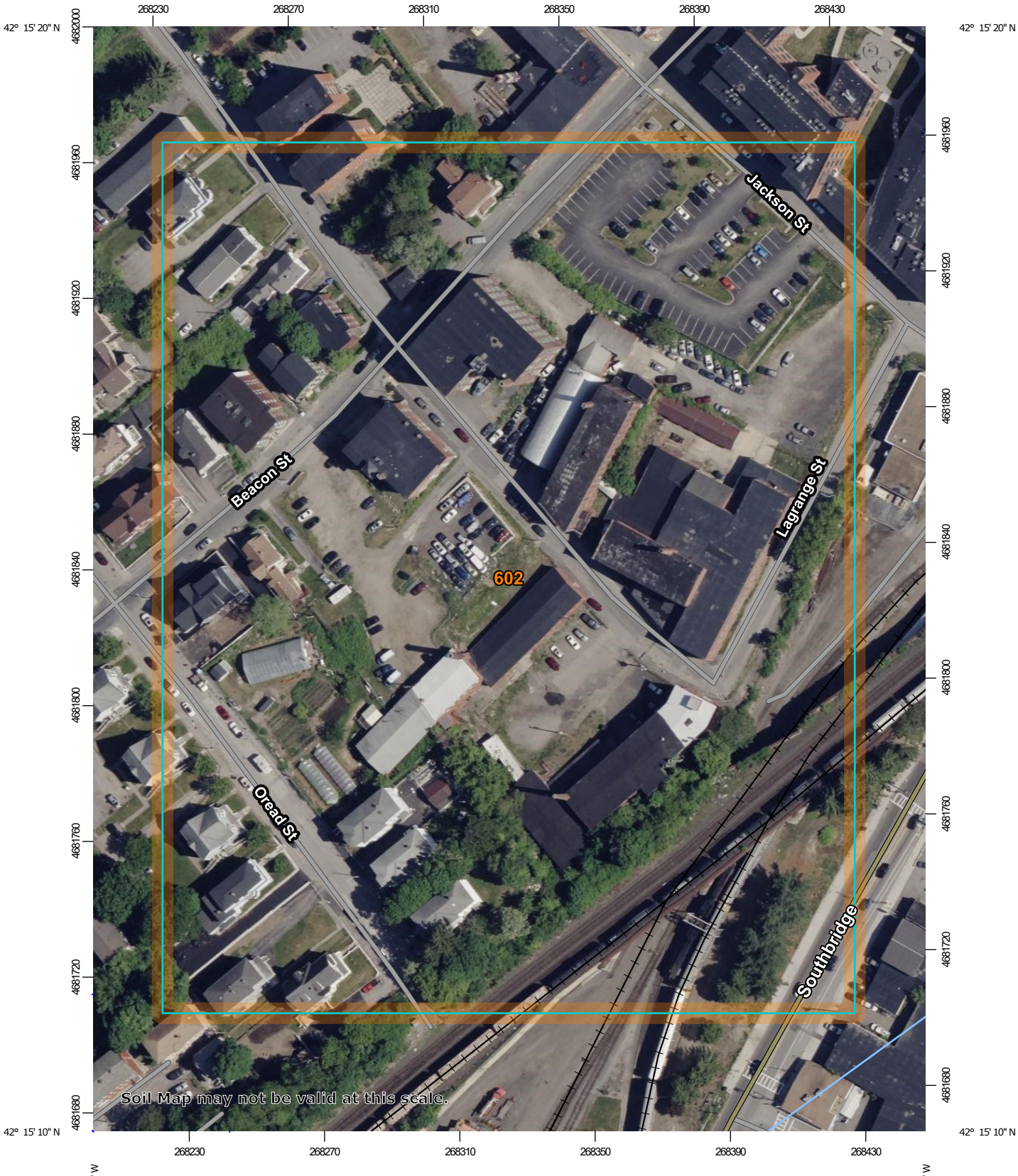
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 2/7/2024 at 8:27 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX C: SOIL AND WETLAND INFORMATION

- *NCRS CUSTOM SOIL RESOURCE REPORT*
- *ON-SITE SOIL TESTING LOGS*

Soil Map—Worcester County, Massachusetts, Northeastern Part
(98 Beacon Street Soil Map)



Map Scale: 1:1,590 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 18, Sep 10, 2023

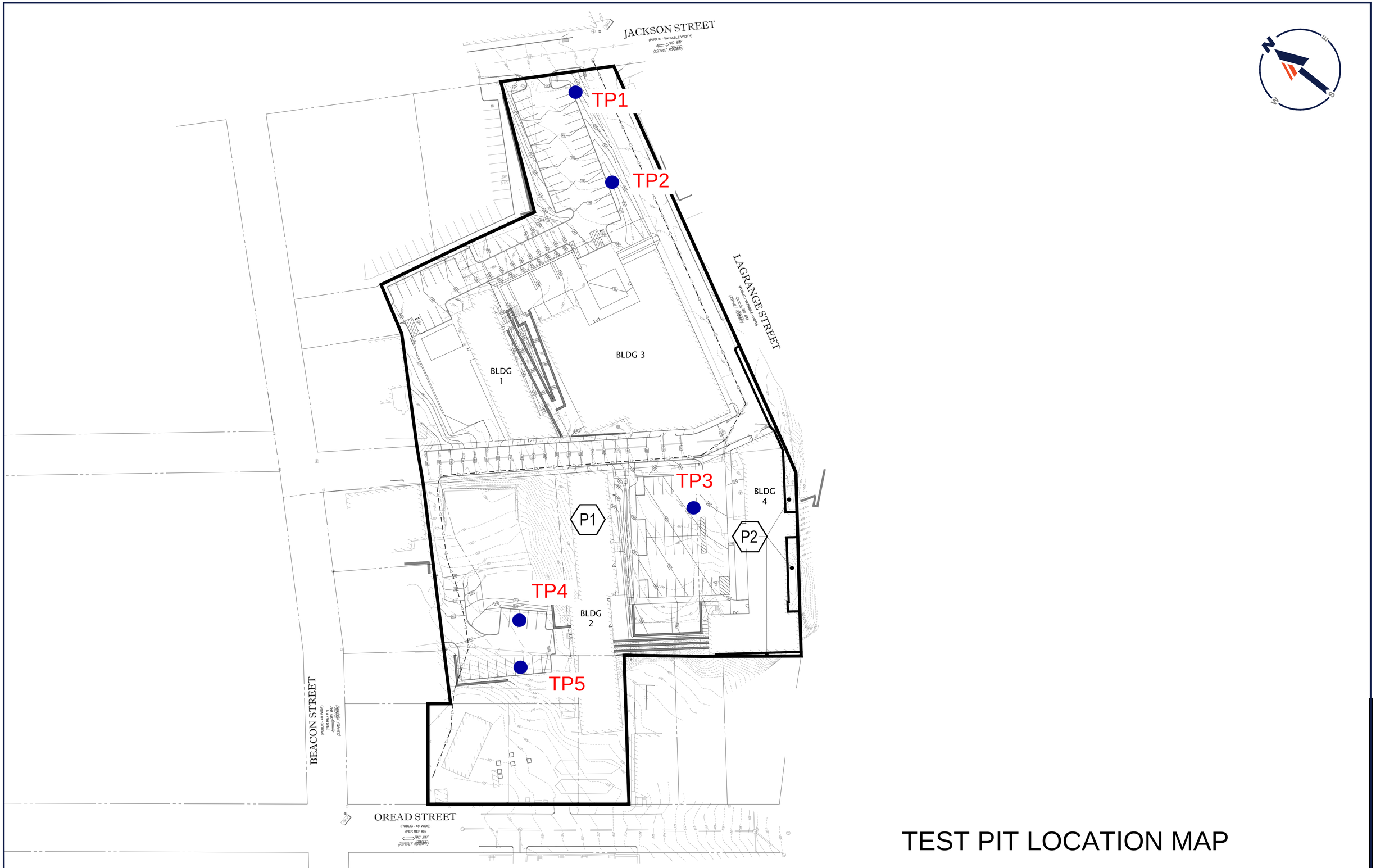
Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 22, 2022—Jun 5, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
602	Urban land	13.0	100.0%
Totals for Area of Interest		**13.0**	**100.0%**



TEST PIT LOCATION MAP

Site Location or lot #	Lagrange St - Worcester, MA				DEEP HOLE # BE 1
Applicant/owner:	Rees Larking Development				
DATE:	July 16, 2021	WEATHER:	Sunny	TEMP: 85 º	
LOCATION: (Refer to sketch attached)	Along entrance drive from Jackson Street				
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Unpaved Parking Area for Auto Body Shop		Landform:		
Vegetation:	Weeds		Slope:	3-4%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	+/-100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	50 ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-64"	FILL	-	-	Bricks, steel cabling, and wall sections throughout
	-	-		
	-	-		
	-	-		

Parent Material (geologic):	Glacial Till	Depth to Bedrock:	None
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	Encountered two concrete slabs at bottom of hole, first could be broken through but not the second. Top of second slab was 64" below grade. For drainage only.

Site Location or lot #	Lagrange St - Worcester, MA				DEEP HOLE # BE 2
Applicant/owner:	Rees Larking Development				
DATE:	July 16, 2021	WEATHER:	Sunny	TEMP: 85 º	
LOCATION: (Refer to sketch attached)	Along entrance drive from Jackson Street				
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Parking Area for Auto Body Shop		Landform:		
Vegetation:	Weeds		Slope:	3-4%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	+/-100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	75 ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-87"	FILL	-	-	Bricks, Pipes, steel cabling, and wall sections throughout
	-	-		
	-	-		
	-	-		

Parent Material (geologic):	Glacial Till	Depth to Bedrock:	None
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		N/A

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	Encountered thick slab at bottom of hole that could not be broken through. Top of slab was 87" below grade. Water encountered at approximately 80" below grade, appeared to be For drainage only.

Site Location or lot #	Lagrange St - Worcester, MA				DEEP HOLE # BE 3
Applicant/owner:	Rees Larking Development				
DATE:	July 16, 2021	WEATHER:	Sunny	TEMP: 85 º	
LOCATION: (Refer to sketch attached)	Along entrance drive from Jackson Street				
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Unpaved parking area for Machine Shop		Landform:		
Vegetation:	N/A		Slope:	5%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	+/-100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	>100 ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-90"	FILL	-	-	Gravel, wood, and other buried materials
	-	-		
	-	-		
	-	-		

Parent Material (geologic):	Glacial Till	Depth to Bedrock:	None
Depth to Groundwater:	Standing Water in Hole:	88"	
	Weeping From Pit Face:	84"	
	Estimated Seasonal High Groundwater:		50"

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:			50"		
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	There appears to be a slab at the eastern edge of the test pit, near the building, approximately 18" below grade. Owner said there are a number of buried walls in front of building that has limited their abaility to construct drain improvements over the years. Two monitoring wells installed in parking area, owner indicated it is part of the ongoing Phase 2. For drainage only.

Site Location or lot #	Lagrange St - Worcester, MA				DEEP HOLE # BE 4
Applicant/owner:	Rees Larking Development				
DATE:	July 16, 2021	WEATHER:	Sunny	TEMP: 85 º	
LOCATION: (Refer to sketch attached)	Along entrance drive from Jackson Street				
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Unpaved Parking area for Paint Shop		Landform:		
Vegetation:	Weeds		Slope:	1-2%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	+/-100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	>100 ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-103"	FILL	-	-	Bricks throughout
	-	-		
	-	-		
	-	-		

Parent Material (geologic):	Glacial Till	Depth to Bedrock:	None
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:					
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	Refusal at 103" where a slab was encountered. Buried wall appeared to be present along side of test pit. For drainage only.

Site Location or lot #	Lagrange St - Worcester, MA				DEEP HOLE # BE 5
Applicant/owner:	Rees Larking Development				
DATE:	July 16, 2021	WEATHER:	Sunny	TEMP: 85 º	
LOCATION: (Refer to sketch attached)	Along entrance drive from Jackson Street				
PERFORMED BY:	Brandon Barry, E.I.T. (Mass SE#14024)				
WITNESSED BY:	N/A (for drainage only)				
Land Use:	Unpaved Delivery area for Paint Shop		Landform:		
Vegetation:	Weeds		Slope:	1-2%	
Stone Walls:	☐ Y ☒ N		Surface Stones:	☐ Y ☒ N	

Distance From:			
Open Water Bodies:	>100 ft ft.	Possible Wet Area:	+/-100 ft.
Drinking Water Well:	N/A ft.	Drainageway:	N/A ft.
Property Line:	>100 ft.	Other:	

DEEP OBSERVATION HOLE LOG

Depth	Soil Horizon	Soil Texture	Soil Color	Other: Structures; Stones; Boulders; Consistency; % gravel
0-3"	FILL	-	-	Gravel
3-29"	Bw	Sandy Loam	10YR6/4	Massive, Friable, 5% Cobbles & Stones
29-104"	C1	Loamy Sand	10YR6/2	Massive, Friable, 5-10% Cobbles & Stones
	-	-		

Parent Material (geologic):	Glacial Till	Depth to Bedrock:	None
Depth to Groundwater:	Standing Water in Hole:	None	
	Weeping From Pit Face:	None	
	Estimated Seasonal High Groundwater:		

DETERMINATION FOR SEASONAL HIGH WATER TABLE

Method used:		Depth observed standing in obs. hole:					
		Depth to weeping from side of obs. hole:					
		Depth to soil mottles, description:			68"		
		Groundwater adjustment:					
Index Well #:	NA	Reading Date:	NA	Index Well Level:	NA	Adj. Factor:	NA
Adj. ground water level:		NA					

Notes:	Mottles at 68". Soils very damp below 80" but no standing or weeping in the pit.

