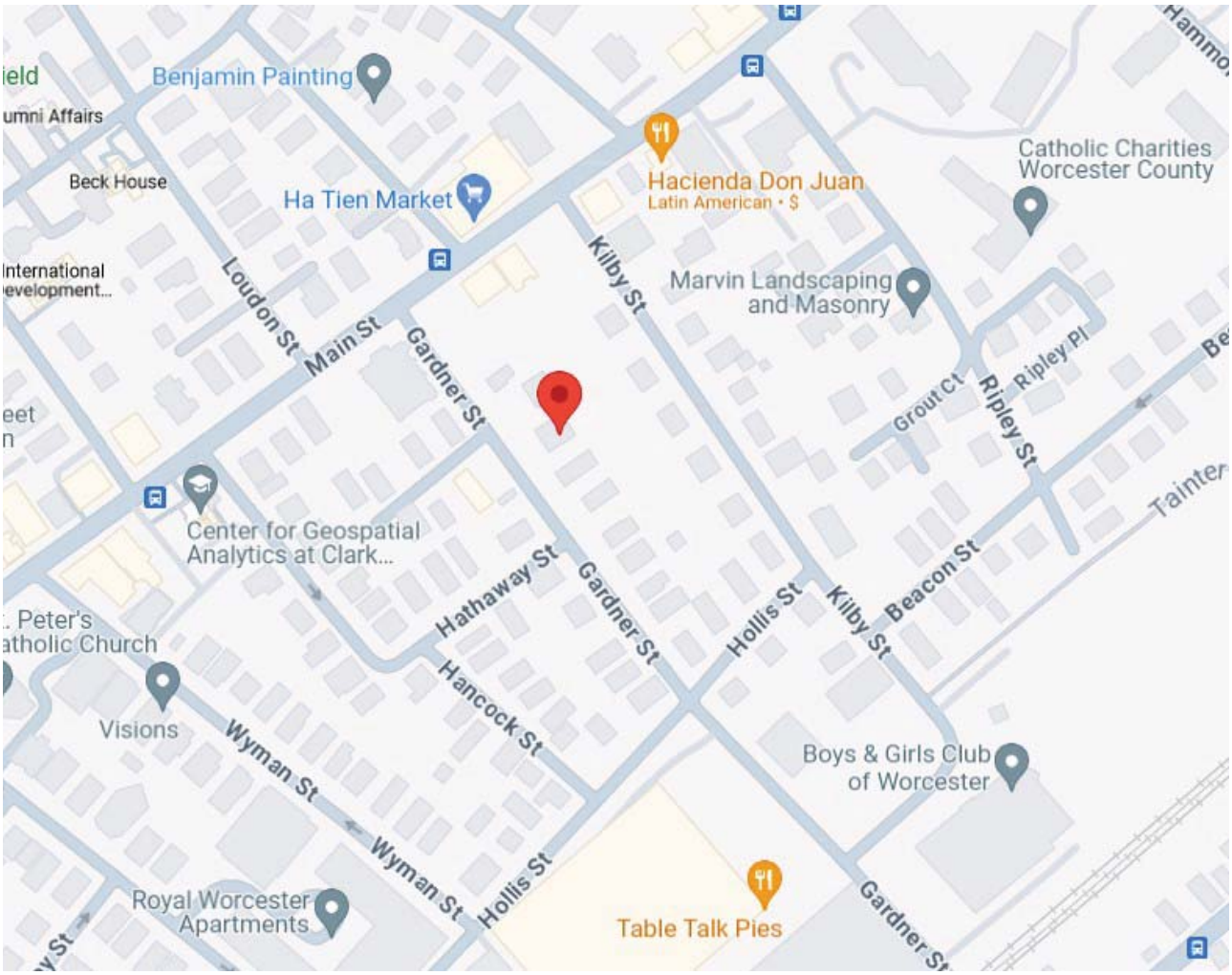


STORMWATER MANAGEMENT REPORT

15 Gardner Street
Worcester, MA

PREPARED BY:

ASA ENGINEERING
SHREWSBURY, MA
November 11,2024

Table of Contents

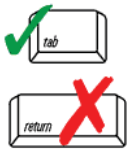
1-STORMWATER CHECK LIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

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.

2- Drainage Report

INTRODUCTION

The purpose of this drainage report is to review the stormwater runoff, focusing on both quality and quantity, in relation to the existing and proposed development conditions. This report will demonstrate, through narrative, calculations, and exhibits, that appropriate best management practices have been employed to mitigate the impacts of the proposed redevelopment. It will show that the proposed site development reduces the rate of runoff at the overall site runoff point during all storm events. Furthermore, the report will illustrate that the proposed stormwater management system complies with the stormwater standards set forth in the Massachusetts Department of Environmental Protection (MA DEP) Stormwater Management Regulations.

The proposed project involves redeveloping an existing single-family lot into an 8-unit apartment building with a footprint of 2,232 square feet. Additionally, the project will include a 2,990-square-foot paved parking lot. The proposed development will also provide a total of 3,300 square feet of green space, of which 2,171 square feet will be designated for recreational use. The site will also feature a walkway connecting the building to the existing city sidewalk.

SITE LOCATION AND DESCRIPTION

The property at 15 Gardner Street, Worcester, MA, is an abandoned single-family lot with an area of 9,450 square feet. The site is located within an RG-5 district zone and features a 2,124 square-foot concrete slab remaining from the original house. The rest of the lot has grass cover surface.

Based on the soil report obtained from the Natural Resources Conservation Service (NRCS), the majority of the site has been classified as Urban Fill Land. Due to previous development in the area, the soil cannot be accurately classified.

A copy of the NRCS Soil Map is provided in the Appendix of this report.

EXISTING DRAINAGE PATTERNS

To demonstrate compliance with the stormwater regulations, the existing drainage patterns were analyzed at “design points”. For the most part, surface runoff sheds towards abutting property at 19 Gardner Street and therefore the design point was selected based visual observation of drainage patterns at abutter property at 19 Gardner Street.

The stormwater runoff model indicates that the proposed development will reduce the rate of runoff at design point analyzed. This reduction is achieved by incorporating subsurface infiltration systems for the proposed building roof runoff and parking lot drainage. Roof drains from proposed buildings will be connected to an on-site drainage infiltration system. This system will facilitate groundwater recharge and storage, with an overflow connected to the street drainage system

The HydroCAD worksheets and hydrographs are included in the “HydroCAD Worksheets” Section of this report.

METHODOLOGY

The peak rate of runoff was determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Stormwater Modeling System by HydroCAD Software Solutions LLC, version 8.50, 2007. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration systems, to perform drainage routing and to combine the results of the runoff hydrographs.

3. Soil Survey of Norfolk County Massachusetts, by United States Department of Agriculture, Natural Resources Conservation Service. Soil types and boundaries were obtained from this reference.

STORMWATER MANAGEMENT STANDARDS

The proposed project is designed to meet or exceed all of the Stormwater Management Standards as determined by MassDEP to the maximum extent practicable. A description of each standard and if it is met is below.

Standard #1 – No New Untreated Discharges or Erosion:
Discharge points will remain unchanged from pre-construction to post-construction. No new untreated discharges are created. All discharges from the proposed building roofs for post-construction will be directed into an onsite drainage collective system with provisions provided for treatment and infiltration. .

Standard #2 – Peak Rate Attenuation:
Calculations have been provided to show that the proposed redevelopment will not cause an increase in peak discharge rates for storm events 2year, 10year and 25year, and it would help reducing it through limited storage provide in the proposed infiltration reservoir. Refer to the HydroCAD calculations provided within this report for detailed breakdowns of each study point.

Pre & Post Construction Runoff

Storm events:	2y @**3.20”**	10y @**4.9”**	25y @**6.20”**	100y @**8.90”**
Existing:	*0.06 cfs*	*0.28 cfs*	*0.50 cfs*	*1.02 cfs*
Proposed:	*0.02cfs*	*0.07 cfs*	*0.34cfs*	*0.81 cfs*

Standard #3 – Recharge to Groundwater:
The project meets this standard with the “post-development site increasing the annual recharge from the pre-development conditions. All discharges from the proposed impervious surfaces post construction will be directed into an onsite drainage collective system with provisions provided for treatment and infiltration. Proposed drainage system consist of all roof runoff to be directed to an site Cultec recharge bed under the building. Under proposed conditions, recharge is provided for the impervious areas being introduced based on the table below:

Hydrologic Group Volume to Recharge (x Total Impervious Area)	
Hydrologic Group	Volume to Recharge x Total Impervious Area
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

Using hydrological group B (note that the majority of existing soil type has been classified as urban fill)
The required recharge volume is given by the following equation:

R_v = F x IA (Equation 1 Stormwater Handbook Volume 3)

Where R_v = Required Recharge Volume, ft^3
F = Target Depth factor (Hydrologic Group C)
IA = Impervious drainage area

For 5,400 square feet of proposed impervious surface (building, Sidewalks & paved parking lot) will be constructed.

R_v = F x IA
= (0.35 inches)(12 inches/foot)(5,400 square feet)
=171.5 cubic feet

1,037 cubic feet of available storage is provided in the underground system.
(See HydroCAD worksheet)

Infiltration system is based on the Static Method of calculation as outlined in the Stormwater Management Handbook).

The system drawdown time is defined as:

$Time_{drawdown} = R_v / (K)(bottom\ area)$

where R_v = Required Recharge Volume, ft3
K =Saturated Hydraulic Conductivity (Rawls table)
Bottom area =bottom area of recharge structure

with a bottom area of 21'x26' (A=525 SF)

and K= 1.02 in

=171.5 ft^3 /((1.02* in/hour)(525 s.f.)(1ft/12 in))
=3.84 hours (<72 hours drain time = ok)

*1.02 inches per hour is a default for HSG "B", based on soil test report.
A two feet separation is required between the bottom of the infiltration structure and the seasonal high Ground water table. Soil test indicated that there are no indication of seasonal high water at Test Hole -

A capture area adjustment is not required as all stormwater is treated through stormwater controls.