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS DRAINAGE MAP*
- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*

LEGEND

- DP# — DESIGN POINT
- EX-# — EXISTING SUBCATCHMENT
- OVERALL ANALYSIS BOUNDARY
- SUBCATCHMENT BOUNDARY
- TIME OF CONCENTRATION

BOHLER

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
SUSTAINABLE DESIGN
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	4/28/2023	ZBA COMMENTS	OCR / MMA
2	2/15/2024	PLANNING BOARD SUBMISSION	OCR / MMA

811 Know what's below. Call before you dig.

ALWAYS CALL 811

It's fast. It's free. It's the law.

PERMIT SET

THIS DRAWING IS INTENDED FOR MUNICIPAL AND/OR AGENCY REVIEW AND APPROVAL. IT IS NOT INTENDED AS A CONSTRUCTION DOCUMENT UNLESS INDICATED OTHERWISE.

PROJECT No.:	MAA220072.00
DRAWN BY:	OCR / CSE
CHECKED BY:	MMA
DATE:	03/03/2023
CAD I.D.:	MAA220072.00-DMAP-2A

PROJECT:

PROPOSED SITE PLAN DOCUMENTS

FOR

98 BEACON STREET LLC

PROPOSED DEVELOPMENT

MAP: 3 LOT: 1A & 8 BEACON STREET, CITY OF WORCESTER, WORCESTER COUNTY, MASSACHUSETTS

BOHLER

352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900

www.BohlerEngineering.com

J.A. KUCICH

PROFESSIONAL ENGINEER

MASSACHUSETTS LICENSE No. 41533
NEW HAMPSHIRE LICENSE No. 15476
CONNECTICUT LICENSE No. 26127
RHODE ISLAND LICENSE No. 2616
MAINE LICENSE No. 24553

SHEET TITLE:

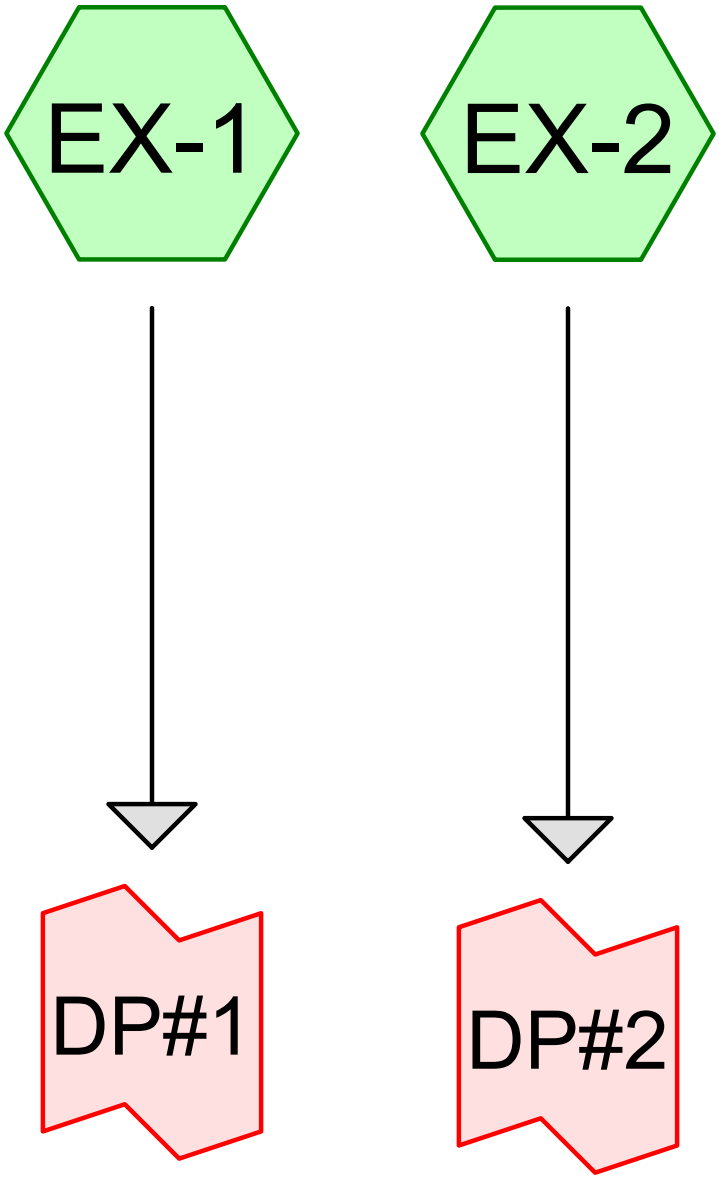
EXISTING CONDITIONS DRAINAGE AREA MAP

SHEET NUMBER:

EXDAM

REVISION 2 - 2/15/2024

P:\2022\MAA220072.00\CAD\DRAWINGS\PLAN SET\DRAINAGE MAPS\MAA220072.00-DMAP-2A-----LAYOUT: EXDAM-EXIST. WATERSHED-24X36



Subcat Reach Pond Link

Routing Diagram for Pre-Development Analysis
Prepared by Bohler Engineers, Printed 2/9/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.647	74	>75% Grass cover, Good, HSG C (EX-1, EX-2)
0.129	96	Gravel surface, HSG C (EX-1)
0.567	98	Paved parking, HSG C (EX-1, EX-2)
0.265	98	Roofs, HSG C (EX-1, EX-2)
1.608	**88**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.608	HSG C	EX-1, EX-2
0.000	HSG D	
0.000	Other	
1.608		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.647	0.000	0.000	0.647	>75% Grass cover, Good	EX-1, EX-2
0.000	0.000	0.129	0.000	0.000	0.129	Gravel surface	EX-1
0.000	0.000	0.567	0.000	0.000	0.567	Paved parking	EX-1, EX-2
0.000	0.000	0.265	0.000	0.000	0.265	Roofs	EX-1, EX-2
0.000	**0.000**	**1.608**	**0.000**	**0.000**	**1.608**	**TOTAL AREA**	

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 EX-1: Runoff Area=11,947 sf 49.33% Impervious Runoff Depth=2.71"
Tc=6.0 min CN=96 Runoff=0.81 cfs 0.062 af

Subcatchment EX-2: Runoff Area=58,108 sf 52.30% Impervious Runoff Depth=1.88"
Flow Length=464' Tc=6.3 min CN=87 Runoff=2.91 cfs 0.209 af

Link DP#1: Inflow=0.81 cfs 0.062 af
Primary=0.81 cfs 0.062 af

Link DP#2: Inflow=2.91 cfs 0.209 af
Primary=2.91 cfs 0.209 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.271 af Average Runoff Depth = 2.02"
48.20% Pervious = 0.775 ac 51.80% Impervious = 0.833 ac

Summary for Subcatchment EX-1:

Runoff = 0.81 cfs @ 12.08 hrs, Volume= 0.062 af, Depth= 2.71"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.16"

Area (sf)	CN	Description
1,070	98	Paved parking, HSG C
449	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
5,604	96	Gravel surface, HSG C
11,947	96	Weighted Average
6,053		50.67% Pervious Area
5,894		49.33% Impervious Area

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

Summary for Subcatchment EX-2:

Runoff = 2.91 cfs @ 12.09 hrs, Volume= 0.209 af, Depth= 1.88"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.16"

Area (sf)	CN	Description
23,650	98	Paved parking, HSG C
27,717	74	>75% Grass cover, Good, HSG C
6,741	98	Roofs, HSG C
58,108	87	Weighted Average
27,717		47.70% Pervious Area
30,391		52.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0350	0.19		**Sheet Flow, A-B** Grass: Short n= 0.150 P2= 3.23"
1.0	114	0.0811	1.99		**Shallow Concentrated Flow, B-C** Short Grass Pasture Kv= 7.0 fps
0.8	300	0.0850	5.92		**Shallow Concentrated Flow, C-D** Paved Kv= 20.3 fps
6.3	464	Total			

Summary for Link DP#1:

Inflow Area = 0.274 ac, 49.33% Impervious, Inflow Depth = 2.71" for 2 Year event
Inflow = 0.81 cfs @ 12.08 hrs, Volume= 0.062 af
Primary = 0.81 cfs @ 12.08 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.334 ac, 52.30% Impervious, Inflow Depth = 1.88" for 2 Year event
Inflow = 2.91 cfs @ 12.09 hrs, Volume= 0.209 af
Primary = 2.91 cfs @ 12.09 hrs, Volume= 0.209 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 EX-1: Runoff Area=11,947 sf 49.33% Impervious Runoff Depth=4.42"
Tc=6.0 min CN=96 Runoff=1.29 cfs 0.101 af

Subcatchment EX-2: Runoff Area=58,108 sf 52.30% Impervious Runoff Depth=3.46"
Flow Length=464' Tc=6.3 min CN=87 Runoff=5.27 cfs 0.385 af

Link DP#1: Inflow=1.29 cfs 0.101 af
Primary=1.29 cfs 0.101 af

Link DP#2: Inflow=5.27 cfs 0.385 af
Primary=5.27 cfs 0.385 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.486 af Average Runoff Depth = 3.63"
48.20% Pervious = 0.775 ac 51.80% Impervious = 0.833 ac

Summary for Subcatchment EX-1:

Runoff = 1.29 cfs @ 12.08 hrs, Volume= 0.101 af, Depth= 4.42"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.89"

Area (sf)	CN	Description
1,070	98	Paved parking, HSG C
449	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
5,604	96	Gravel surface, HSG C
11,947	96	Weighted Average
6,053		50.67% Pervious Area
5,894		49.33% Impervious Area

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

Summary for Subcatchment EX-2:

Runoff = 5.27 cfs @ 12.09 hrs, Volume= 0.385 af, Depth= 3.46"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.89"

Area (sf)	CN	Description
23,650	98	Paved parking, HSG C
27,717	74	>75% Grass cover, Good, HSG C
6,741	98	Roofs, HSG C
58,108	87	Weighted Average
27,717		47.70% Pervious Area
30,391		52.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0350	0.19		**Sheet Flow, A-B**
					Grass: Short n= 0.150 P2= 3.23"
1.0	114	0.0811	1.99		**Shallow Concentrated Flow, B-C**
					Short Grass Pasture Kv= 7.0 fps
0.8	300	0.0850	5.92		**Shallow Concentrated Flow, C-D**
					Paved Kv= 20.3 fps
6.3	464	Total			

Summary for Link DP#1:

Inflow Area = 0.274 ac, 49.33% Impervious, Inflow Depth = 4.42" for 10 Year event
Inflow = 1.29 cfs @ 12.08 hrs, Volume= 0.101 af
Primary = 1.29 cfs @ 12.08 hrs, Volume= 0.101 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.334 ac, 52.30% Impervious, Inflow Depth = 3.46" for 10 Year event
Inflow = 5.27 cfs @ 12.09 hrs, Volume= 0.385 af
Primary = 5.27 cfs @ 12.09 hrs, Volume= 0.385 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 EX-1: Runoff Area=11,947 sf 49.33% Impervious Runoff Depth=5.50"
Tc=6.0 min CN=96 Runoff=1.59 cfs 0.126 af

Subcatchment EX-2: Runoff Area=58,108 sf 52.30% Impervious Runoff Depth=4.49"
Flow Length=464' Tc=6.3 min CN=87 Runoff=6.75 cfs 0.499 af

Link DP#1: Inflow=1.59 cfs 0.126 af
Primary=1.59 cfs 0.126 af

Link DP#2: Inflow=6.75 cfs 0.499 af
Primary=6.75 cfs 0.499 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.625 af Average Runoff Depth = 4.66"
48.20% Pervious = 0.775 ac 51.80% Impervious = 0.833 ac

Summary for Subcatchment EX-1:

Runoff = 1.59 cfs @ 12.08 hrs, Volume= 0.126 af, Depth= 5.50"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=5.97"

Area (sf)	CN	Description
1,070	98	Paved parking, HSG C
449	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
5,604	96	Gravel surface, HSG C
11,947	96	Weighted Average
6,053		50.67% Pervious Area
5,894		49.33% Impervious Area

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

Summary for Subcatchment EX-2:

Runoff = 6.75 cfs @ 12.09 hrs, Volume= 0.499 af, Depth= 4.49"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=5.97"

Area (sf)	CN	Description
23,650	98	Paved parking, HSG C
27,717	74	>75% Grass cover, Good, HSG C
6,741	98	Roofs, HSG C
58,108	87	Weighted Average
27,717		47.70% Pervious Area
30,391		52.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0350	0.19		**Sheet Flow, A-B**
					Grass: Short n= 0.150 P2= 3.23"
1.0	114	0.0811	1.99		**Shallow Concentrated Flow, B-C**
					Short Grass Pasture Kv= 7.0 fps
0.8	300	0.0850	5.92		**Shallow Concentrated Flow, C-D**
					Paved Kv= 20.3 fps
6.3	464	Total			

Summary for Link DP#1:

Inflow Area = 0.274 ac, 49.33% Impervious, Inflow Depth = 5.50" for 25 Year event
Inflow = 1.59 cfs @ 12.08 hrs, Volume= 0.126 af
Primary = 1.59 cfs @ 12.08 hrs, Volume= 0.126 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.334 ac, 52.30% Impervious, Inflow Depth = 4.49" for 25 Year event
Inflow = 6.75 cfs @ 12.09 hrs, Volume= 0.499 af
Primary = 6.75 cfs @ 12.09 hrs, Volume= 0.499 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 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 EX-1: Runoff Area=11,947 sf 49.33% Impervious Runoff Depth=7.16"
Tc=6.0 min CN=96 Runoff=2.04 cfs 0.164 af

Subcatchment EX-2: Runoff Area=58,108 sf 52.30% Impervious Runoff Depth=6.10"
Flow Length=464' Tc=6.3 min CN=87 Runoff=9.03 cfs 0.678 af

Link DP#1: Inflow=2.04 cfs 0.164 af
Primary=2.04 cfs 0.164 af

Link DP#2: Inflow=9.03 cfs 0.678 af
Primary=9.03 cfs 0.678 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.842 af Average Runoff Depth = 6.28"
48.20% Pervious = 0.775 ac 51.80% Impervious = 0.833 ac

Summary for Subcatchment EX-1:

Runoff = 2.04 cfs @ 12.08 hrs, Volume= 0.164 af, Depth= 7.16"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=7.64"

Area (sf)	CN	Description
1,070	98	Paved parking, HSG C
449	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
5,604	96	Gravel surface, HSG C
11,947	96	Weighted Average
6,053		50.67% Pervious Area
5,894		49.33% Impervious Area

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

Summary for Subcatchment EX-2:

Runoff = 9.03 cfs @ 12.09 hrs, Volume= 0.678 af, Depth= 6.10"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=7.64"

Area (sf)	CN	Description
23,650	98	Paved parking, HSG C
27,717	74	>75% Grass cover, Good, HSG C
6,741	98	Roofs, HSG C
58,108	87	Weighted Average
27,717		47.70% Pervious Area
30,391		52.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.5	50	0.0350	0.19		**Sheet Flow, A-B**
					Grass: Short n= 0.150 P2= 3.23"
1.0	114	0.0811	1.99		**Shallow Concentrated Flow, B-C**
					Short Grass Pasture Kv= 7.0 fps
0.8	300	0.0850	5.92		**Shallow Concentrated Flow, C-D**
					Paved Kv= 20.3 fps
6.3	464	Total			

Summary for Link DP#1:

Inflow Area = 0.274 ac, 49.33% Impervious, Inflow Depth = 7.16" for 100 Year event
Inflow = 2.04 cfs @ 12.08 hrs, Volume= 0.164 af
Primary = 2.04 cfs @ 12.08 hrs, Volume= 0.164 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

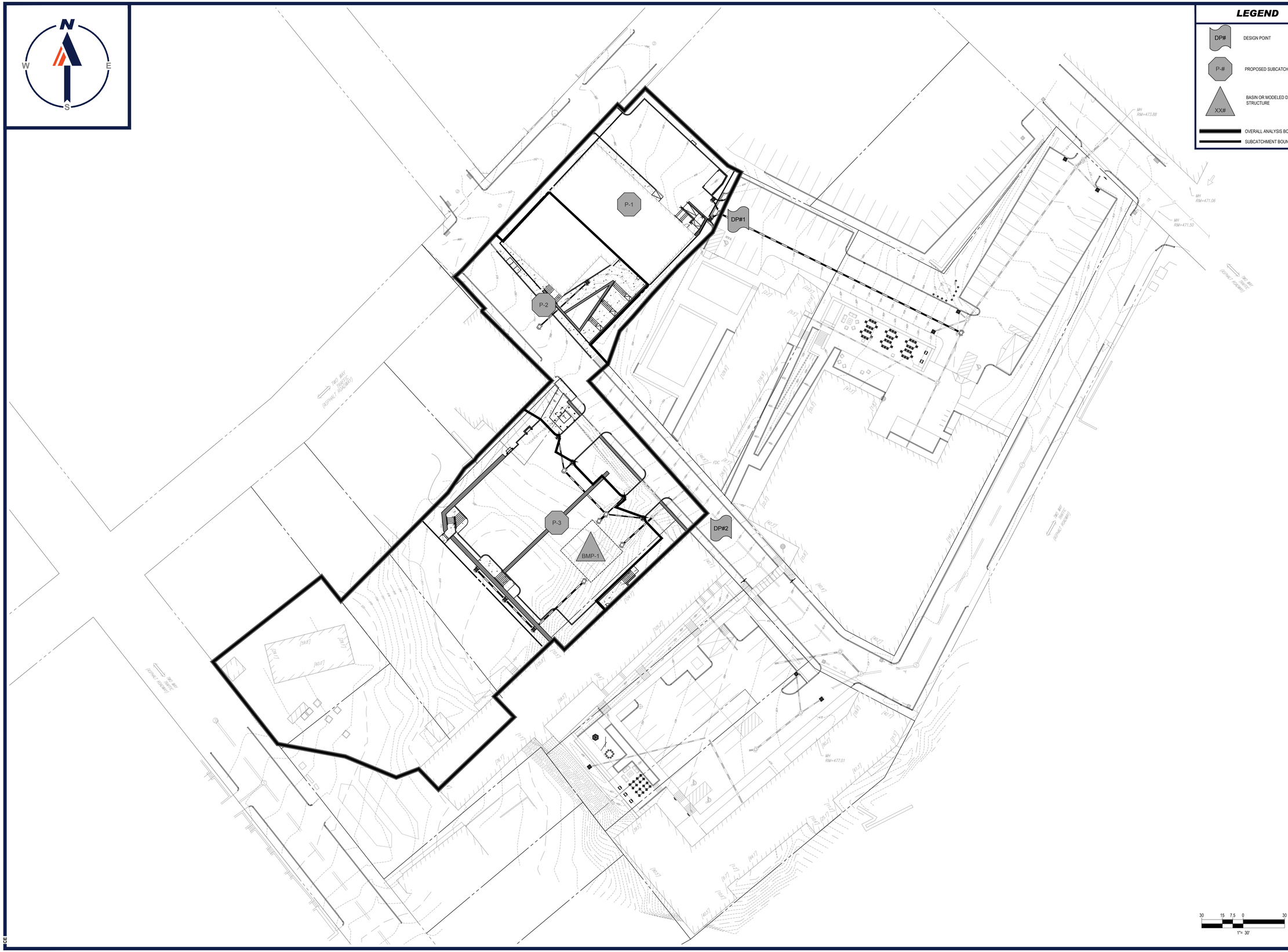
Summary for Link DP#2:

Inflow Area = 1.334 ac, 52.30% Impervious, Inflow Depth = 6.10" for 100 Year event
Inflow = 9.03 cfs @ 12.09 hrs, Volume= 0.678 af
Primary = 9.03 cfs @ 12.09 hrs, Volume= 0.678 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs

APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS DRAINAGE MAP*
- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*



LEGEND

- DP# — DESIGN POINT
- P-# — PROPOSED SUBCATCHMENT
- XX# — BASIN OR MODELED DRAINAGE STRUCTURE
- OVERALL ANALYSIS BOUNDARY
- SUBCATCHMENT BOUNDARY

BOHLER

SITE CIVIL AND CONSULTING ENGINEERING
LAND SURVEYING
PROGRAM MANAGEMENT
LANDSCAPE ARCHITECTURE
SUSTAINABLE DESIGN
PERMITTING SERVICES
TRANSPORTATION SERVICES

REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	4/28/2023	ZBA COMMENTS	OCR / MMA
2	2/15/2024	PLANNING BOARD SUBMISSION	OCR / MMA

811 Know what's below. Call before you dig.

ALWAYS CALL 811

It's fast. It's free. It's the law.

PERMIT SET

THIS DRAWING IS INTENDED FOR MUNICIPAL AND/OR AGENCY REVIEW AND APPROVAL. IT IS NOT INTENDED AS A CONSTRUCTION DOCUMENT UNLESS INDICATED OTHERWISE.

PROJECT No.:	MAA220072.00
DRAWN BY:	OCR / CSE
CHECKED BY:	MMA
DATE:	03/03/2023
CAD I.D.:	MAA220072.00-DMAP-2A

PROJECT:

PROPOSED SITE PLAN DOCUMENTS

FOR

98 BEACON STREET LLC

PROPOSED DEVELOPMENT

MAP: 3 LOT: 1A & 8
BEACON STREET,
CITY OF WORCESTER,
WORCESTER COUNTY,
MASSACHUSETTS

BOHLER
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
www.BohlerEngineering.com

J.A. KUCICH
PROFESSIONAL ENGINEER
MASSACHUSETTS LICENSE No. 41530
NEW HAMPSHIRE LICENSE No. 15424
CONNECTICUT LICENSE No. 28127
RHODE ISLAND LICENSE No. 14516
MAINE LICENSE No. 22553

SHEET TITLE:

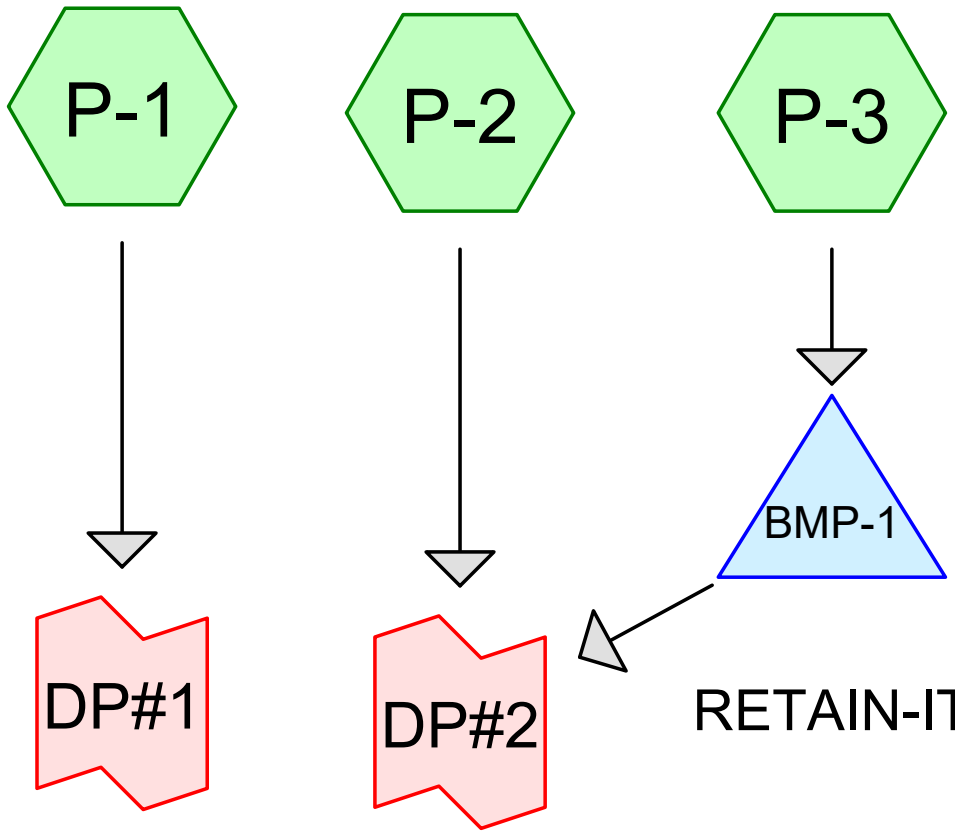
PROPOSED CONDITIONS DRAINAGE AREA MAP

SHEET NUMBER:

PRDAM

REVISION 2 - 2/15/2024

P:\2022\MAA220072.00\CAD\DRAWINGS\PLAN SET\DRAINAGE MAPS\MAA220072.00-DMAP-2A-----3-LAYOUT PRDAM-PROP WATERSHED-24X36



Subcat Reach Pond Link

Routing Diagram for Post-Development Analysis
Prepared by Bohler Engineers, Printed 2/15/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.571	74	>75% Grass cover, Good, HSG C (P-1, P-2, P-3)
0.772	98	Paved parking, HSG C (P-1, P-2, P-3)
0.265	98	Roofs, HSG C (P-1, P-2, P-3)
1.608	**89**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
1.608	HSG C	P-1, P-2, P-3
0.000	HSG D	
0.000	Other	
1.608		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.571	0.000	0.000	0.571	>75% Grass cover, Good	P-1, P-2, P-3
0.000	0.000	0.772	0.000	0.000	0.772	Paved parking	P-1, P-2, P-3
0.000	0.000	0.265	0.000	0.000	0.265	Roofs	P-1, P-2, P-3
0.000	**0.000**	**1.608**	**0.000**	**0.000**	**1.608**	**TOTAL AREA**	