Therefore, this standard has been met.

Standard 4 – Water Quality:

The project is a redevelopment project and there are no catch basins specified in the garage parking lot. All the runoff from the project will be generated from the roof runoff which 100 % will be directed to the underground infiltration units without any requirement for pretreatment. Water Quality Depth of 0.5 inches is utilized for Water quality treatment does not apply.

Long term pollution prevention plan has been included as part of the Operation and Maintenance Plan. Structural stormwater best management practices are sized to capture the required water quality volume.

The project is not located in a critical area and therefore

The Project complies with Standard 4.

Standard 5 – Land Use with Higher Potential Pollutant Loads (LUHPPLs):
The proposed project is not a Land Use with Higher Potential Pollutant Loads and therefore Standard 5 does not apply to this project.

Standard 6 – Critical Areas
The proposed project is not located in an area defined as a Critical Area and therefore Standard 6 does not apply to this project.

Standard 7 – Redevelopments and Other Projects Subject to the Standards only to the Maximum Extent Practicable
Standards are met to the maximum extent practicable as described in this section thereby meeting this Standard.

Standard 8 – Construction Period Pollution Prevention & Erosion & Sediment Control
An Erosion Control plan has been incorporated with the design plans. Also, due to limited area of disturbance the project does not requires a Stormwater Pollution Prevention Plan under the EPA NPDES program.

Standard 9 – Operations and Maintenance Plan
Refer to the Operations and Maintenance Plan included in this report.

Standard 10 – Prohibition of Illicit Discharges
No illicit discharges exist on site. The storm water management system proposed shall not be connected to the wastewater management system and shall not be contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, oil, or grease per Massachusetts DEP Storm Water Standard 10. The Illicit discharge statement is included in the appendix of this report.

3- Operation & Maintenance Plan

OPERATION AND MAINTENANCE PLAN

In accordance with the standards set forth by the Stormwater Management Regulations issued by the Department of Environmental Protection (DEP), this report has prepared the following Operation and Maintenance (O&M) plan for the proposed stormwater management system at 15 Gardner Street site. This O&M plan addressed post construction pollution prevention and maintenance of stormwater systems.

This plan is broken into two major sections. The first section describes pollution prevention techniques to encourage source controls that prevent pollution. The second section is devoted to a post-development operation and maintenance plan of the stormwater management system. An operation and maintenance schedule has been included at the end of the report.

Basic Information

Owner:	TBD
Address:	15 Gardner Street
City:	Worcester, MA

Section 1 Pollution Prevention

As a food recycling facility, the largest potential sources of pollution includes food packaging and normal maintenance truck fluids in this facility. It is anticipated that all of these materials will be stored and maintained inside specialized containers that are only access by trained personnel. However the following pollution prevention techniques are provided in the event that there is a spill outside the facility that may enter the stormwater management system.

Good House Keeping

The following measures will be employed to control potential sources of contamination and prevent pollution at The Project property:

Deicing

To prevent increased pollutant concentrations in stormwater discharges, the amount of road salt applied will be controlled. Calibration devices for spreaders in trucks will be encouraged to contractors employed to plow the parking area. The amount of deicing materials used will be monitored with the goal of using only enough to make the roadway and parking areas safe.

Snow Storage/Disposal

Snow storage/disposal will be allowed in unused areas of the property away from storm drainage systems and wetland resource areas.

Pavement Sweeping

N/A.

Fertilizer/Pesticide/Herbicide Application

Applications of treatment materials will be used throughout the site. Their application adjacent to the stormwater systems will be limited. Slow release fertilizer will be used and applied in the minimum amounts recommended by the manufacturer. Once applied, the fertilizer will be worked into the soil to limit exposure to stormwater. Storage will be in a closed structure; and the contents of any partially used bags will be transferred to a sealable, plastic bin to avoid spills.

Materials Management/Housekeeping Practices

The following product-specific practices will be followed on-site. Recommendations are provided for petroleum products, fertilizers, solvents, paints, and other hazardous substances, and concrete.

Petroleum Products – Routine maintenance of course equipment is anticipated. No chemicals, fluids or fuels from vehicles will be drained into the stormwater system. All fluids will be collected in appropriate containers and disposed of according to State regulations. Storage of diesel and unleaded fuel will be regulated by the State Fire Marshall and will be in an approved container. No petroleum-based or asphalt substances will be stored within 100 feet of a waterway.

Solvents, Paints, and other Hazardous Substances - All containers will be tightly sealed and stored indoors when not required for use. Excess materials will not be discharged to the storm sewer system, but will be properly disposed according to manufacturer's instructions or state and local regulations. Outside storage on the property will be prohibited.

Spill Prevention and Control

The Property Manager/Groundskeeper will be responsible for training of people in the proper handling and cleanup of spilled materials. No spilled hazardous materials or hazardous wastes will be allowed to come in contact with storm water discharges. If such contact occurs, the storm water discharge will be contained on site until appropriate measures in compliance with State and Federal regulations are taken to dispose of such contaminated storm water.

In order to minimize the potential for a spill of hazardous materials to come into contact with storm water, the following steps will be implemented:

1. All materials with hazardous properties (such as pesticides, petroleum products, fertilizers, detergents, construction chemicals, acids, paints, paint solvents, cleaning solvents, additives for soil stabilization, concrete curing compounds and additives, 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 the 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 at the maintenance area of the site.

4. Manufacturers 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.

In the event of a spill, the following procedures should be followed:

1. All spills will be cleaned up immediately after discovery.

2. The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with the hazardous substances.

3. The Owner and Property Manager will be notified immediately.

4. Spills of toxic or hazardous materials will be reported to the appropriate federal, state, and/or local government agency, regardless of the size of the spill.

5. If the spilt material enters the drainage system, the catch basin or other structure acting as the inlet shall be cleaned via a vac truck as soon as possible and before the next rainfall event to the extent practicable.

The Property Manager will be the spill prevention and response coordinator. He will designate the individuals who will receive spill prevention and response training. These individuals will each become responsible for a particular phase of prevention and response. The names of these personnel will be posted in the material storage area and other applicable areas onsite.

Section 2 Stormwater Management System – Operation and Maintenance

1. Paved Areas – N/A

2. Salt for de-icing during the winter months shall be limited to the minimum amount practicable. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

3. The Infiltration System: Inspect and maintain twice a year and after every rain event. Removal of all debris from the area and avoid storage of any material on or around the infiltration system.

4. All sediments removed from the infiltration systems shall be disposed of properly, and in accordance with applicable local and state regulations.

5. All vegetated areas on the site shall be stabilized and maintained to control erosion. Any disturbed areas shall be re-seeded as soon as practicable. Trash and debris should be removed on a regular basis.

6. Work within any drainage structures shall performed in accordance with the latest OSHA regulations, and only by individuals with appropriate OSHA certification.

Maintenance Responsibilities - All post-construction maintenance activities shall be documented and kept on file for up to 3 years. Copies of said document shall be submitted to the Zoning Board of Appeals and the Town Engineer.

4- Exhibits

Table B-1. Requirements for Determining Field Infiltration Rates

Infiltration Design Method	NRCS Hydrologic Soil Groups			
	A	B	C	D
Static Method	Soil Textural Analysis	Soil Textural Analysis	Saturated Hydraulic Conductivity Testing	Infiltration Not Allowed
Simple Dynamic Method	Soil Textural Analysis	Soil Textural Analysis	Saturated Hydraulic Conductivity Testing	Infiltration Not Allowed
Dynamic Field Method	Saturated Hydraulic Conductivity Testing	Saturated Hydraulic Conductivity Testing	Saturated Hydraulic Conductivity Testing	Infiltration Not Allowed