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

Subcatchment P-1: Runoff Area=12,075 sf 85.05% Impervious Runoff Depth=2.51"
Tc=6.0 min CN=94 Runoff=0.78 cfs 0.058 af

Subcatchment P-2: Runoff Area=16,855 sf 85.35% Impervious Runoff Depth=2.51"
Tc=6.0 min CN=94 Runoff=1.09 cfs 0.081 af

Subcatchment P-3: Runoff Area=41,125 sf 49.93% Impervious Runoff Depth=1.80"
Tc=6.0 min CN=86 Runoff=1.99 cfs 0.142 af

Pond BMP-1: RETAIN-IT Peak Elev=487.45' Storage=0.025 af Inflow=1.99 cfs 0.142 af
Outflow=1.34 cfs 0.136 af

Link DP#1: Inflow=0.78 cfs 0.058 af
Primary=0.78 cfs 0.058 af

Link DP#2: Inflow=2.28 cfs 0.216 af
Primary=2.28 cfs 0.216 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.280 af Average Runoff Depth = 2.09"
35.49% Pervious = 0.571 ac 64.51% Impervious = 1.037 ac

Summary for Subcatchment P-1:

Runoff = 0.78 cfs @ 12.08 hrs, Volume= 0.058 af, Depth= 2.51"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.16"

Area (sf)	CN	Description
5,446	98	Paved parking, HSG C
1,805	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
12,075	94	Weighted Average
1,805		14.95% Pervious Area
10,270		85.05% Impervious Area

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

Summary for Subcatchment P-2:

Runoff = 1.09 cfs @ 12.08 hrs, Volume= 0.081 af, Depth= 2.51"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.16"

Area (sf)	CN	Description
11,437	98	Paved parking, HSG C
2,469	74	>75% Grass cover, Good, HSG C
2,949	98	Roofs, HSG C
16,855	94	Weighted Average
2,469		14.65% Pervious Area
14,386		85.35% Impervious Area

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

Summary for Subcatchment P-3:

Runoff = 1.99 cfs @ 12.09 hrs, Volume= 0.142 af, Depth= 1.80"
Routed to Pond BMP-1 : RETAIN-IT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2 Year Rainfall=3.16"

Area (sf)	CN	Description
16,744	98	Paved parking, HSG C
20,590	74	>75% Grass cover, Good, HSG C
3,791	98	Roofs, HSG C
41,125	86	Weighted Average
20,590		50.07% Pervious Area
20,535		49.93% Impervious Area

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

Summary for Pond BMP-1: RETAIN-IT

Inflow Area = 0.944 ac, 49.93% Impervious, Inflow Depth = 1.80" for 2 Year event
Inflow = 1.99 cfs @ 12.09 hrs, Volume= 0.142 af
Outflow = 1.34 cfs @ 12.18 hrs, Volume= 0.136 af, Atten= 33%, Lag= 5.3 min
Primary = 1.34 cfs @ 12.18 hrs, Volume= 0.136 af
Routed to Link DP#2 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 487.45' @ 12.18 hrs Surf.Area= 0.029 ac Storage= 0.025 af

Plug-Flow detention time= 55.8 min calculated for 0.136 af (96% of inflow)
Center-of-Mass det. time= 32.1 min (855.2 - 823.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	486.20'	0.006 af	**32.00'W x 40.00'L x 4.17'H Field A** 0.122 af Overall - 0.108 af Embedded = 0.015 af x 40.0% Voids
#2A	486.70'	0.076 af	**retain_it retain_it 3.0'** x 20 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 4 Rows adjusted for 85.0 cf perimeter wall
		0.082 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	486.70'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.70' / 485.50' S= 0.0414 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	487.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	486.70'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.34 cfs @ 12.18 hrs HW=487.45' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.34 cfs of 1.87 cfs potential flow)
  ├─**2=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)
  └─**3=Orifice/Grate** (Orifice Controls 1.34 cfs @ 3.42 fps)

Summary for Link DP#1:

Inflow Area = 0.277 ac, 85.05% Impervious, Inflow Depth = 2.51" for 2 Year event
Inflow = 0.78 cfs @ 12.08 hrs, Volume= 0.058 af
Primary = 0.78 cfs @ 12.08 hrs, Volume= 0.058 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.331 ac, 60.23% Impervious, Inflow Depth = 1.95" for 2 Year event
Inflow = 2.28 cfs @ 12.11 hrs, Volume= 0.216 af
Primary = 2.28 cfs @ 12.11 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

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

Subcatchment P-1: Runoff Area=12,075 sf 85.05% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=94 Runoff=1.27 cfs 0.097 af

Subcatchment P-2: Runoff Area=16,855 sf 85.35% Impervious Runoff Depth=4.20"
Tc=6.0 min CN=94 Runoff=1.77 cfs 0.135 af

Subcatchment P-3: Runoff Area=41,125 sf 49.93% Impervious Runoff Depth=3.36"
Tc=6.0 min CN=86 Runoff=3.68 cfs 0.265 af

Pond BMP-1: RETAIN-IT Peak Elev=487.92' Storage=0.037 af Inflow=3.68 cfs 0.265 af
Outflow=3.15 cfs 0.259 af

Link DP#1: Inflow=1.27 cfs 0.097 af
Primary=1.27 cfs 0.097 af

Link DP#2: Inflow=4.70 cfs 0.394 af
Primary=4.70 cfs 0.394 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.497 af Average Runoff Depth = 3.71"
35.49% Pervious = 0.571 ac 64.51% Impervious = 1.037 ac

Summary for Subcatchment P-1:

Runoff = 1.27 cfs @ 12.08 hrs, Volume= 0.097 af, Depth= 4.20"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.89"

Area (sf)	CN	Description
5,446	98	Paved parking, HSG C
1,805	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
12,075	94	Weighted Average
1,805		14.95% Pervious Area
10,270		85.05% Impervious Area

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

Summary for Subcatchment P-2:

Runoff = 1.77 cfs @ 12.08 hrs, Volume= 0.135 af, Depth= 4.20"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.89"

Area (sf)	CN	Description
11,437	98	Paved parking, HSG C
2,469	74	>75% Grass cover, Good, HSG C
2,949	98	Roofs, HSG C
16,855	94	Weighted Average
2,469		14.65% Pervious Area
14,386		85.35% Impervious Area

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

Summary for Subcatchment P-3:

Runoff = 3.68 cfs @ 12.09 hrs, Volume= 0.265 af, Depth= 3.36"
Routed to Pond BMP-1 : RETAIN-IT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Year Rainfall=4.89"

Area (sf)	CN	Description
16,744	98	Paved parking, HSG C
20,590	74	>75% Grass cover, Good, HSG C
3,791	98	Roofs, HSG C
41,125	86	Weighted Average
20,590		50.07% Pervious Area
20,535		49.93% Impervious Area

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

Summary for Pond BMP-1: RETAIN-IT

Inflow Area = 0.944 ac, 49.93% Impervious, Inflow Depth = 3.36" for 10 Year event
Inflow = 3.68 cfs @ 12.09 hrs, Volume= 0.265 af
Outflow = 3.15 cfs @ 12.13 hrs, Volume= 0.259 af, Atten= 14%, Lag= 2.9 min
Primary = 3.15 cfs @ 12.13 hrs, Volume= 0.259 af
Routed to Link DP#2 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 487.92' @ 12.13 hrs Surf.Area= 0.029 ac Storage= 0.037 af

Plug-Flow detention time= 38.5 min calculated for 0.259 af (98% of inflow)
Center-of-Mass det. time= 24.9 min (830.2 - 805.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	486.20'	0.006 af	**32.00'W x 40.00'L x 4.17'H Field A** 0.122 af Overall - 0.108 af Embedded = 0.015 af x 40.0% Voids
#2A	486.70'	0.076 af	**retain_it retain_it 3.0'** x 20 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 4 Rows adjusted for 85.0 cf perimeter wall
		0.082 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	486.70'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.70' / 485.50' S= 0.0414 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	487.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	486.70'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.14 cfs @ 12.13 hrs HW=487.91' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Passes 3.14 cfs of 3.20 cfs potential flow)
↑**2=Sharp-Crested Rectangular Weir** (Weir Controls 1.29 cfs @ 1.52 fps)
3=Orifice/Grate (Orifice Controls 1.86 cfs @ 4.73 fps)

Summary for Link DP#1:

Inflow Area = 0.277 ac, 85.05% Impervious, Inflow Depth = 4.20" for 10 Year event
Inflow = 1.27 cfs @ 12.08 hrs, Volume= 0.097 af
Primary = 1.27 cfs @ 12.08 hrs, Volume= 0.097 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.331 ac, 60.23% Impervious, Inflow Depth = 3.55" for 10 Year event
Inflow = 4.70 cfs @ 12.12 hrs, Volume= 0.394 af
Primary = 4.70 cfs @ 12.12 hrs, Volume= 0.394 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

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

Subcatchment P-1: Runoff Area=12,075 sf 85.05% Impervious Runoff Depth=5.27"
Tc=6.0 min CN=94 Runoff=1.57 cfs 0.122 af

Subcatchment P-2: Runoff Area=16,855 sf 85.35% Impervious Runoff Depth=5.27"
Tc=6.0 min CN=94 Runoff=2.20 cfs 0.170 af

Subcatchment P-3: Runoff Area=41,125 sf 49.93% Impervious Runoff Depth=4.38"
Tc=6.0 min CN=86 Runoff=4.74 cfs 0.345 af

Pond BMP-1: RETAIN-IT Peak Elev=488.17' Storage=0.043 af Inflow=4.74 cfs 0.345 af
Outflow=3.73 cfs 0.339 af

Link DP#1: Inflow=1.57 cfs 0.122 af
Primary=1.57 cfs 0.122 af

Link DP#2: Inflow=5.72 cfs 0.508 af
Primary=5.72 cfs 0.508 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.636 af Average Runoff Depth = 4.75"
35.49% Pervious = 0.571 ac 64.51% Impervious = 1.037 ac

Summary for Subcatchment P-1:

Runoff = 1.57 cfs @ 12.08 hrs, Volume= 0.122 af, Depth= 5.27"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=5.97"

Area (sf)	CN	Description
5,446	98	Paved parking, HSG C
1,805	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
12,075	94	Weighted Average
1,805		14.95% Pervious Area
10,270		85.05% Impervious Area

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

Summary for Subcatchment P-2:

Runoff = 2.20 cfs @ 12.08 hrs, Volume= 0.170 af, Depth= 5.27"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=5.97"

Area (sf)	CN	Description
11,437	98	Paved parking, HSG C
2,469	74	>75% Grass cover, Good, HSG C
2,949	98	Roofs, HSG C
16,855	94	Weighted Average
2,469		14.65% Pervious Area
14,386		85.35% Impervious Area

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

Summary for Subcatchment P-3:

Runoff = 4.74 cfs @ 12.09 hrs, Volume= 0.345 af, Depth= 4.38"
Routed to Pond BMP-1 : RETAIN-IT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Year Rainfall=5.97"

Area (sf)	CN	Description
16,744	98	Paved parking, HSG C
20,590	74	>75% Grass cover, Good, HSG C
3,791	98	Roofs, HSG C
41,125	86	Weighted Average
20,590		50.07% Pervious Area
20,535		49.93% Impervious Area

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

Summary for Pond BMP-1: RETAIN-IT

Inflow Area = 0.944 ac, 49.93% Impervious, Inflow Depth = 4.38" for 25 Year event
Inflow = 4.74 cfs @ 12.09 hrs, Volume= 0.345 af
Outflow = 3.73 cfs @ 12.15 hrs, Volume= 0.339 af, Atten= 21%, Lag= 3.7 min
Primary = 3.73 cfs @ 12.15 hrs, Volume= 0.339 af
Routed to Link DP#2 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 488.17' @ 12.15 hrs Surf.Area= 0.029 ac Storage= 0.043 af

Plug-Flow detention time= 32.8 min calculated for 0.339 af (98% of inflow)
Center-of-Mass det. time= 22.3 min (820.1 - 797.9)

Volume	Invert	Avail.Storage	Storage Description
#1A	486.20'	0.006 af	**32.00'W x 40.00'L x 4.17'H Field A** 0.122 af Overall - 0.108 af Embedded = 0.015 af x 40.0% Voids
#2A	486.70'	0.076 af	**retain_it retain_it 3.0'** x 20 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 4 Rows adjusted for 85.0 cf perimeter wall
		0.082 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	486.70'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.70' / 485.50' S= 0.0414 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	487.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	486.70'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.73 cfs @ 12.15 hrs HW=488.17' TW=0.00' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 3.73 cfs @ 4.75 fps)
└**2=Sharp-Crested Rectangular Weir** (Passes < 4.17 cfs potential flow)
└**3=Orifice/Grate** (Passes < 2.09 cfs potential flow)

Summary for Link DP#1:

Inflow Area = 0.277 ac, 85.05% Impervious, Inflow Depth = 5.27" for 25 Year event
Inflow = 1.57 cfs @ 12.08 hrs, Volume= 0.122 af
Primary = 1.57 cfs @ 12.08 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.331 ac, 60.23% Impervious, Inflow Depth = 4.58" for 25 Year event
Inflow = 5.72 cfs @ 12.11 hrs, Volume= 0.508 af
Primary = 5.72 cfs @ 12.11 hrs, Volume= 0.508 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

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

Subcatchment P-1: Runoff Area=12,075 sf 85.05% Impervious Runoff Depth=6.92"
Tc=6.0 min CN=94 Runoff=2.04 cfs 0.160 af

Subcatchment P-2: Runoff Area=16,855 sf 85.35% Impervious Runoff Depth=6.92"
Tc=6.0 min CN=94 Runoff=2.84 cfs 0.223 af

Subcatchment P-3: Runoff Area=41,125 sf 49.93% Impervious Runoff Depth=5.98"
Tc=6.0 min CN=86 Runoff=6.37 cfs 0.471 af

Pond BMP-1: RETAIN-IT Peak Elev=488.69' Storage=0.057 af Inflow=6.37 cfs 0.471 af
Outflow=4.62 cfs 0.465 af

Link DP#1: Inflow=2.04 cfs 0.160 af
Primary=2.04 cfs 0.160 af

Link DP#2: Inflow=7.11 cfs 0.688 af
Primary=7.11 cfs 0.688 af

Total Runoff Area = 1.608 ac Runoff Volume = 0.854 af Average Runoff Depth = 6.37"
35.49% Pervious = 0.571 ac 64.51% Impervious = 1.037 ac

Summary for Subcatchment P-1:

Runoff = 2.04 cfs @ 12.08 hrs, Volume= 0.160 af, Depth= 6.92"
Routed to Link DP#1 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=7.64"

Area (sf)	CN	Description
5,446	98	Paved parking, HSG C
1,805	74	>75% Grass cover, Good, HSG C
4,824	98	Roofs, HSG C
12,075	94	Weighted Average
1,805		14.95% Pervious Area
10,270		85.05% Impervious Area

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

Summary for Subcatchment P-2:

Runoff = 2.84 cfs @ 12.08 hrs, Volume= 0.223 af, Depth= 6.92"
Routed to Link DP#2 :

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=7.64"

Area (sf)	CN	Description
11,437	98	Paved parking, HSG C
2,469	74	>75% Grass cover, Good, HSG C
2,949	98	Roofs, HSG C
16,855	94	Weighted Average
2,469		14.65% Pervious Area
14,386		85.35% Impervious Area

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

Summary for Subcatchment P-3:

Runoff = 6.37 cfs @ 12.08 hrs, Volume= 0.471 af, Depth= 5.98"
Routed to Pond BMP-1 : RETAIN-IT

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Year Rainfall=7.64"

Area (sf)	CN	Description
16,744	98	Paved parking, HSG C
20,590	74	>75% Grass cover, Good, HSG C
3,791	98	Roofs, HSG C
41,125	86	Weighted Average
20,590		50.07% Pervious Area
20,535		49.93% Impervious Area

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

Summary for Pond BMP-1: RETAIN-IT

Inflow Area = 0.944 ac, 49.93% Impervious, Inflow Depth = 5.98" for 100 Year event
Inflow = 6.37 cfs @ 12.08 hrs, Volume= 0.471 af
Outflow = 4.62 cfs @ 12.16 hrs, Volume= 0.465 af, Atten= 28%, Lag= 4.5 min
Primary = 4.62 cfs @ 12.16 hrs, Volume= 0.465 af
Routed to Link DP#2 :

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 488.69' @ 12.16 hrs Surf.Area= 0.029 ac Storage= 0.057 af

Plug-Flow detention time= 27.7 min calculated for 0.465 af (99% of inflow)
Center-of-Mass det. time= 19.7 min (809.0 - 789.3)

Volume	Invert	Avail.Storage	Storage Description
#1A	486.20'	0.006 af	**32.00'W x 40.00'L x 4.17'H Field A** 0.122 af Overall - 0.108 af Embedded = 0.015 af x 40.0% Voids
#2A	486.70'	0.076 af	**retain_it retain_it 3.0'** x 20 Inside #1 Inside= 84.0"W x 36.0"H => 21.33 sf x 8.00'L = 170.6 cf Outside= 96.0"W x 44.0"H => 29.33 sf x 8.00'L = 234.7 cf 4 Rows adjusted for 85.0 cf perimeter wall
		0.082 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Primary	486.70'	**12.0" Round Culvert** L= 29.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 486.70' / 485.50' S= 0.0414 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	487.70'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)
#3	Device 1	486.70'	**6.0" Vert. Orifice/Grate X 2.00** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.62 cfs @ 12.16 hrs HW=488.69' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 4.62 cfs @ 5.88 fps)
  └─**2=Sharp-Crested Rectangular Weir** (Passes < 12.24 cfs potential flow)
  └─**3=Orifice/Grate** (Passes < 2.49 cfs potential flow)

Summary for Link DP#1:

Inflow Area = 0.277 ac, 85.05% Impervious, Inflow Depth = 6.92" for 100 Year event
Inflow = 2.04 cfs @ 12.08 hrs, Volume= 0.160 af
Primary = 2.04 cfs @ 12.08 hrs, Volume= 0.160 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Link DP#2:

Inflow Area = 1.331 ac, 60.23% Impervious, Inflow Depth = 6.20" for 100 Year event
Inflow = 7.11 cfs @ 12.11 hrs, Volume= 0.688 af
Primary = 7.11 cfs @ 12.11 hrs, Volume= 0.688 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

APPENDIX F: STORMWATER CALCULATIONS

- *MA STANDARD #4 – WATER QUALITY AND TSS REMOVAL*
- *NOAA RAINFALL DATA*
- *PIPE AND INLET SIZING*

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA
Bohler Job Number: MAA220072.00
2/15/2024
1" Water Quality Volume to Flow Rate Calculation Sheet

Compute Water Quality Flow with the following Equation

WQF = (qu)(A)(WQV)

Site Plan Callout		qu (from 1" - qu Table)	Impervious Area (SF)	Ai (sq/mi)	WQV (inches)		**WQF (cfs)**
SWQU -1	=	774	8908	0.000320	1	=	**0.25**

Water Quality Flow Rate = WQF
Water Quality Volume = WQV*
Unit peak discharge (csm/in) = qu**
Impervious Area in watershed (square miles) = Ai

*WQV is expressed in watershed inches (you must use 1.0-inches in all cases with this method and not 0.5-inches)
** calculate the qu based on the time of concentration (see 1" - qu Table)

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

Available Models

CDS Model	Treatment Capacity[3] (cfs)	Maximum Sediment Storage Capacity (CF)
1515	1.0	26
w/ 1' added sump	1.0	33
w/ 2' added sump	1.0	40
w/ 3' added sump	1.0	47
2015_4	1.4	50
w/ 1' added sump	1.4	63
w/ 2' added sump	1.4	75
w/ 3' added sump	1.4	88
2015	1.4	79
w/ 1' added sump	1.4	98
w/ 2' added sump	1.4	118
2020	2.2	90
w/ 1' added sump	2.2	110
w/ 2' added sump	2.2	129
2025	3.2	97
w/ 1' added sump	3.2	117
w/ 2' added sump	3.2	136
3020	3.9	134
w/ 1' added sump	3.9	163
w/ 2' added sump	3.9	191
3030	6.1	157
w/ 1' added sump	6.1	185
w/ 2' added sump	6.1	213
4030	7.9	329
w/ 1' added sump	7.9	379
w/ 2' added sump	7.9	429
4040	12.4	381
w/ 1' added sump	12.4	431
w/ 2' added sump	12.4	482

1. Structure diameter represents the typical inside dimension of the concrete structure. Offline systems will require additional concrete diversion components
2. Depth below pipe can vary to accommodate site specific design. Depth below pipe invert represents the depth from the pipe invert to the inside bottom of concrete structure.
3. Treatment Capacity is based on laboratory testing using OK-110 (average d50 particle size of approximately 100 microns) and a 2400 micron screen.

Sediment Depths Indicating Required Servicing*			
CDS Model	Standard Sediment Depth (in.)	w/ 1' added Sump Sediment Depth (in.)	w/ 2' added Sump Sediment Depth (in.)
1515	18	27	36
2015_4	18	30	42
2015	18	30	42
2020	18	30	42
2025	18	30	42
3020	18	30	42
3030	18	39	42
4030	27	39	51
4040	27	39	51

* Based on 75% capacity of isolated sump.

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA
Bohler Job Number: MAA220072.00
February 15, 2024

MA DEP Standard 4: TSS Removal Calculation Worksheet

BMP Treatment Train: Deep-Sump Hooded Catch Basins to Water Quality Unit (SWQU-1)

A BMP	B TSS Removal Rate	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep-sump Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Proprietary Water Quality Unit (SWQU-1)	**0.80**	**0.75**	**0.60**	**0.15**
		Total TSS Removal =	**85%**	

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

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

NOAA Atlas 14, Volume 10, Version 3
Location name: Worcester, Massachusetts, USA*
Latitude: 42.255°, Longitude: -71.8085°
Elevation: 500 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	0.341 (0.273-0.421)	0.401 (0.321-0.495)	0.499 (0.398-0.619)	0.580 (0.459-0.725)	0.692 (0.527-0.906)	0.777 (0.578-1.04)	0.865 (0.620-1.21)	0.960 (0.652-1.38)	1.09 (0.710-1.64)	1.20 (0.756-1.84)
10-min	0.483 (0.387-0.596)	0.568 (0.454-0.702)	0.707 (0.563-0.877)	0.822 (0.651-1.03)	0.981 (0.747-1.28)	1.10 (0.819-1.48)	1.22 (0.879-1.71)	1.36 (0.923-1.96)	1.54 (1.00-2.32)	1.69 (1.07-2.60)
15-min	0.568 (0.455-0.701)	0.668 (0.534-0.825)	0.832 (0.663-1.03)	0.967 (0.766-1.21)	1.15 (0.879-1.51)	1.30 (0.963-1.74)	1.44 (1.03-2.01)	1.60 (1.09-2.30)	1.82 (1.18-2.73)	1.99 (1.26-3.06)
30-min	0.772 (0.618-0.953)	0.909 (0.727-1.12)	1.13 (0.902-1.40)	1.32 (1.04-1.64)	1.57 (1.20-2.06)	1.77 (1.31-2.37)	1.96 (1.41-2.74)	2.18 (1.48-3.14)	2.48 (1.61-3.72)	2.72 (1.72-4.18)
60-min	0.976 (0.782-1.20)	1.15 (0.920-1.42)	1.43 (1.14-1.78)	1.67 (1.32-2.08)	1.99 (1.52-2.61)	2.24 (1.66-3.00)	2.49 (1.79-3.47)	2.76 (1.88-3.98)	3.14 (2.04-4.72)	3.44 (2.18-5.29)
2-hr	1.24 (0.998-1.52)	1.47 (1.18-1.80)	1.84 (1.48-2.27)	2.16 (1.72-2.68)	2.59 (1.99-3.38)	2.91 (2.18-3.90)	3.25 (2.36-4.54)	3.64 (2.48-5.22)	4.21 (2.75-6.29)	4.69 (2.98-7.16)
3-hr	1.42 (1.14-1.73)	1.69 (1.36-2.06)	2.13 (1.72-2.62)	2.50 (2.00-3.09)	3.01 (2.32-3.92)	3.38 (2.55-4.53)	3.79 (2.77-5.30)	4.27 (2.91-6.10)	4.98 (3.25-7.41)	5.58 (3.55-8.49)
6-hr	1.77 (1.44-2.15)	2.13 (1.73-2.58)	2.72 (2.20-3.31)	3.20 (2.58-3.93)	3.87 (3.01-5.02)	4.37 (3.32-5.82)	4.91 (3.61-6.85)	5.55 (3.80-7.89)	6.53 (4.28-9.66)	7.37 (4.70-11.1)
12-hr	2.18 (1.78-2.62)	2.64 (2.16-3.19)	3.41 (2.78-4.13)	4.04 (3.27-4.93)	4.91 (3.84-6.34)	5.56 (4.24-7.36)	6.26 (4.63-8.68)	7.10 (4.88-10.0)	8.37 (5.50-12.3)	9.46 (6.05-14.2)
24-hr	2.58 (2.13-3.09)	3.16 (2.60-3.79)	4.10 (3.37-4.95)	4.89 (3.99-5.93)	5.97 (4.69-7.66)	6.77 (5.20-8.92)	7.64 (5.68-10.5)	8.68 (5.99-12.2)	10.3 (6.78-15.0)	11.6 (7.48-17.4)
2-day	2.95 (2.45-3.51)	3.63 (3.01-4.32)	4.73 (3.91-5.67)	5.65 (4.64-6.81)	6.92 (5.47-8.82)	7.85 (6.07-10.3)	8.87 (6.64-12.2)	10.1 (7.01-14.1)	12.1 (7.98-17.5)	13.7 (8.84-20.3)
3-day	3.21 (2.68-3.81)	3.94 (3.28-4.68)	5.13 (4.26-6.12)	6.12 (5.04-7.35)	7.49 (5.94-9.52)	8.49 (6.58-11.1)	9.59 (7.20-13.1)	10.9 (7.60-15.2)	13.0 (8.65-18.8)	14.9 (9.59-21.9)
4-day	3.44 (2.88-4.08)	4.21 (3.52-4.99)	5.46 (4.54-6.50)	6.50 (5.37-7.78)	7.93 (6.31-10.1)	8.99 (6.98-11.7)	10.1 (7.63-13.9)	11.6 (8.04-16.0)	13.8 (9.13-19.8)	15.7 (10.1-23.0)
7-day	4.11 (3.46-4.84)	4.94 (4.15-5.83)	6.31 (5.28-7.46)	7.44 (6.18-8.86)	9.00 (7.18-11.3)	10.2 (7.91-13.1)	11.4 (8.59-15.4)	12.9 (9.02-17.8)	15.2 (10.1-21.8)	17.2 (11.1-25.1)
10-day	4.77 (4.03-5.60)	5.64 (4.76-6.63)	7.07 (5.93-8.34)	8.25 (6.87-9.79)	9.88 (7.90-12.3)	11.1 (8.65-14.2)	12.4 (9.32-16.6)	13.9 (9.75-19.1)	16.2 (10.8-23.1)	18.1 (11.7-26.4)
20-day	6.82 (5.80-7.95)	7.75 (6.57-9.04)	9.26 (7.82-10.8)	10.5 (8.81-12.4)	12.2 (9.83-15.1)	13.6 (10.6-17.1)	14.9 (11.2-19.6)	16.3 (11.5-22.2)	18.4 (12.3-25.9)	19.9 (13.0-28.9)
30-day	8.54 (7.28-9.91)	9.49 (8.08-11.0)	11.0 (9.37-12.9)	12.3 (10.4-14.5)	14.1 (11.4-17.3)	15.5 (12.1-19.4)	16.9 (12.6-21.9)	18.2 (12.9-24.6)	20.0 (13.5-28.1)	21.3 (13.9-30.8)
45-day	10.7 (9.13-12.3)	11.7 (9.96-13.5)	13.3 (11.3-15.4)	14.6 (12.3-17.1)	16.5 (13.3-20.0)	17.9 (14.0-22.2)	19.3 (14.4-24.7)	20.6 (14.6-27.6)	22.1 (15.0-31.0)	23.2 (15.1-33.3)
60-day	12.4 (10.7-14.3)	13.5 (11.5-15.5)	15.1 (12.9-17.5)	16.5 (14.0-19.3)	18.4 (14.9-22.3)	19.9 (15.6-24.6)	21.4 (15.9-27.2)	22.6 (16.1-30.2)	24.0 (16.3-33.5)	24.9 (16.3-35.7)