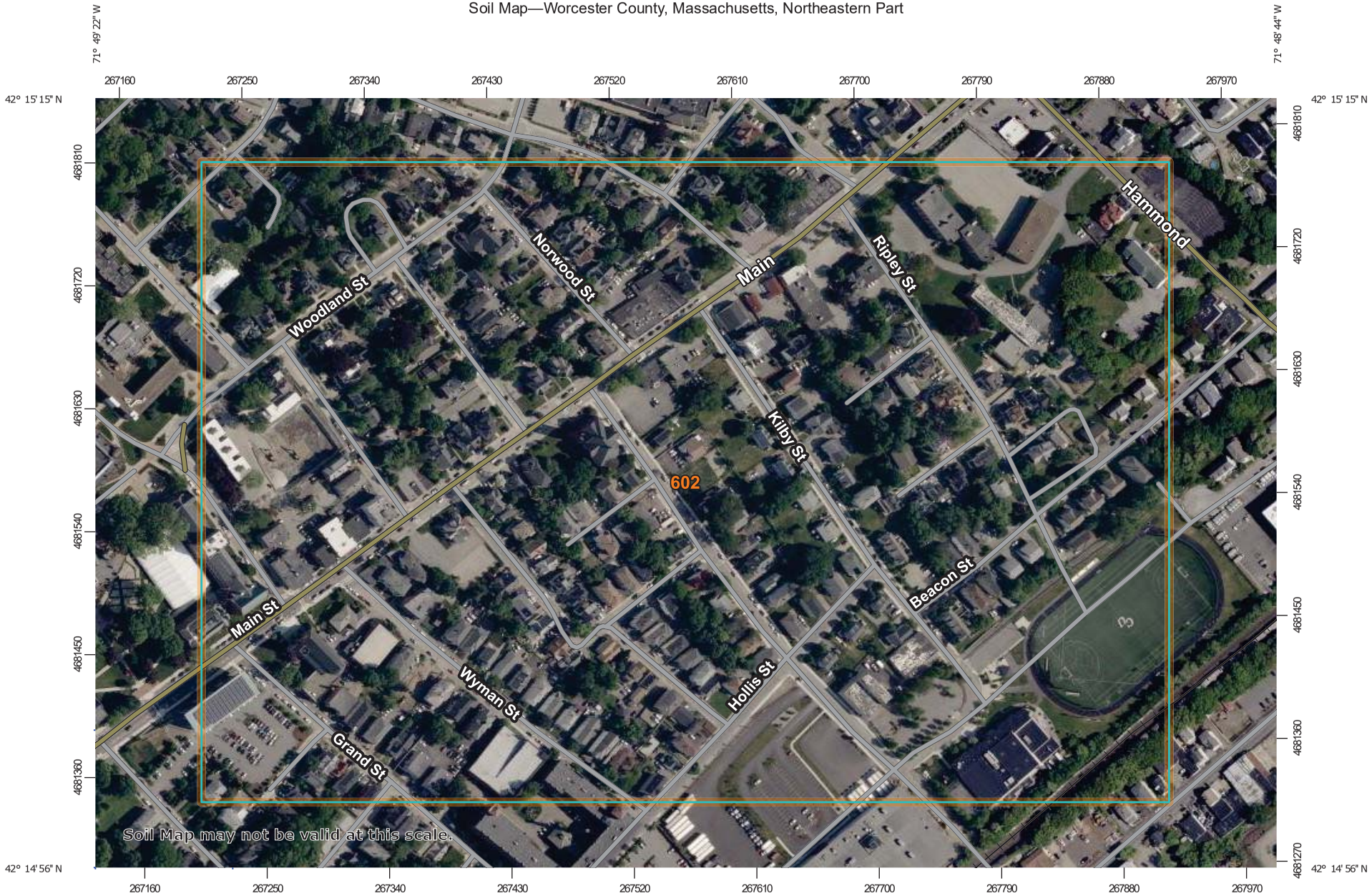
Table B-2. Default (Rawls) Infiltration Rates

Texture Class	NRCS Hydrologic Soil Group (HSG)	Infiltration Rate Inches/Hour
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Source: Rawls, Brakensiek and Saxton, 1982.

- The slowest of the Hydrologic Soil Groups determined to exist at the point where infiltration is proposed shall be used.
    - *Example:* Two samples are taken at a proposed infiltration bioretention system in the actual soil layer where recharge is proposed. One sample indicates sandy soils. The second sample indicates a sandy loam soil. The default infiltration rate used for the design analysis must use the sandy loam rate and not the sandy soil rate. Soils must not be composited for purposes of the soil textural analysis.

- When the "Dynamic Field" method is used to size the infiltration system (regardless of Hydrologic Soil Group) or infiltration is proposed within Hydrologic Soil Group C soils



Map Scale: 1:3,970 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

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	82.7	100.0%
Totals for Area of Interest		**82.7**	**100.0%**

Worcester County, Massachusetts, Northeastern Part

102D—Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes

Map Unit Setting

National map unit symbol: 2w69h
Elevation: 0 to 1,540 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Chatfield, extremely stony, and similar soils: 35 percent
Hollis, extremely stony, and similar soils: 30 percent
Rock outcrop: 20 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Chatfield, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 1 inches: slightly decomposed plant material
A - 1 to 2 inches: fine sandy loam
Bw - 2 to 30 inches: gravelly fine sandy loam
2R - 30 to 40 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 41 inches to lithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: B
Ecological site: F144AY034CT - Well Drained Till Uplands
Hydric soil rating: No

Description of Hollis, Extremely Stony

Setting

Landform: Ridges, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex
Across-slope shape: Linear, convex
Parent material: Coarse-loamy melt-out till derived from granite, gneiss, and/or schist

Typical profile

Oi - 0 to 2 inches: slightly decomposed plant material
A - 2 to 7 inches: gravelly fine sandy loam
Bw - 7 to 16 inches: gravelly fine sandy loam
2R - 16 to 26 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 8 to 23 inches to lithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY033MA - Shallow Dry Till Uplands
Hydric soil rating: No

Description of Rock Outcrop

Setting

Landform: Ridges, hills
Parent material: Igneous and metamorphic rock

Typical profile

R - 0 to 79 inches: bedrock

Properties and qualities

Slope: 15 to 35 percent
Depth to restrictive feature: 0 inches to lithic bedrock
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Available water supply, 0 to 60 inches: Very low (about 0.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydrologic Soil Group: D
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 7 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Leicester, extremely stony

Percent of map unit: 4 percent
Landform: Ground moraines, hills, drainageways, depressions
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Sutton, extremely stony

Percent of map unit: 2 percent
Landform: Ground moraines, hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear

Hydric soil rating: No

Data Source Information

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

Worcester County, Massachusetts, Northeastern Part

602—Urban land

Map Unit Setting

National map unit symbol: w3q8
Mean annual precipitation: 32 to 50 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

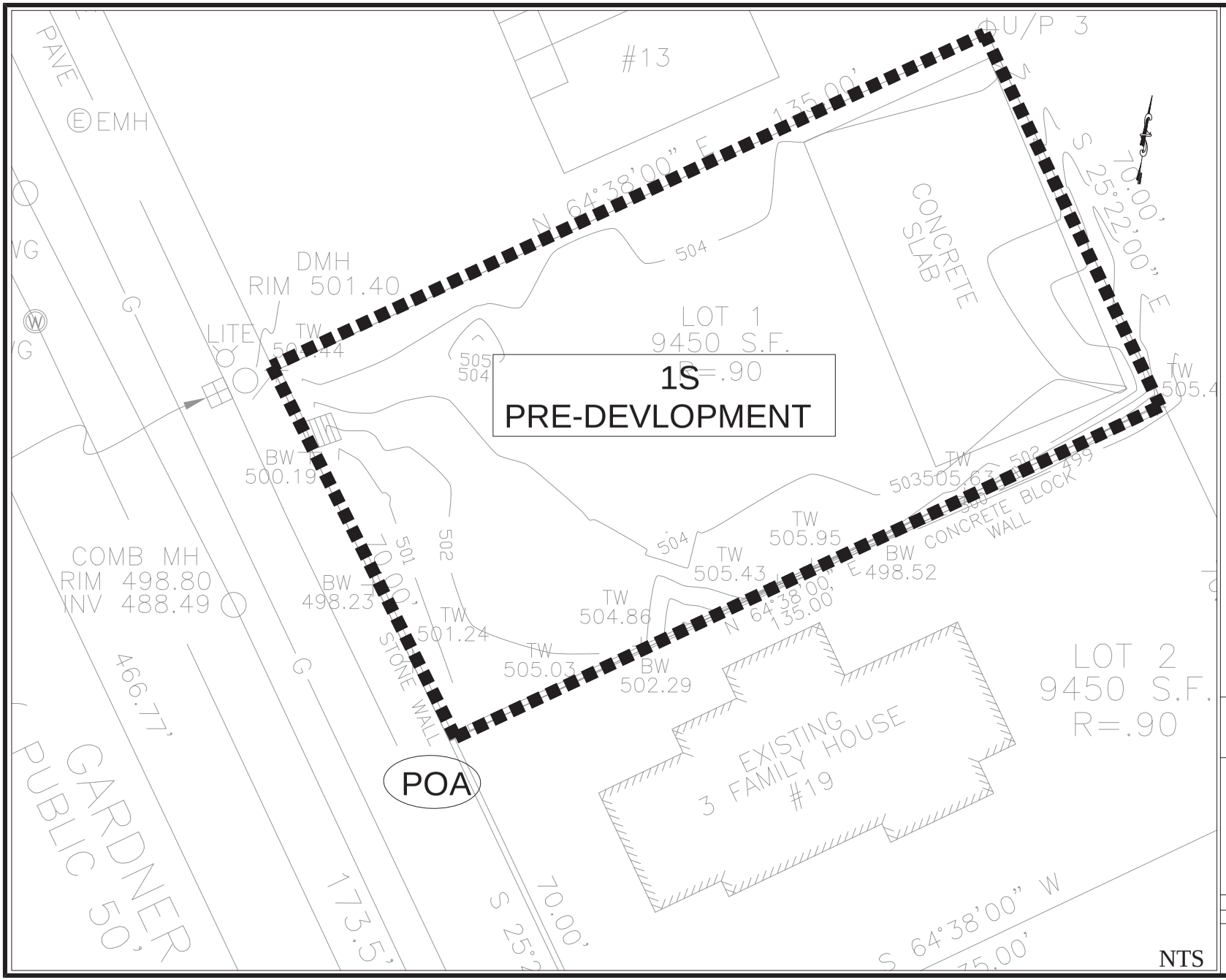
Setting

Parent material: Excavated and filled land

Data Source Information

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

5- HydroCad Worksheet



SUBCATCHMENT
PLAN
(PRE-DEVELOPMENT)