[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.

Back to Top

PF graphical

NOAA Atlas 14, Volume 10, Version 3
Location name: Worcester, Massachusetts, USA*
Latitude: 42.255°, Longitude: -71.8085°
Elevation: 500 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	4.09 (3.28-5.05)	4.81 (3.85-5.94)	5.99 (4.78-7.43)	6.96 (5.51-8.70)	8.30 (6.32-10.9)	9.32 (6.94-12.5)	10.4 (7.44-14.5)	11.5 (7.82-16.6)	13.1 (8.52-19.7)	14.3 (9.07-22.0)
10-min	2.90 (2.32-3.58)	3.41 (2.72-4.21)	4.24 (3.38-5.26)	4.93 (3.91-6.16)	5.89 (4.48-7.70)	6.61 (4.91-8.86)	7.35 (5.27-10.3)	8.15 (5.54-11.8)	9.26 (6.02-13.9)	10.2 (6.43-15.6)
15-min	2.27 (1.82-2.80)	2.67 (2.14-3.30)	3.33 (2.65-4.13)	3.87 (3.06-4.83)	4.62 (3.52-6.04)	5.18 (3.85-6.95)	5.76 (4.14-8.04)	6.39 (4.34-9.22)	7.27 (4.73-10.9)	7.96 (5.04-12.2)
30-min	1.54 (1.24-1.91)	1.82 (1.45-2.25)	2.26 (1.80-2.81)	2.63 (2.09-3.29)	3.14 (2.40-4.12)	3.53 (2.63-4.74)	3.93 (2.82-5.48)	4.36 (2.96-6.29)	4.96 (3.23-7.44)	5.43 (3.44-8.35)
60-min	0.976 (0.782-1.20)	1.15 (0.920-1.42)	1.43 (1.14-1.78)	1.67 (1.32-2.08)	1.99 (1.52-2.61)	2.24 (1.66-3.00)	2.49 (1.79-3.47)	2.76 (1.88-3.98)	3.14 (2.04-4.72)	3.44 (2.18-5.29)
2-hr	0.619 (0.499-0.759)	0.734 (0.591-0.901)	0.922 (0.739-1.14)	1.08 (0.859-1.34)	1.29 (0.993-1.69)	1.45 (1.09-1.95)	1.62 (1.18-2.27)	1.82 (1.24-2.61)	2.11 (1.37-3.14)	2.34 (1.49-3.58)
3-hr	0.471 (0.381-0.575)	0.561 (0.453-0.687)	0.709 (0.571-0.871)	0.832 (0.665-1.03)	1.00 (0.772-1.30)	1.13 (0.849-1.51)	1.26 (0.921-1.76)	1.42 (0.969-2.03)	1.66 (1.08-2.47)	1.86 (1.18-2.83)
6-hr	0.295 (0.240-0.358)	0.355 (0.288-0.431)	0.453 (0.367-0.553)	0.534 (0.430-0.656)	0.646 (0.502-0.839)	0.729 (0.553-0.972)	0.819 (0.602-1.14)	0.927 (0.635-1.32)	1.09 (0.714-1.61)	1.23 (0.785-1.86)
12-hr	0.180 (0.148-0.217)	0.219 (0.179-0.265)	0.282 (0.230-0.342)	0.335 (0.271-0.409)	0.407 (0.318-0.525)	0.461 (0.352-0.611)	0.519 (0.384-0.720)	0.589 (0.405-0.832)	0.694 (0.456-1.02)	0.785 (0.502-1.18)
24-hr	0.107 (0.088-0.128)	0.131 (0.108-0.157)	0.171 (0.140-0.206)	0.203 (0.166-0.247)	0.248 (0.195-0.319)	0.282 (0.216-0.371)	0.318 (0.236-0.439)	0.361 (0.249-0.507)	0.428 (0.282-0.625)	0.485 (0.311-0.723)
2-day	0.061 (0.051-0.073)	0.075 (0.062-0.090)	0.098 (0.081-0.118)	0.117 (0.096-0.141)	0.144 (0.113-0.183)	0.163 (0.126-0.214)	0.184 (0.138-0.254)	0.210 (0.146-0.293)	0.251 (0.166-0.364)	0.285 (0.184-0.423)
3-day	0.044 (0.037-0.052)	0.054 (0.045-0.065)	0.071 (0.059-0.085)	0.085 (0.070-0.102)	0.103 (0.082-0.132)	0.117 (0.091-0.154)	0.133 (0.100-0.182)	0.152 (0.105-0.211)	0.181 (0.120-0.261)	0.206 (0.133-0.304)
4-day	0.035 (0.030-0.042)	0.043 (0.036-0.051)	0.056 (0.047-0.067)	0.067 (0.055-0.081)	0.082 (0.065-0.104)	0.093 (0.072-0.121)	0.105 (0.079-0.144)	0.120 (0.083-0.166)	0.143 (0.095-0.206)	0.163 (0.105-0.239)
7-day	0.024 (0.020-0.028)	0.029 (0.024-0.034)	0.037 (0.031-0.044)	0.044 (0.036-0.052)	0.053 (0.042-0.067)	0.060 (0.047-0.078)	0.067 (0.051-0.091)	0.076 (0.053-0.105)	0.090 (0.060-0.129)	0.102 (0.066-0.149)
10-day	0.019 (0.016-0.023)	0.023 (0.019-0.027)	0.029 (0.024-0.034)	0.034 (0.028-0.040)	0.041 (0.032-0.051)	0.046 (0.036-0.059)	0.051 (0.038-0.069)	0.057 (0.040-0.079)	0.067 (0.045-0.096)	0.075 (0.048-0.110)
20-day	0.014 (0.012-0.016)	0.016 (0.013-0.018)	0.019 (0.016-0.022)	0.021 (0.018-0.025)	0.025 (0.020-0.031)	0.028 (0.022-0.035)	0.031 (0.023-0.040)	0.034 (0.024-0.046)	0.038 (0.025-0.054)	0.041 (0.027-0.060)
30-day	0.011 (0.010-0.013)	0.013 (0.011-0.015)	0.015 (0.013-0.017)	0.017 (0.014-0.020)	0.019 (0.015-0.023)	0.021 (0.016-0.026)	0.023 (0.017-0.030)	0.025 (0.017-0.034)	0.027 (0.018-0.039)	0.029 (0.019-0.042)
45-day	0.009 (0.008-0.011)	0.010 (0.009-0.012)	0.012 (0.010-0.014)	0.013 (0.011-0.015)	0.015 (0.012-0.018)	0.016 (0.012-0.020)	0.017 (0.013-0.022)	0.019 (0.013-0.025)	0.020 (0.013-0.028)	0.021 (0.014-0.030)
60-day	0.008 (0.007-0.009)	0.009 (0.008-0.010)	0.010 (0.008-0.012)	0.011 (0.009-0.013)	0.012 (0.010-0.015)	0.013 (0.010-0.017)	0.014 (0.011-0.018)	0.015 (0.011-0.020)	0.016 (0.011-0.023)	0.017 (0.011-0.024)

[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.

Back to Top

PF graphical

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA
Bohler Job Number: MAA220072.00
February 15, 2024

Rational Pipe Sizing Calculations

Design Period Storm:		**25**	**Year**	**Design Period Intensity***			**8.3**	**in/hr**									
LOCATION		IMPERVIOUS			OTHER			SUM CA	Tc (min)	I (in/hr)	Q (cfs)	D (in)	S (ft/ft)	Material	n	Q Full (cfs)	V Full (fps)
FROM	TO	A	C	CA	A	C	CA										
CB-101	DMH-101	0.16	0.95	0.15	0.00	0.30	0.00	0.15	6	8.3	1.26	8	0.009	PVC	0.010	1.51	4.32
CB-102	DMH-101	0.07	0.95	0.07	0.00	0.30	0.00	0.07	6	8.3	0.55	8	0.013	PVC	0.010	1.79	5.13
DMH-101	DMH-102	0.23	0.95	0.22	0.00	0.30	0.00	0.22	6	8.3	1.81	12	0.069	HDPE	0.012	10.13	12.90
CB-201	DMH-201	0.10	0.95	0.10	0.01	0.30	0.00	0.10	6	8.3	0.81	8	0.011	PVC	0.010	1.62	4.63
DMH-201	EXIST	0.10	0.95	0.10	0.01	0.30	0.00	0.10	6	8.3	0.81	12	0.085	HDPE	0.012	11.25	14.33
CB-301	DMH-301	0.02	0.95	0.02	0.03	0.30	0.01	0.03	6	8.3	0.23	8	0.020	PVC	0.010	2.23	6.40
CB-302	DMH-301	0.13	0.95	0.12	0.00	0.30	0.00	0.12	6	8.3	1.03	8	0.018	PVC	0.010	2.10	6.00
DMH-301	SQWU-1	0.15	0.95	0.14	0.03	0.30	0.01	0.15	6	8.3	1.26	12	0.021	HDPE	0.012	5.53	7.04
CB-303	SWQU-1	0.01	0.95	0.01	0.00	0.30	0.00	0.01	6	8.3	0.08	8	0.020	PVC	0.010	2.23	6.38
CB-304	SWQU-1	0.13	0.95	0.12	0.02	0.30	0.01	0.13	6	8.3	1.07	8	0.020	PVC	0.010	2.24	6.43
SWQU-1	ICS-1	0.29	0.95	0.28	0.05	0.30	0.02	0.29	6	8.3	2.41	15	0.014	HDPE	0.012	8.37	6.82
YD-101	YD-102	0.10	0.95	0.10	0.31	0.30	0.09	0.19	6	8.3	1.56	12	0.020	HDPE	0.012	5.47	6.97
YD-102	YD-103	0.17	0.95	0.16	0.41	0.30	0.12	0.28	6	8.3	2.36	12	0.020	HDPE	0.012	5.51	7.02
YD-103	ICS-2	0.17	0.95	0.16	0.43	0.30	0.13	0.29	6	8.3	2.41	12	0.030	HDPE	0.012	6.66	8.48
OCS-1	EXIST DMH	Refer to HydroCAD 25-year storm event									4.75	12	0.041	HDPE	0.012	7.82	9.96

*Rainfall intensity provided by NOAA Atlas 14, Volume 10, Version 3 on 2/7/2024

Prepared By:
BOHLER
352 Turnpike Road
Southborough, MA 01772
(508) 480-9900

APPENDIX G: OPERATION AND MAINTENANCE

- *STORMWATER OPERATION AND MAINTENANCE PLAN*
- *INSPECTION REPORT*
- *INSPECTION AND MAINTENANCE LOG FORM*
- *LONG-TERM POLLUTION PREVENTION PLAN*
- *ILLICIT DISCHARGE STATEMENT*
- *SPILL PREVENTION*
- *PROPOSED OPERATION AND MAINTENANCE MAP*
- *MANUFACTURER'S INSPECTION AND MAINTENANCE MANUALS*

STORMWATER OPERATION AND MAINTENANCE PLAN

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA 01608

RESPONSIBLE PARTY DURING CONSTRUCTION:

98 Beacon Street, LLC
2 Tammie Road
Hopedale, MA 01747

RESPONSIBLE PARTY POST CONSTRUCTION:

98 Beacon Street, LLC
2 Tammie Road
Hopedale, MA 01747

Construction Phase

During the construction phase, all erosion control devices and measures shall be maintained in accordance with the final record plans, local/state approvals and conditions, the EPA Construction General Permit and the Stormwater Pollution Prevention Plan (SWPPP) if applicable. Additionally, the maintenance of all erosion / siltation control measures during construction shall be the responsibility of the general contractor. Contact information of the OWNER and CONTRACTOR shall be listed in the SWPPP for this site. The SWPPP also includes information regarding construction period allowable and illicit discharges, housekeeping and emergency response procedures. Upon proper notice to the property owner, the Town/City or its authorized designee shall be allowed to enter the property at a reasonable time and in a reasonable manner for the purposes of inspection.

Post Development Controls

Once construction is completed, the post development stormwater controls are to be operated and maintained in compliance with the following permanent procedures (note that the continued implementation of these procedures shall be the responsibility of the Owner or its assignee):

1. Parking lots: Sweep at least two (2) times per year and on a more frequent basis depending on sanding operations. Swept areas shall include all parking, drive aisles, and access aisles. All resulting sweepings shall be collected and properly disposed of offsite in accordance with MADEP and other applicable requirements.

   Approximate Maintenance Budget: $1,000/year

2. Catch basins, yard drains, trench drains, manholes and piping: Inspect two (2) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned two (2) times per year or whenever the depth of deposits is greater than or equal to one half the depth from the bottom of the invert of the lowest pipe in the catch basin or underground system. Accumulated sediment and hydrocarbons present must be removed

and properly disposed of off-site in accordance with MADEP and other applicable requirements.

Approximate Maintenance Budget: $500/year per structure.

3. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached).

   Approximate Maintenance Budget: $1,000/year per unit.

4. Underground Detention Basin: Preventative maintenance after every major storm event during the first three (3) months of operation and at least twice per year thereafter. Inspect structure and pretreatment BMP to ensure proper operation after every major storm event (generally equal or greater to 3.0 inches in 24 hours) for the first three months. The outlet of the basin, if any, shall be inspected for erosion and sedimentation, and rip-rap shall be promptly repaired in the case of erosion. Sediment collecting in the bottom of the basin shall be inspected twice annually, and removal shall commence any time the sediment reaches a depth of six inches anywhere in the basin. Any sediment removed shall be disposed of in accordance with MADEP and other applicable requirements.

   Approximate Maintenance Budget: Cleaning - $1,000/year, Inspection - $200/year

All components of the stormwater system will be accessible by the owner or their assignee.

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA 01608

RESPONSIBLE PARTY:

98 Beacon Street, LLC
2 Tammie Road
Hopedale, MA 01747

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Water Quality Units:	
Underground Detention Basin:	
Other:	

Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):
Catch Basins:
Water Quality Units:
Underground Detention Basin:
Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM

98 Beacon Street, LLC
98 Beacon Street – Worcester, MA

Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA 01608

RESPONSIBLE PARTY DURING CONSTRUCTION:

98 Beacon Street, LLC
2 Tammie Road
Hopedale, MA 01747

RESPONSIBLE PARTY POST CONSTRUCTION:

98 Beacon Street, LLC
2 Tammie Road
Hopedale, MA 01747

For this site, the Long-Term Pollution Prevention Plan will consist of the following:

- The property owner shall be responsible for "good housekeeping" including proper periodic maintenance of building and pavement areas, curbing, landscaping, etc.
- Proper storage and removal of solid waste (dumpsters).
- Sweeping of parking lots, drive aisles and access aisles a minimum of twice per year with a commercial cleaning unit. Any sediment removed shall be disposed of in accordance with applicable local and state requirements.
- Regular inspections and maintenance of Stormwater Management System as noted in the "O&M Plan".
- Snow removal shall be the responsibility of the property owner. Snow shall not be plowed, dumped and/or placed in forebays, infiltration basins or similar stormwater controls. Salting and/or sanding of pavement / walkway areas during winter conditions shall only be done in accordance with all state/local requirements and approvals.

OPERATON AND MAINTENANCE TRAINING PROGRAM

The Owner will coordinate an annual in-house training session to discuss the Operations and Maintenance Plan, the Long-Term Pollution Prevention Plan, and the Spill Prevention Plan and response procedures. Annual training will include the following:

Discuss the Operations and Maintenance Plan

- Explain the general operations of the stormwater management system and its BMPs
- 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 Procedures

- Explain the process in the event of a spill
- Identify potential sources of spills and procedures for cleanup and /or reporting and notification
- Complete a yearly inventory or Materials Safety Data sheets of all tenants and confirm that no potentially harmful chemicals are in use.

ILLICIT DISCHARGE STATEMENT

Certain types of non-stormwater discharges are allowed under the U.S. Environmental Protection Agency Construction General Permit. These types of discharges will be allowed under the conditions that no pollutants will be allowed to come in contact with the water prior to or after its discharge. The control measures which have been outlined previously in this LTPPP will be strictly followed to ensure that no contamination of these non-storm water discharges takes place. Any existing illicit discharges, if discovered during the course of the work, will be reported to MassDEP and the local DPW, as applicable, to be addressed in accordance with their respective policies. No illicit discharges will be allowed in conjunction with the proposed improvements.

Duly Acknowledged:

_____

Name & Title Date

SPILL PREVENTION AND RESPONSE PROCEDURES (POST CONSTRUCTION)

In order to prevent or minimize the potential for a spill of Hazardous Substances or Oil or come into contact with stormwater, the following steps will be implemented:

1. All Hazardous Substances or Oil (such as pesticides, petroleum products, fertilizers, detergents, acids, paints, paint solvents, cleaning solvents, etc.) will be stored in a secure location, with their lids on, preferably under cover, when not in use.

2. The minimum practical quantity of all such materials will be kept on site.

3. A spill control and containment kit (containing, for example, absorbent materials, acid neutralizing powder, brooms, dust pans, mops, rags, gloves, goggles, plastic and metal trash containers, etc.) will be provided on site.

4. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be trained regarding these procedures and the location of the information and cleanup supplies.

5. It is the OWNER's responsibility to ensure that all Hazardous Waste on site is disposed of properly by a licensed hazardous material disposal company. The OWNER is responsible for not exceeding Hazardous Waste storage requirements mandated by the EPA or state and local authorities.

In the event of a spill of Hazardous Substances or Oil, the following procedures should be followed:

1. All measures should be taken to contain and abate the spill and to prevent the discharge of the Hazardous Substance or Oil to stormwater or off-site. (The spill area should be kept well ventilated and personnel should wear appropriate protective clothing to prevent injury from contact with the Hazardous Substances.)

2. For spills of less than five (5) gallons of material, proceed with source control and containment, clean-up with absorbent materials or other applicable means unless an imminent hazard or other circumstances dictate that the spill should be treated by a professional emergency response contractor.

3. For spills greater than five (5) gallons of material immediately contact the MADEP at the toll-free 24-hour statewide emergency number: **1-888-304-1133**, the local fire department (**9-1-1**) and an approved emergency response contractor. Provide information on the type of material spilled, the location of the spill, the quantity spilled, and the time of the spill to the emergency response contractor or coordinator, and proceed with prevention, containment and/or clean-up if so desired. (Use the form provided, or similar).

4. If there is a Reportable Quantity (RQ) release, then the National Response Center should be notified immediately at (800) 424-8802; within 14 days a report should be submitted to the EPA regional office describing the release, the date and circumstances of the release and the steps taken to prevent another release. This Pollution Prevention Plan should be updated to reflect any such steps or actions taken and measures to prevent the same from reoccurring.

SPILL PREVENTION CONTROL AND COUNTERMEASURE FORM

98 Beacon Street, LLC
98 Beacon Street
Worcester, MA 01608

Where a release containing a hazardous substance occurs, the following steps shall be taken by the facility manager and/or supervisor:

1. Immediately notify The City of Worcester Fire Department (at **9-1-1**)

2. All measures must be taken to contain and abate the spill and to prevent the discharge of the pollutant(s) to off-site locations, receiving waters, wetlands and/or resource areas.

3. Notify the Worcester Health Department (Inspectional Service Department) at (508) 799-1198 and the Worcester Conservation Commission at (508) 799-1400, ext. 31440.

4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the Worcester Health Department and Conservation Commission.

Date of spill:_____ Time:_____ Reported By:_____

Weather Conditions:_____

Material Spilled	**Location of Spill**	**Approximate Quantity of Spill (in gallons)**	**Agency(s) Notified**	**Date of Notification**

Cause of Spill: _____

_____

Measures Taken to Clean up Spill: _____

_____

Type of equipment: _____ Make: _____ Size: _____

License or S/N: _____

Location and Method of Disposal _____

_____

Procedures, method, and precautions instituted to prevent a similar occurrence from recurring: _____

_____

_____

Additional Contact Numbers:

- DEPARTMENT OF ENVIRONMENTAL PROTECTION (DEP) EMERGENCY PHONE: 1-888-304-1133
- NATIONAL RESPONSE CENTER PHONE: (800) 424-8802
- U.S. ENVIRONMENTAL PROTECTION AGENCY PHONE: (888) 372-7341

CONTECH®
ENGINEERED SOLUTIONS

CDS® Inspection and Maintenance Guide

CDS TECHNOLOGIES

Maintenance

The CDS system should be inspected at regular intervals and maintained when necessary to ensure optimum performance. The rate at which the system collects pollutants will depend more heavily on site activities than the size of the unit. For example, unstable soils or heavy winter sanding will cause the grit chamber to fill more quickly but regular sweeping of paved surfaces will slow accumulation.

Inspection

Inspection is the key to effective maintenance and is easily performed. Pollutant transport and deposition may vary from year to year and regular inspections will help ensure that the system is cleaned out at the appropriate time. At a minimum, inspections should be performed twice per year (e.g. spring and fall) however more frequent inspections may be necessary in climates where winter sanding operations may lead to rapid accumulations, or in equipment washdown areas. Installations should also be inspected more frequently where excessive amounts of trash are expected.

The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions in the inlet and separation screen. The inspection should also quantify the accumulation of hydrocarbons, trash, and sediment in the system. Measuring pollutant accumulation can be done with a calibrated dipstick, tape measure or other measuring instrument. If absorbent material is used for enhanced removal of hydrocarbons, the level of discoloration of the sorbent material should also be identified during inspection. It is useful and often required as part of an operating permit to keep a record of each inspection. A simple form for doing so is provided.

Access to the CDS unit is typically achieved through two manhole access covers. One opening allows for inspection and cleanout of the separation chamber (cylinder and screen) and isolated sump. The other allows for inspection and cleanout of sediment captured and retained outside the screen. For deep units, a single manhole access point would allows both sump cleanout and access outside the screen.

The CDS system should be cleaned when the level of sediment has reached 75% of capacity in the isolated sump or when an appreciable level of hydrocarbons and trash has accumulated. If absorbent material is used, it should be replaced when significant discoloration has occurred. Performance will not be impacted until 100% of the sump capacity is exceeded however it is recommended that the system be cleaned prior to that for easier removal of sediment. The level of sediment is easily determined by measuring from finished grade down to the top of the sediment pile. To avoid underestimating the level of sediment in the chamber, the measuring device must be lowered to the top of the sediment pile carefully. Particles at the top of the pile typically offer less resistance to the end of the rod than consolidated particles toward the bottom of the pile. Once this measurement is recorded, it should be compared to the as-built drawing for the unit to determine weather the height of the sediment pile off the bottom of the sump floor exceeds 75% of the total height of isolated sump.

Cleaning

Cleaning of a CDS systems should be done during dry weather conditions when no flow is entering the system. The use of a vacuum truck is generally the most effective and convenient method of removing pollutants from the system. Simply remove the manhole covers and insert the vacuum hose into the sump. The system should be completely drained down and the sump fully evacuated of sediment. The area outside the screen should also be cleaned out if pollutant build-up exists in this area.