15 GARDNER STREET
WORCESTER, MA

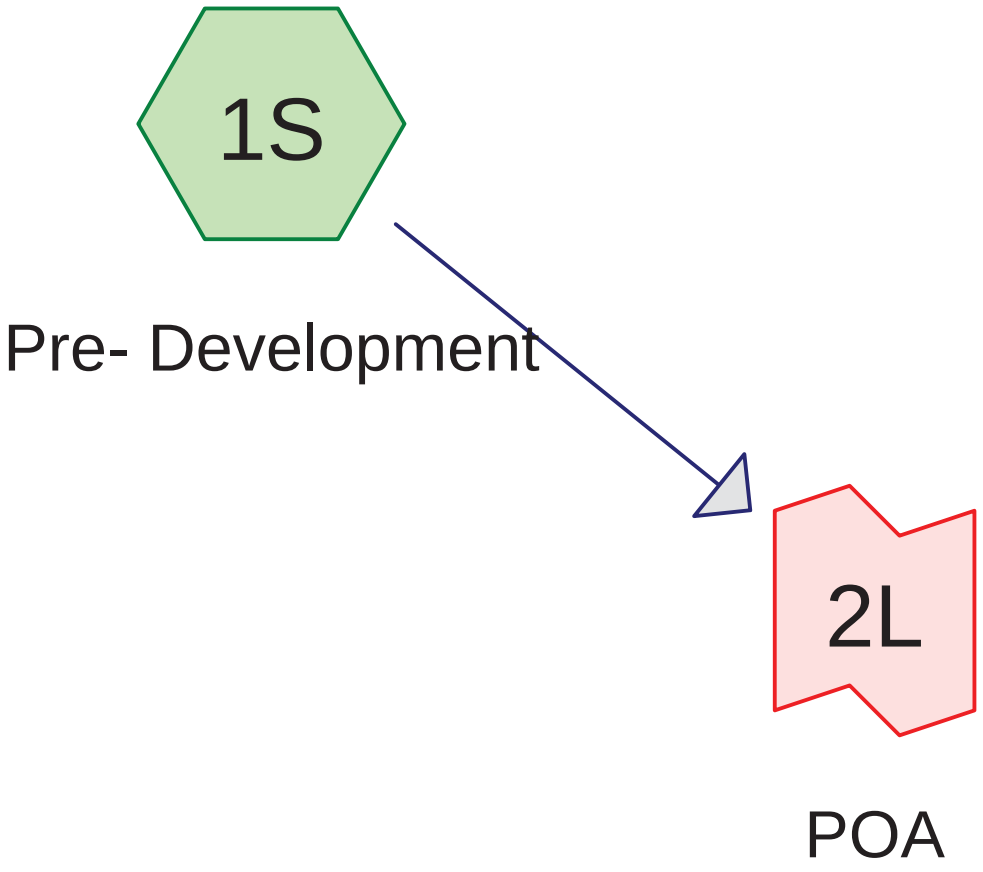
PREPARED FOR:

RODRIGO HULKFINISH

PREPARED BY:
A.S. ENGINEERING
SHREWSBURY, MA
(978)-377-5084
moeazi1100@yahoo.com

DATED : 7/22/24

REVISION NO.	DATE



Subcat Reach Pond Link

Drainage Diagram for Worcester 15 Gardner Pre Development
Prepared by {enter your company name here}, Printed 7/13/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.168	49	50-75% Grass cover, Fair, HSG A (1S)
0.049	98	Concrete Slab (1S)
0.217		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.168	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.049	Other	1S
0.217		**TOTAL AREA**

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre- Development Runoff Area=9,450 sf 22.48% Impervious Runoff Depth>0.36"
Flow Length=150' Tc=5.0 min CN=60 Runoff=0.06 cfs 0.006 af

Link 2L: POA Manual Hydrograph Inflow=0.06 cfs 0.006 af
Primary=0.06 cfs 0.006 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.006 af Average Runoff Depth = 0.36"
77.52% Pervious = 0.168 ac 22.48% Impervious = 0.049 ac

Summary for Subcatchment 1S: Pre- Development

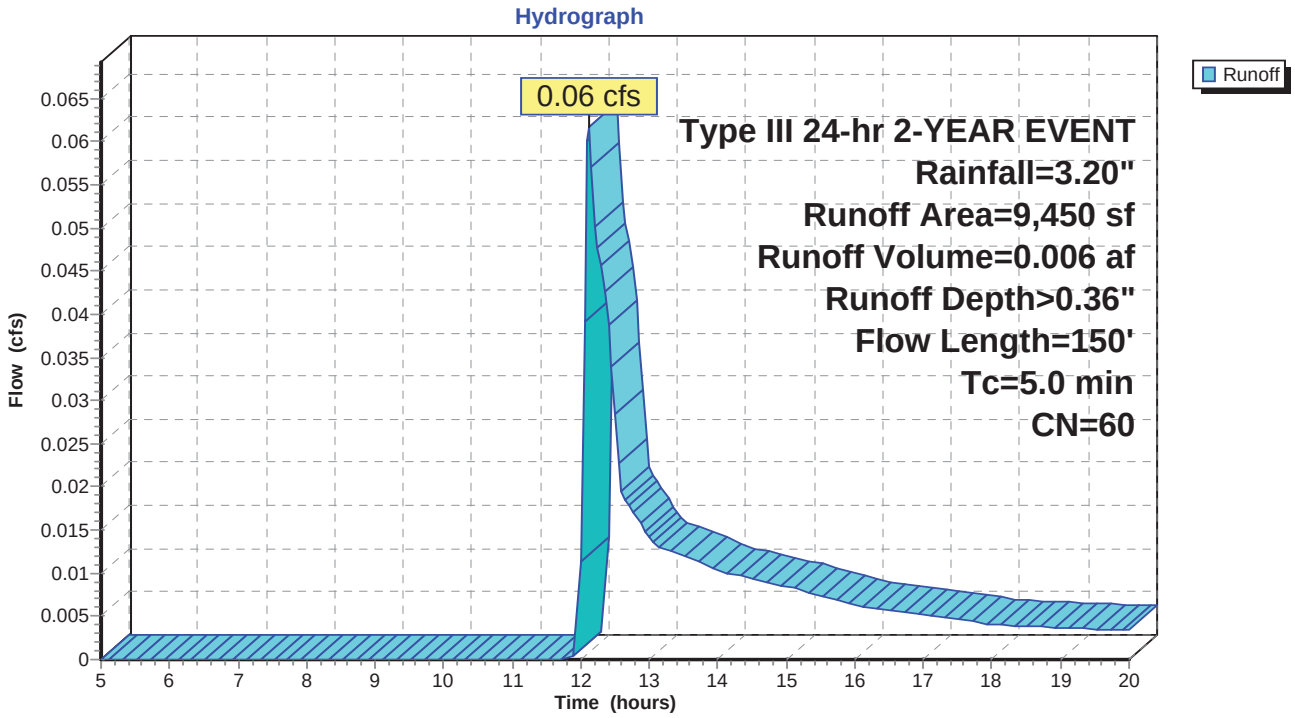
Runoff = 0.06 cfs @ 12.12 hrs, Volume= 0.006 af, Depth> 0.36"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEAR EVENT Rainfall=3.20"

	Area (sf)	CN	Description
*	2,124	98	Concrete Slab
	7,326	49	50-75% Grass cover, Fair, HSG A
	9,450	60	Weighted Average
	7,326		Pervious Area
	2,124		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	150		0.50		**Direct Entry,**

Subcatchment 1S: Pre- Development



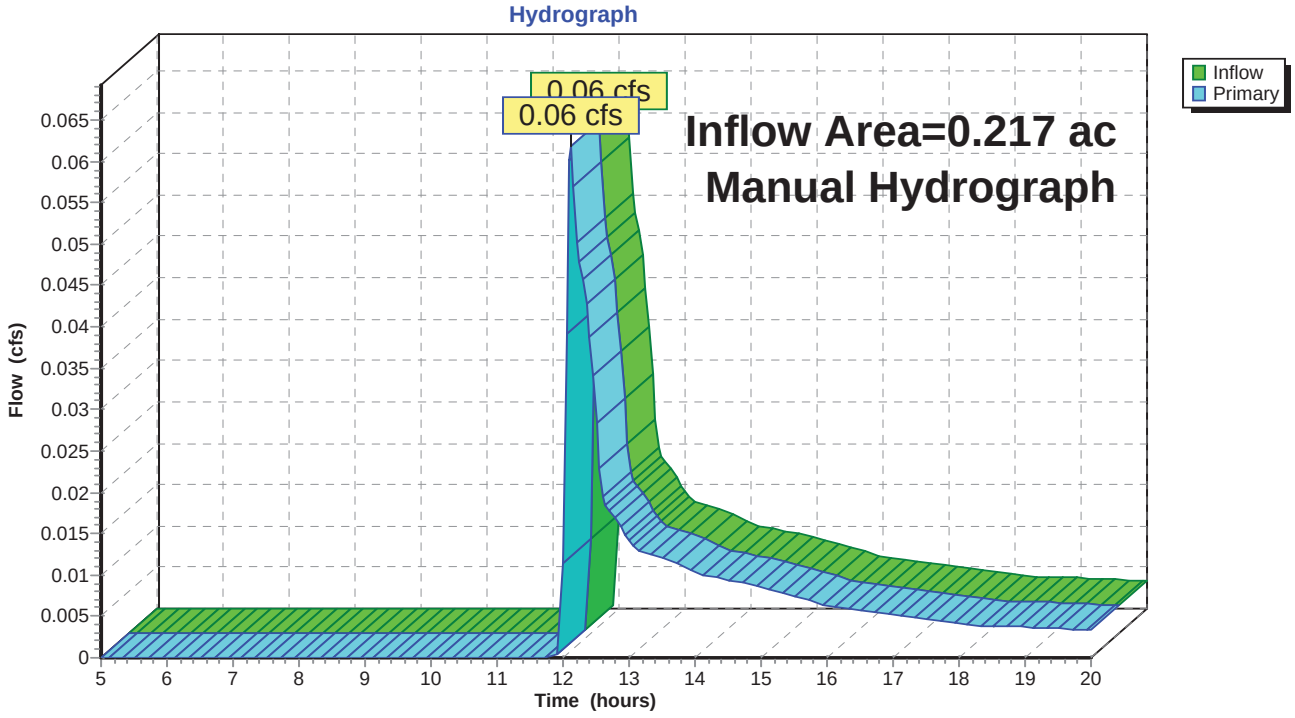
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 22.48% Impervious, Inflow Depth > 0.36" for 2-YEAR EVENT event
Inflow = 0.06 cfs @ 12.12 hrs, Volume= 0.006 af
Primary = 0.06 cfs @ 12.12 hrs, Volume= 0.006 af, Atten= 0%, Lag= 0.0 min

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

Constant Inflow= 0.00 cfs

Link 2L: POA



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre- Development Runoff Area=9,450 sf 22.48% Impervious Runoff Depth>1.12"
Flow Length=150' Tc=5.0 min CN=60 Runoff=0.28 cfs 0.020 af

Link 2L: POA Manual Hydrograph Inflow=0.28 cfs 0.020 af
Primary=0.28 cfs 0.020 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.020 af Average Runoff Depth = 1.12"
77.52% Pervious = 0.168 ac 22.48% Impervious = 0.049 ac

Summary for Subcatchment 1S: Pre- Development

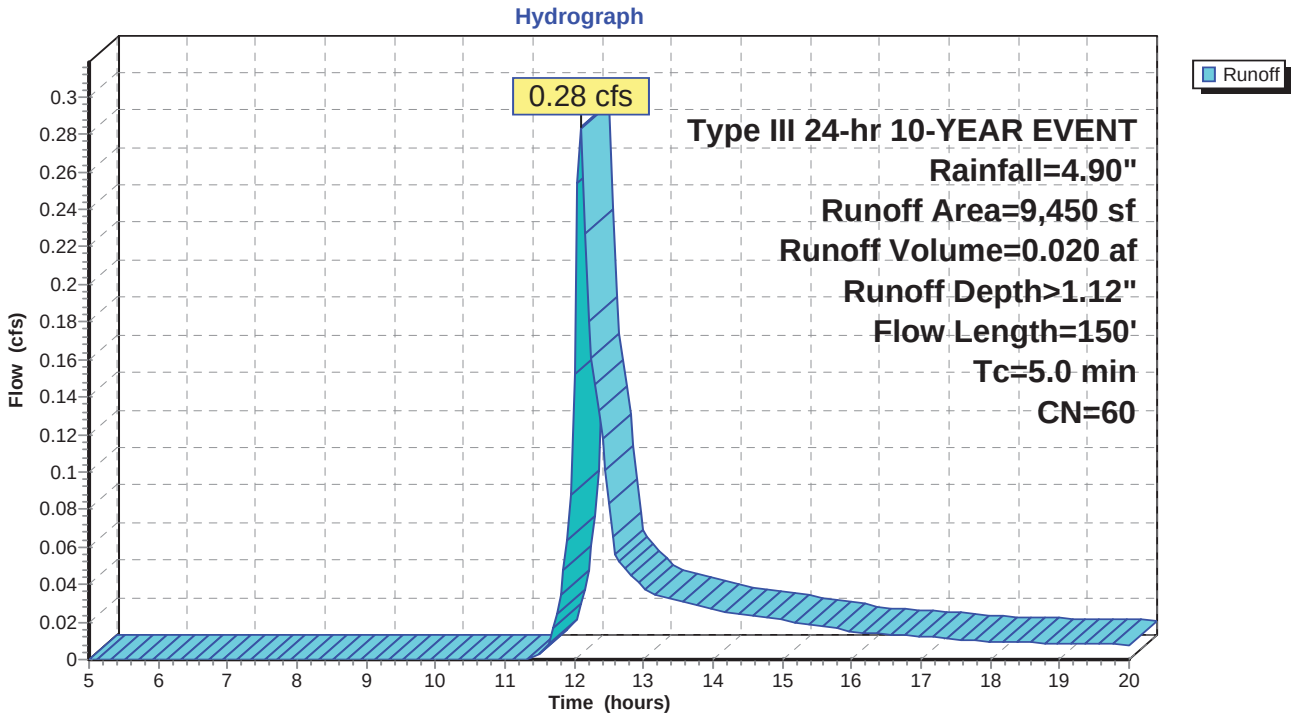
Runoff = 0.28 cfs @ 12.09 hrs, Volume= 0.020 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEAR EVENT Rainfall=4.90"

	Area (sf)	CN	Description
*	2,124	98	Concrete Slab
	7,326	49	50-75% Grass cover, Fair, HSG A
	9,450	60	Weighted Average
	7,326		Pervious Area
	2,124		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	150		0.50		**Direct Entry,**

Subcatchment 1S: Pre- Development



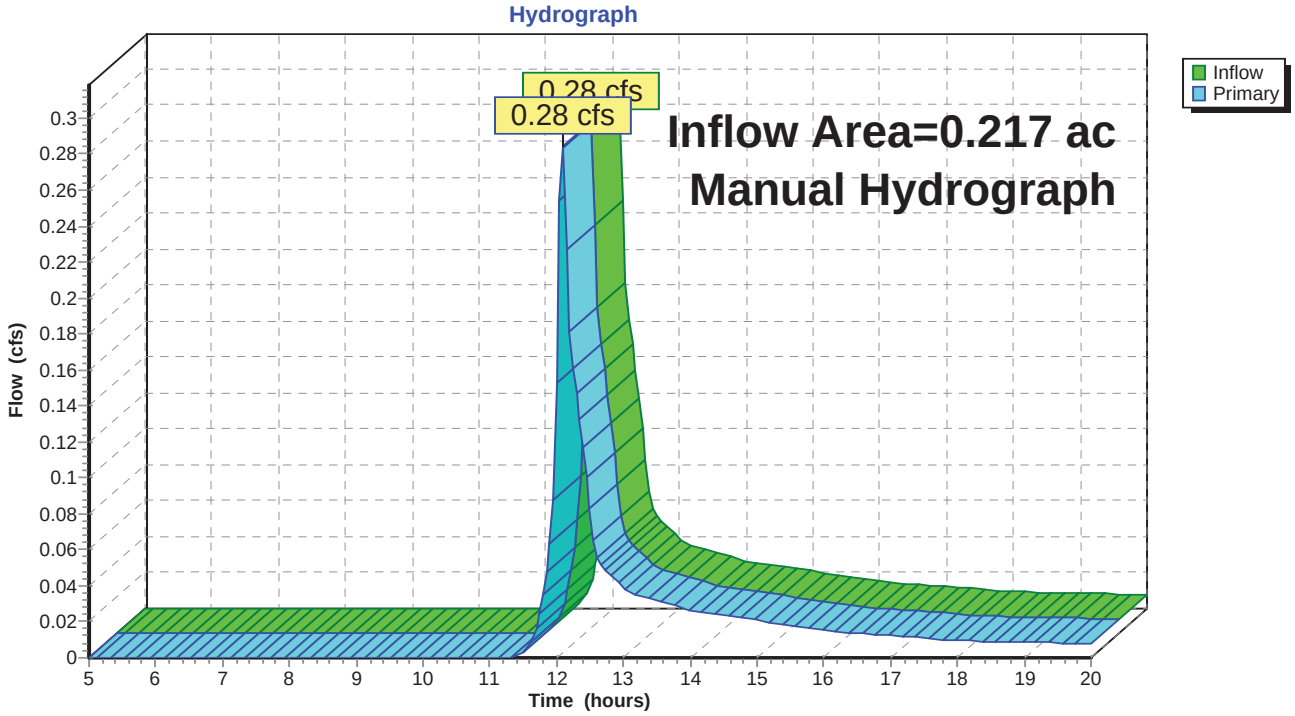
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 22.48% Impervious, Inflow Depth > 1.12" for 10-YEAR EVENT event
Inflow = 0.28 cfs @ 12.09 hrs, Volume= 0.020 af
Primary = 0.28 cfs @ 12.09 hrs, Volume= 0.020 af, Atten= 0%, Lag= 0.0 min

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

Constant Inflow= 0.00 cfs

Link 2L: POA



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre- Development Runoff Area=9,450 sf 22.48% Impervious Runoff Depth>1.88"
Flow Length=150' Tc=5.0 min CN=60 Runoff=0.50 cfs 0.034 af

Link 2L: POA Manual Hydrograph Inflow=0.50 cfs 0.034 af
Primary=0.50 cfs 0.034 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.034 af Average Runoff Depth = 1.88"
77.52% Pervious = 0.168 ac 22.48% Impervious = 0.049 ac

Summary for Subcatchment 1S: Pre- Development

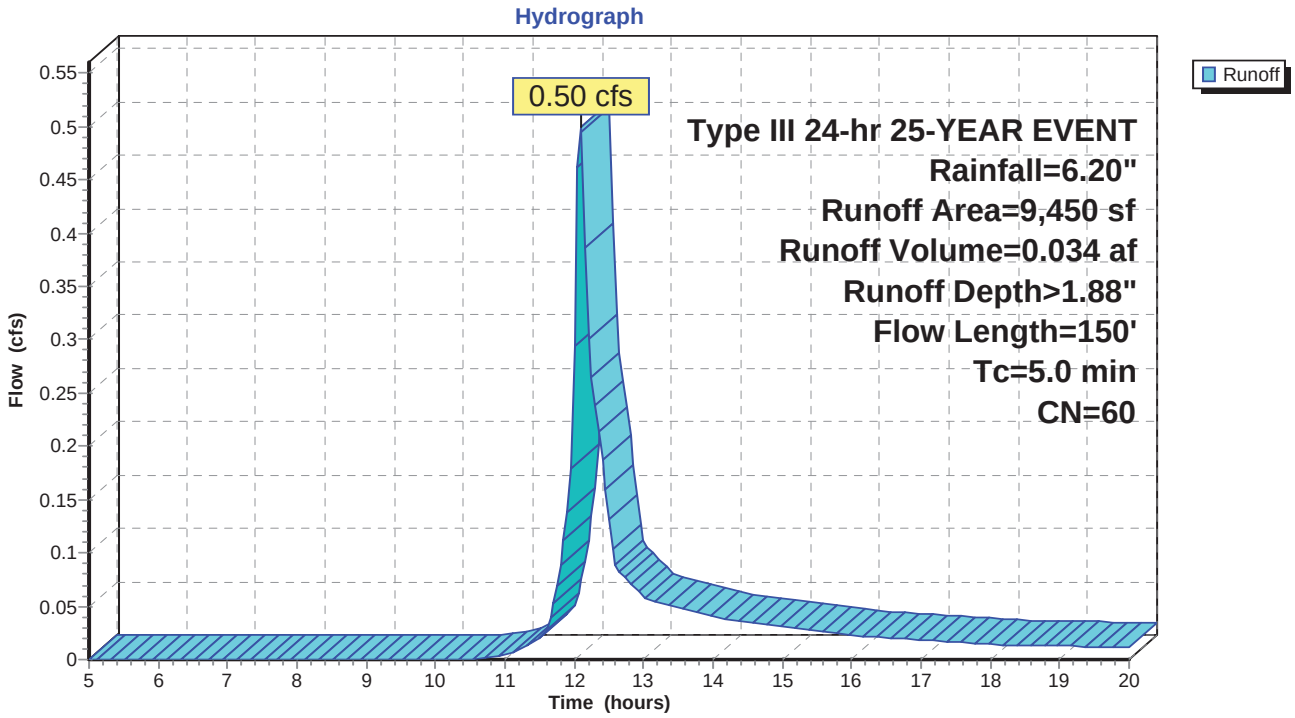
Runoff = 0.50 cfs @ 12.09 hrs, Volume= 0.034 af, Depth> 1.88"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR EVENT Rainfall=6.20"