In installations where the risk of petroleum spills is small, liquid contaminants may not accumulate as quickly as sediment. However, the system should be cleaned out immediately in the event of an oil or gasoline spill should be cleaned out immediately. Motor oil and other hydrocarbons that accumulate on a more routine basis should be removed when an appreciable layer has been captured. To remove these pollutants, it may be preferable to use absorbent pads since they are usually less expensive to dispose than the oil/water emulsion that may be created by vacuuming the oily layer. Trash and debris can be netted out to separate it from the other pollutants. The screen should be power washed to ensure it is free of trash and debris.

Manhole covers should be securely seated following cleaning activities to prevent leakage of runoff into the system from above and also to ensure that proper safety precautions have been followed. Confined space entry procedures need to be followed if physical access is required. Disposal of all material removed from the CDS system should be done in accordance with local regulations. In many jurisdictions, disposal of the sediments may be handled in the same manner as the disposal of sediments removed from catch basins or deep sump manholes.

CDS Model	Diameter		Distance from Water Surface to Top of Sediment Pile		Sediment Storage Capacity	
	ft	m	ft	m	y^3	m^3
CDS1515	3	0.9	3.0	0.9	0.5	0.4
CDS2015	4	1.2	3.0	0.9	0.9	0.7
CDS2015	5	1.3	3.0	0.9	1.3	1.0
CDS2020	5	1.3	3.5	1.1	1.3	1.0
CDS2025	5	1.3	4.0	1.2	1.3	1.0
CDS3020	6	1.8	4.0	1.2	2.1	1.6
CDS3025	6	1.8	4.0	1.2	2.1	1.6
CDS3030	6	1.8	4.6	1.4	2.1	1.6
CDS3035	6	1.8	5.0	1.5	2.1	1.6
CDS4030	8	2.4	4.6	1.4	5.6	4.3
CDS4040	8	2.4	5.7	1.7	5.6	4.3
CDS4045	8	2.4	6.2	1.9	5.6	4.3
CDS5640	10	3.0	6.3	1.9	8.7	6.7
CDS5653	10	3.0	7.7	2.3	8.7	6.7
CDS5668	10	3.0	9.3	2.8	8.7	6.7
CDS5678	10	3.0	10.3	3.1	8.7	6.7

Table 1: CDS Maintenance Indicators and Sediment Storage Capacities

Support

- Drawings and specifications are available at www.contechstormwater.com.
- Site-specific design support is available from our engineers.

Contech Engineered Solutions LLC provides site solutions for the civil engineering industry. Contech's portfolio includes bridges, drainage, sanitary sewer, stormwater, earth stabilization and wastewater treament products. For information, visit www.ContechES.com or call 800.338.1122

CONTECH®
ENGINEERED SOLUTIONS
800.925.5240
www.ContechES.com

CDS Inspection & Maintenance Log

CDS Model: _____ Location: _____

Date	Water depth to sediment[1]	Floatable Layer Thickness[2]	Describe Maintenance Performed	Maintenance Personnel	Comments

1. The water depth to sediment is determined by taking two measurements with a stadia rod: one measurement from the manhole opening to the top of the sediment pile and the other from the manhole opening to the water surface. If the difference between these measurements is less than the values listed in table 1 the system should be cleaned out. **Note: to avoid underestimating the volume of sediment in the chamber, the measuring device must be carefully lowered to the top of the sediment pile.**

2. For optimum performance, the system should be cleaned out when the floating hydrocarbon layer accumulates to an appreciable thickness. In the event of an oil spill, the system should be cleaned immediately.

retain-it®
Stormwater Management Systems

OWNERS MAINTENANCE MANUAL

retain-it, LLC
560 Salmon Brook Street
Granby, CT 06035
(860) 413-3050

retain-it ®

Owners Maintenance Manual

Table of Contents

Description

retain-it ® is a subsurface Storm Water Management system constructed of precast concrete structures. They are installed in a side by side configuration creating a continuous internal flow channel integrated throughout the system. Systems are constructed with designated inlet and outlet modules, some with multiple inlets and outlets depending on the site storm water system layout. Infiltration systems typically have an inlet and sidewalls/ base constructed on a stone infiltration blanket with geofabric installed at the native soil interface. Other systems incorporate outlet flow control devices. Detention systems are typically lined with a watertight membrane and have inlet and outlet control devices.

The retain-it ® system can consist of multiple varying layouts, with no two the same. Given this, it should be noted that the operation and maintenance requirements are very similar regardless of the intended layout. It is important that the end user know the specific elements of each system so as to understand how best to optimize it's operation.

Installation per Design: Operation is simple to follow where the installation was performed in accordance with the design specifications, drawings and calculations. Specifics shall be identified in the design drawings. As-built drawings will benefit the locating of specific design modules where the system has been buried below a parking lot area. Optional access manholes or removable grates may be installed above every inlet/outlet pipe and at critical design elements designated by the design.

Daily Operation and Long Term Maintenance: In general, daily usage of the system is self sufficient and will operate without requiring any outside assistance, except for periodic inspection to verify optimal performance and maintenance for removal of collected pollutants. A longer term maintenance program should incorporate a more thorough inspection of the all elements of the system to verify proper operating condition. This is more important with the infiltration type of systems where the soil infiltration surface may become restricted due to fine particle build up. Long term maintenance should include provisions for cleaning and removal of collected solids, oils and debris from the system.

System Operation: The system operational function is initiated according to rainfall runoff flows entering the structure. Internally, the runoff flows in a set pattern or sequence throughout the module layout in accordance with the hydraulic design conditions. The flows primarily operate on system head derived from the changes in

elevation from the internal water surface and the outlet invert elevation. Some designs incorporate internal flow controls to satisfy hydraulic conditions that enhance water quality treatment or other intended purposes. Modified systems may incorporate a pump, but in general there are no mechanical apparatus required.

End user operations primarily consist of inspection and maintenance of the system over time.

Periodic Inspection: Important note - All storm water management systems react differently depending on the conditions that are characteristic to the contributing water shed. Variables such as storm intensity, runoff flow rates, site geology, surface stabilization and pollution load will affect the system operation. As does the inspection and maintenance frequency to ensure optimum effectiveness.

Inspections should be done periodically, with a greater number scheduled during the system start up and less frequently as the operator becomes familiar with the system performance characteristics. It is recommended that the end user keep records of the performance using the inspection log record sheet found in the back of this manual. These records shall identify the cycle of maintenance “system calibration” required for the specific applications based on the contributing water shed variables operating under “normal” conditions.

Please note that immediate maintenance may be required during “non-normal” events such as during adverse weather conditions or emergency fuel spills. See information on emergency spills in this manual.

Visual inspection of all assessable components shall be performed throughout the lifetime of the system. Access has been supplied at critical points to monitor hydraulic performance and removed pollutants buildup.

Standard Maintenance:

After construction has been completed and all disturbed surfaces have been stabilized by means of vegetation, asphalt or concrete surfaces, and all drainage system components have been constructed and are free of construction debris and sediments; then the storm water management system can be considered in an operational status.

Periodic visual inspections will help to identify issues of concern.The usual indicators are signs of slow flows, backed up water, visible oil, trash and debris or an excessive amount of sediment in the storage area.

Normal operational flows can be observed to flow freely at the predicted design elevations, from the inlet to the outlet module, following a serpintine path thru the storage and attenuation modules. Note that some modules are designed to permanently

retain water where others may hold water and slowly release it over a typical 24 hour period. During a storm water event, the flows and water surface elevations will fluctuate from a low flow to a high flow/ storage status. The storage modules should fill during the event and drain down within a 24 hour period after the event has stopped. All pipes, orifices, weirs and standpipes should pass flows freely and at optimum capacity.

Standard maintenance is performed using a vacuum truck to suction the accumulated sediments, oils and greases and trash and debris from the system. Whereas an on-site maintenance staff can remove these items by hand, it is preferred that the vacuum truck be used as dictated by specific system conditions. When a specialized module designed to have a permanent water level is used, the vacuum truck should pump the liquid level down to inspect the below water elevation structures and sump storage areas.

Oils and greases can be handled by on-site staff by utilizing absorbent products that soak up the oils (and not) converting the oils from a liquid into a manageable solid form. These oil soaked absorbent materials should be disposed of in an approved manner.

Sediments, trash and debris shall be removed and disposed of in an approved manner.

Any indications of hazardous material, determined by visual inspection, testing, smell or abnormality, should be reported and handled per appropriate regulations.

Flow Conditions

System operators should familiarize themselves with proper hydraulic flow condition indicators, acceptable depths of sedimentation, debris and trash build up, and concentrations of oils and greases.

Hydraulic flow conditions are those that are established by the design as either a flow/storage or as a water quality treatment function. Both have performance characteristics that can be visually identified so as to determine the effective and efficient operation of the system.

The engineering design drawings should note the various expected water surface level elevations that are achieved during different design storms within the various modules. Since it is difficult for a visual inspection to coincide with the exact time given water elevations are predicted, the following guidelines are given for evaluation.

Visual Inspection Guide:

<u>Internal Flow Evaluation</u>

Low flow: water should flow freely from the inlet to the outlet, travelling the intended attenuation path thru the system with the water surface elevation below the structure

beam height (12” deep), the system should drain completely 24 hours after a storm event,

Medium flow: the system should hold and maintain a water level during the 24 hour storm event and yet continually fill as the storm increases or drain downward as the event recedes. Flow within the system should occur freely from inlet to outlet only being restricted when a flow control structure has been integrally designed in place. Flow control devices may result in a water level backing up either temporarily or permanently; noting devices such as water quality modules may require a permanent water level to operate properly (see water quality treatment). Other system applications should drain completely 24 hours after a storm event.

High flow: the system should fill to the maximum design storm water level elevation (hydraulic grade line) per design. In most cases, that is the highest storage elevation available in the system, at the underside of the module top slab, or the invert of the overflow pipe. As the storm event recedes, the water level should begin to drain down via flow thru the system and discharge. The system should drain completely within 24 hours after a storm event.

Pollutant Storage Capacities

<u>Oil and Grease</u>

Oil and Grease Collection (with optional Oil water separator module specified) - Oil and grease accumulation is generally a function related to vehicle parking lot and drive areas, oil generating land uses or emergency spill conditions. It is important to maintain the system from accumulating excessive volumes of oils in that they may wash over into other sections of the system potentially clogging and reducing the infiltration capacity, blocking control devices and contaminating the overall system. The following standards apply.

Oil should not accumulate more than a visible sheen on the water surface in the oil water separation module only. A sheen is described as a fine, thin oil layer on the water surface identified by the glossy rainbow colors. A dipstick (dry wooden stick) can be used as a probe to determine the thickness of oil on the surface.

Accumulated oils could be associated with insufficient maintenance or a potential large volume oil resource. Any accumulation of oil should be promptly maintained by an experienced waste handler. Emergency spills such as those generated by an accidental spill shall be contained and removed immediately before the next storm event. Spills shall be handled in accordance with local environmental regulations. See spill and accumulated oil maintenance procedures.

Sediments

Sediments (with optional primary grit module or sedimentation modules specified) - Sediments shall be periodically removed from the system as they accumulate within the designated storage modules. The inlet modules are generally equipped with a sediment storage sump located in the base of the inlet structure. Inspection should be performed after major storm events or a minimum of annually, unless a different inspection cycle has been determined to be sufficient. Inspection shall consist of using a probe to determine the presence of and depth of the accumulated solids. Access is via the 24" manhole.

Note that excessive volumes of sediments will reduce the performance and efficiency of the system. Regional accumulations of solids such as those associated with ice and snow, may result in large springtime volumes of sand and gravels used for traction and ice control.

Trash and Debris

Trash and Debris (with optional trash and debris module specified) - Trash and debris accumulates in the inlet module in three forms; floating debris, neutrally buoyant, and heavy material. The floating debris is visible from the access manhole floating on the water surface in the form of but not limited to wood, paper, plastic, foam, bottles and cans. The neutrally buoyant material resides below the surface and combines with the natural flow regime of the system. It is hard to detect and can only be recognized when at a high concentration appears as a thickening of the water viscosity. Heavier material will simply settle to the sump base and combine with the sediments.

Note that trash and debris typically cause the most problems when they become lodged in a flow control device such as an outlet elbow, riser pipe, and orifice or weir structure. This can be detected visibly when the system is pumped down during maintenance. It can also be evaluated as a condition when flow is impeded and the water level backs up higher than the design elevations.

Emergency Spill Conditions (with optional emergency spill control module specified):

Emergency spill conditions are defined as an excessive accumulation of hydrocarbons such as oil, gasoline, diesel fuel, transmission oil or antifreeze usually resulting from an accidental discharge. Excessive accumulation is described as any amount larger than a thin "sheen" visible on the water surface.

Care should be given in handling these types of fluids. The incident should be reported to the appropriate authorities and should be mitigated by a hazardous waste consultant approved for such matters.

retain-it ®

Maintenance Log

Storm Water Management System

Location: ID #:

Date	Inspection Notes	Inspector

Note the following conditions:

Inlet Module

Outlet Module

Water Quality Module

Oil Elbow

Oil Accumulation

Sedimentation Accumulation

Trash and Debris Quantity

Flow Conditions

Flow Control Outlet Structure

Overflow Pipe