	Area (sf)	CN	Description
*	2,124	98	Concrete Slab
	7,326	49	50-75% Grass cover, Fair, HSG A
	9,450	60	Weighted Average
	7,326		Pervious Area
	2,124		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	150		0.50		**Direct Entry,**

Subcatchment 1S: Pre- Development



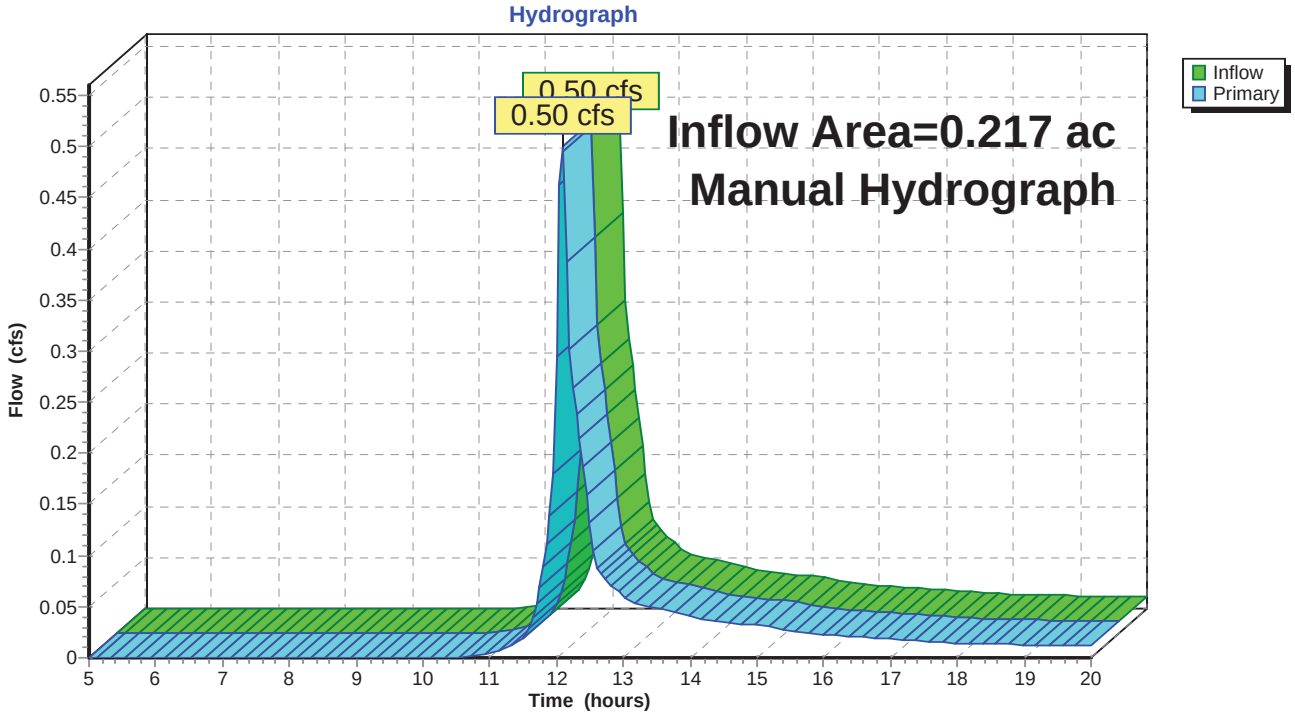
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 22.48% Impervious, Inflow Depth > 1.88" for 25-YEAR EVENT event
Inflow = 0.50 cfs @ 12.09 hrs, Volume= 0.034 af
Primary = 0.50 cfs @ 12.09 hrs, Volume= 0.034 af, Atten= 0%, Lag= 0.0 min

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

Constant Inflow= 0.00 cfs

Link 2L: POA



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre- Development Runoff Area=9,450 sf 22.48% Impervious Runoff Depth>3.72"
Flow Length=150' Tc=5.0 min CN=60 Runoff=1.02 cfs 0.067 af

Link 2L: POA Manual Hydrograph Inflow=1.02 cfs 0.067 af
Primary=1.02 cfs 0.067 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.067 af Average Runoff Depth = 3.72"
77.52% Pervious = 0.168 ac 22.48% Impervious = 0.049 ac

Summary for Subcatchment 1S: Pre- Development

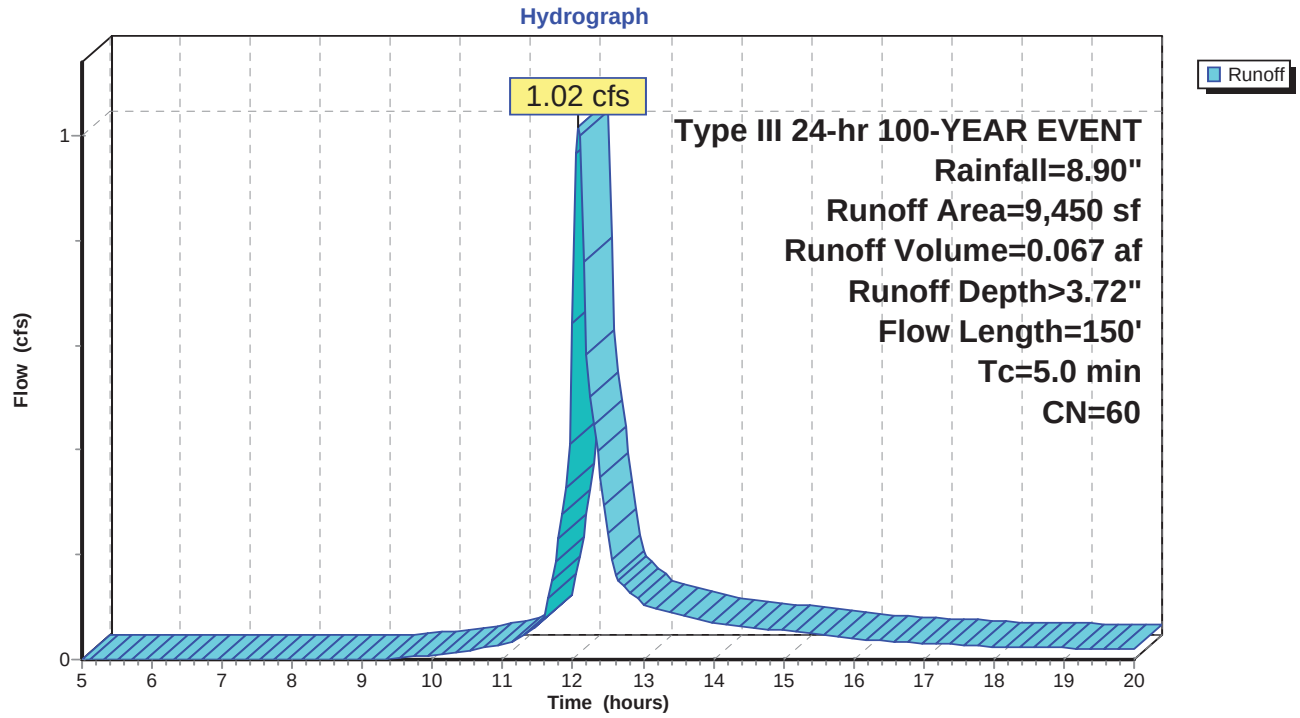
Runoff = 1.02 cfs @ 12.08 hrs, Volume= 0.067 af, Depth> 3.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEAR EVENT Rainfall=8.90"

	Area (sf)	CN	Description
*	2,124	98	Concrete Slab
	7,326	49	50-75% Grass cover, Fair, HSG A
	9,450	60	Weighted Average
	7,326		Pervious Area
	2,124		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	150		0.50		**Direct Entry,**

Subcatchment 1S: Pre- Development



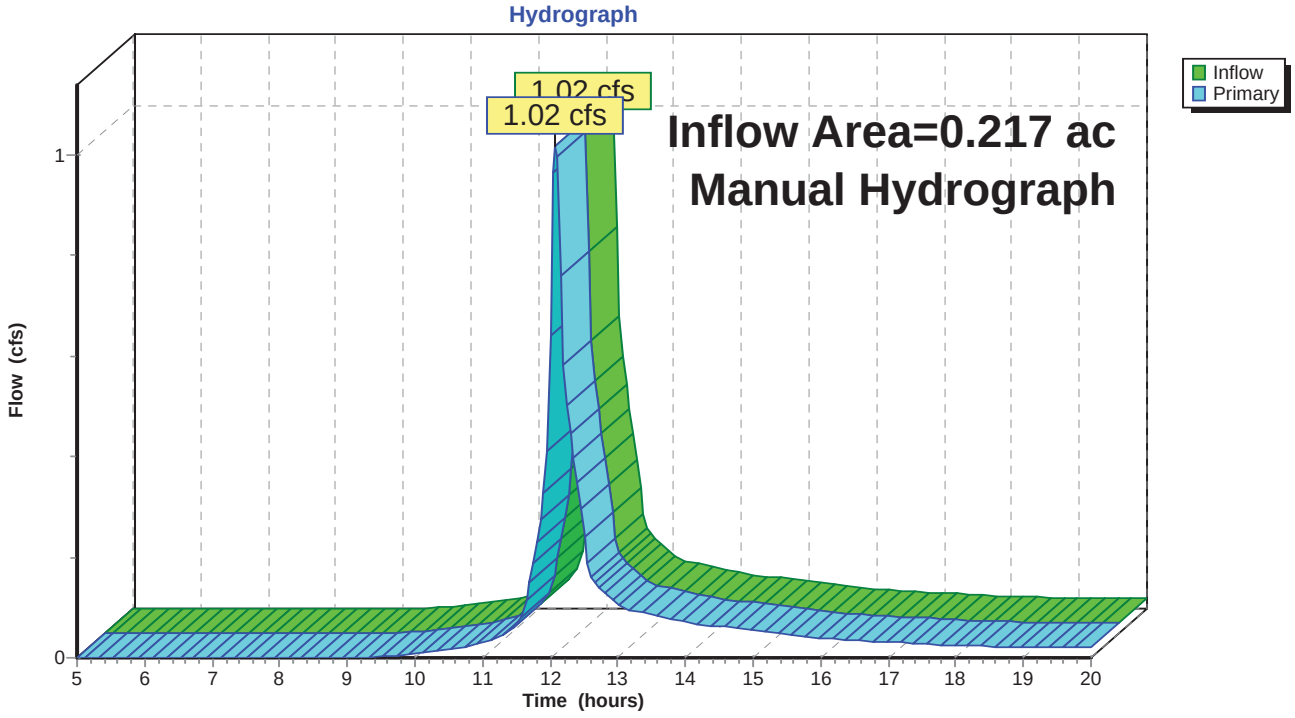
Summary for Link 2L: POA

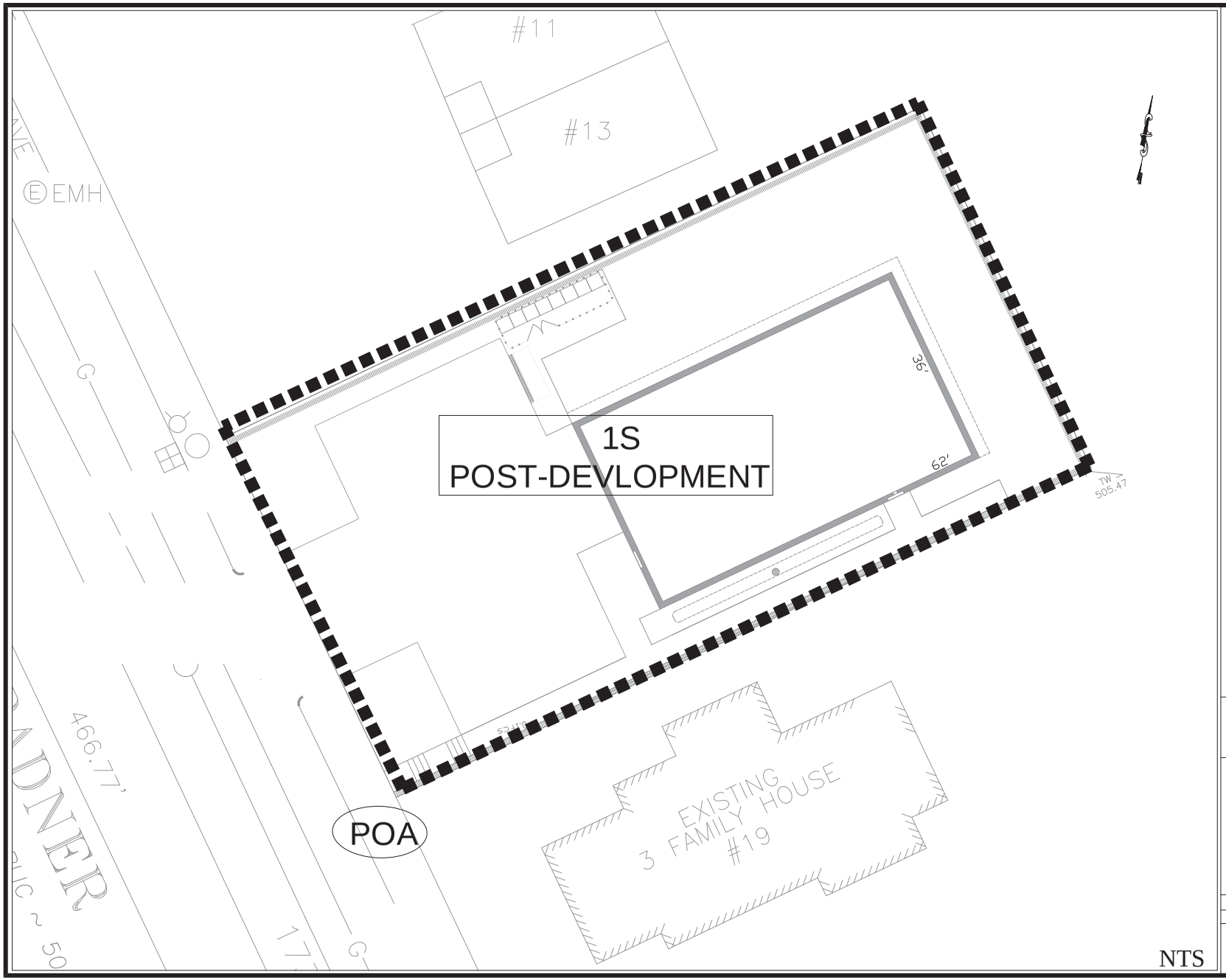
Inflow Area = 0.217 ac, 22.48% Impervious, Inflow Depth > 3.72" for 100-YEAR EVENT event
Inflow = 1.02 cfs @ 12.08 hrs, Volume= 0.067 af
Primary = 1.02 cfs @ 12.08 hrs, Volume= 0.067 af, Atten= 0%, Lag= 0.0 min

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

Constant Inflow= 0.00 cfs

Link 2L: POA





SUBCATCHMENT PLAN (POST-DEVELOPMENT)

15 GARDNER STREET
WORCESTER, MA

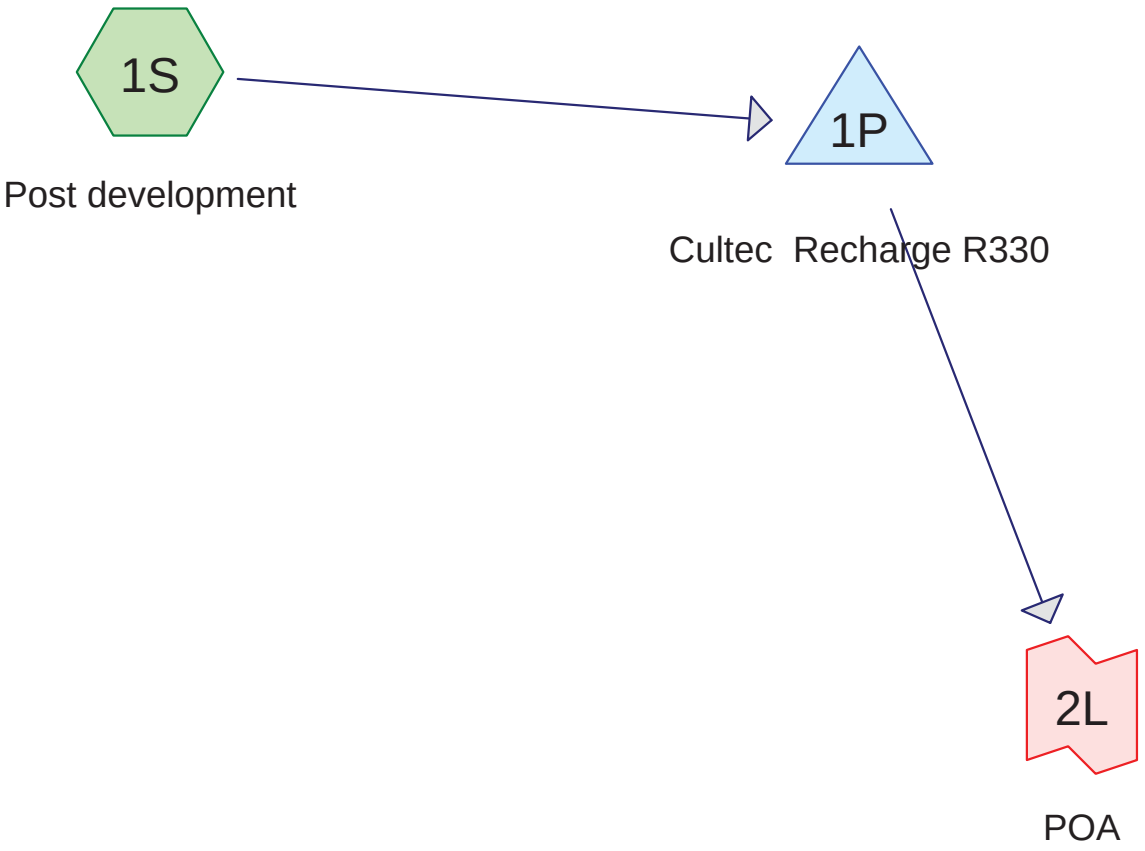
PREPARED FOR:

RODRIGO HULKFINISH

PREPARED BY:
A.S. ENGINEERING
SHREWSBURY, MA
(978)-377-5084
moeazi1100@yahoo.com

DATED : 7/22/24

REVISION NO.	DATE



Subcat Reach Pond Link

Drainage Diagram for Worcester 15 Gardner- Post Developmen-Final
Prepared by {enter your company name here}, Printed 11/10/2024

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.076	39	>75% Grass cover, Good, HSG A (1S)
0.006	49	Grass Pavers (1S)
0.051	98	Building (1S)
0.069	98	Paved Parking lot (1S)
0.015	98	Walkways (1S)
0.217		**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Goup	Subcatchment Numbers
0.076	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.141	Other	1S
0.217		**TOTAL AREA**

Time span=0.00-33.00 hrs, dt=0.05 hrs, 661 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post development Runoff Area=9,440 sf 62.22% Impervious Runoff Depth=1.15"
Flow Length=68' Tc=5.0 min CN=76 Runoff=0.28 cfs 0.021 af

Pond 1P: Cultec Recharge R330 Peak Elev=495.60' Storage=443 cf Inflow=0.28 cfs 0.021 af
Outflow=0.02 cfs 0.021 af

Link 2L: POA Manual Hydrograph Inflow=0.02 cfs 0.021 af
Primary=0.02 cfs 0.021 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.021 af Average Runoff Depth = 1.15"
37.78% Pervious = 0.082 ac 62.22% Impervious = 0.135 ac

Summary for Subcatchment 1S: Post development

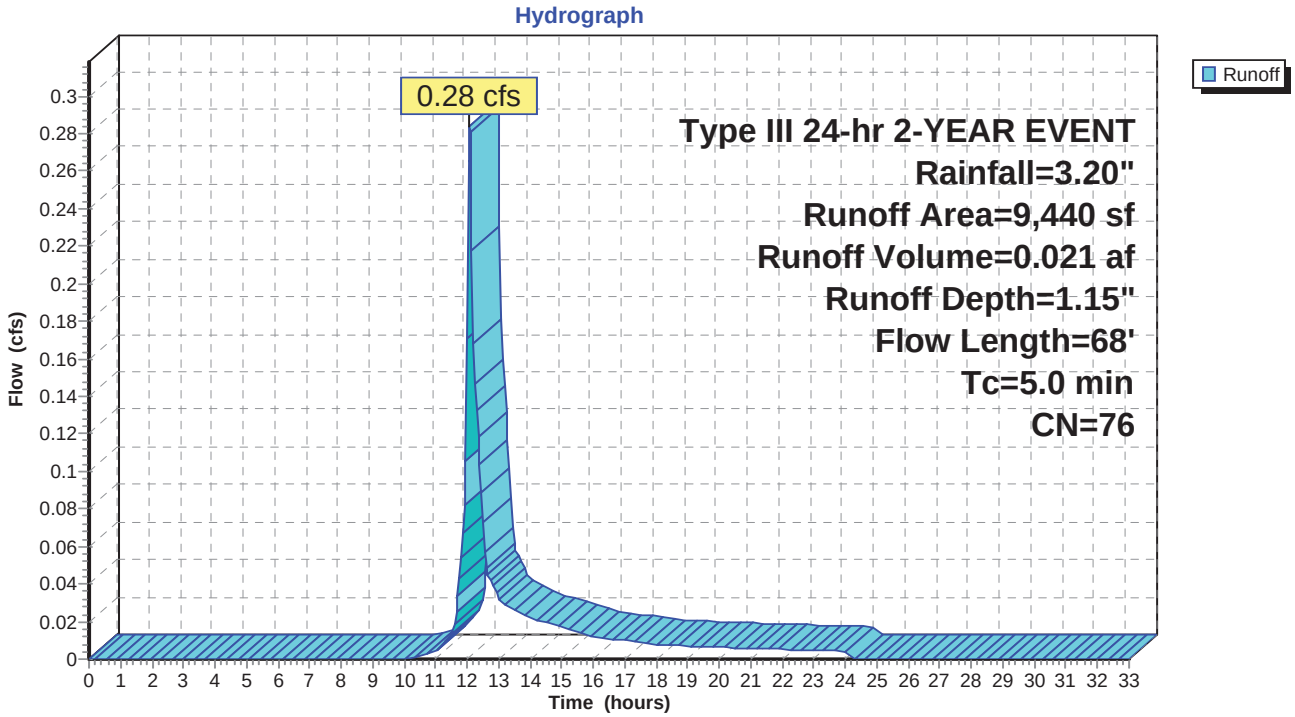
Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.021 af, Depth= 1.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-YEAR EVENT Rainfall=3.20"

	Area (sf)	CN	Description
*	2,232	98	Building
*	2,990	98	Paved Parking lot
*	652	98	Walkways
*	266	49	Grass Pavers
	3,300	39	>75% Grass cover, Good, HSG A
	9,440	76	Weighted Average
	3,566		Pervious Area
	5,874		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	68		0.23		**Direct Entry,**

Subcatchment 1S: Post development



Summary for Pond 1P: Cultec Recharge R330

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth = 1.15" for 2-YEAR EVENT event
Inflow = 0.28 cfs @ 12.08 hrs, Volume= 0.021 af
Outflow = 0.02 cfs @ 15.06 hrs, Volume= 0.021 af, Atten= 94%, Lag= 178.6 min
Primary = 0.02 cfs @ 15.06 hrs, Volume= 0.021 af

Routing by Stor-Ind method, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Peak Elev= 495.60' @ 15.06 hrs Surf.Area= 713 sf Storage= 443 cf

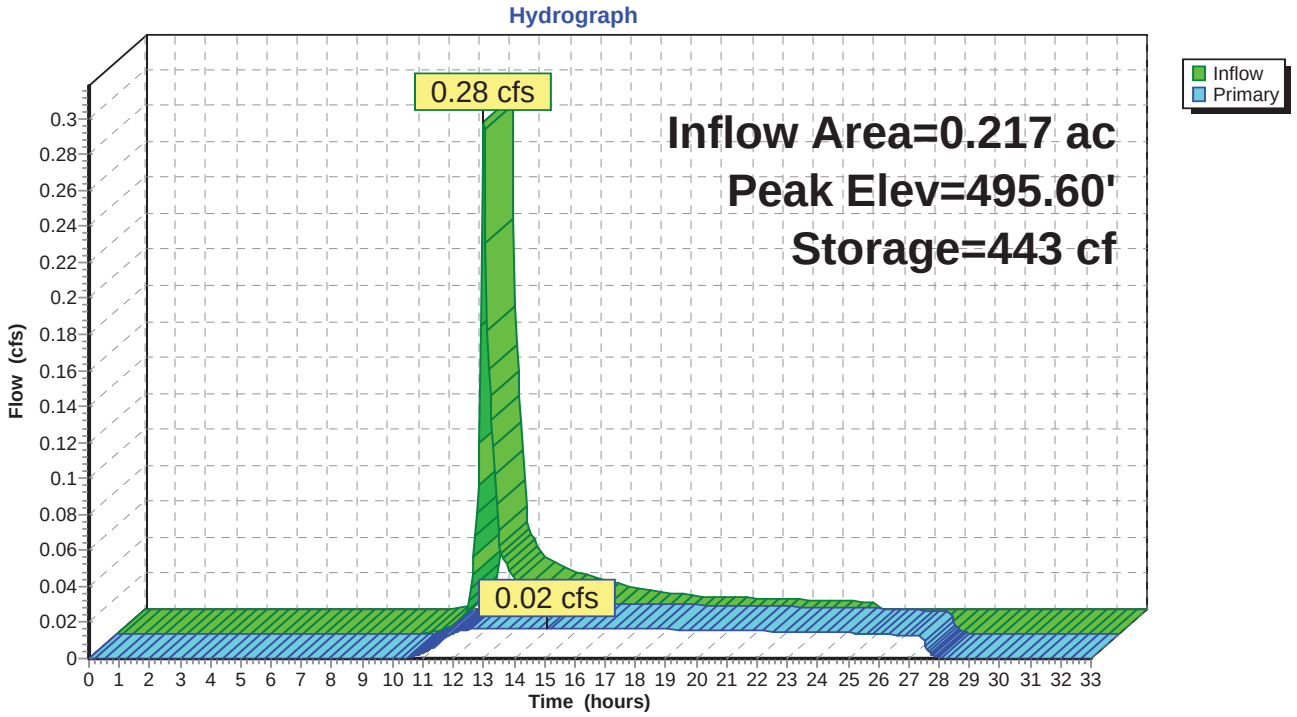
Plug-Flow detention time= 296.3 min calculated for 0.021 af (100% of inflow)
Center-of-Mass det. time= 296.2 min (1,150.9 - 854.7)

Volume	Invert	Avail.Storage	Storage Description
#1	494.34'	974 cf	**21.00'W x 25.00'L x 3.66'H Prismatoid Z=1.5** 2,993 cf Overall - 559 cf Embedded = 2,434 cf x 40.0% Voids
#2	494.84'	559 cf	**47.8"W x 30.0"H x 6.25'L Cultec R-330** x 12 Inside #1
		1,532 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	494.34'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	496.45'	**6.0" x 46.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 488.49' S= 0.1730 '/' Cc= 0.900 n= 0.011 PVC, smooth interior

Primary OutFlow Max=0.02 cfs @ 15.06 hrs HW=495.60' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)
└─**2=Culvert** (Controls 0.00 cfs)

Pond 1P: Cultec Recharge R330



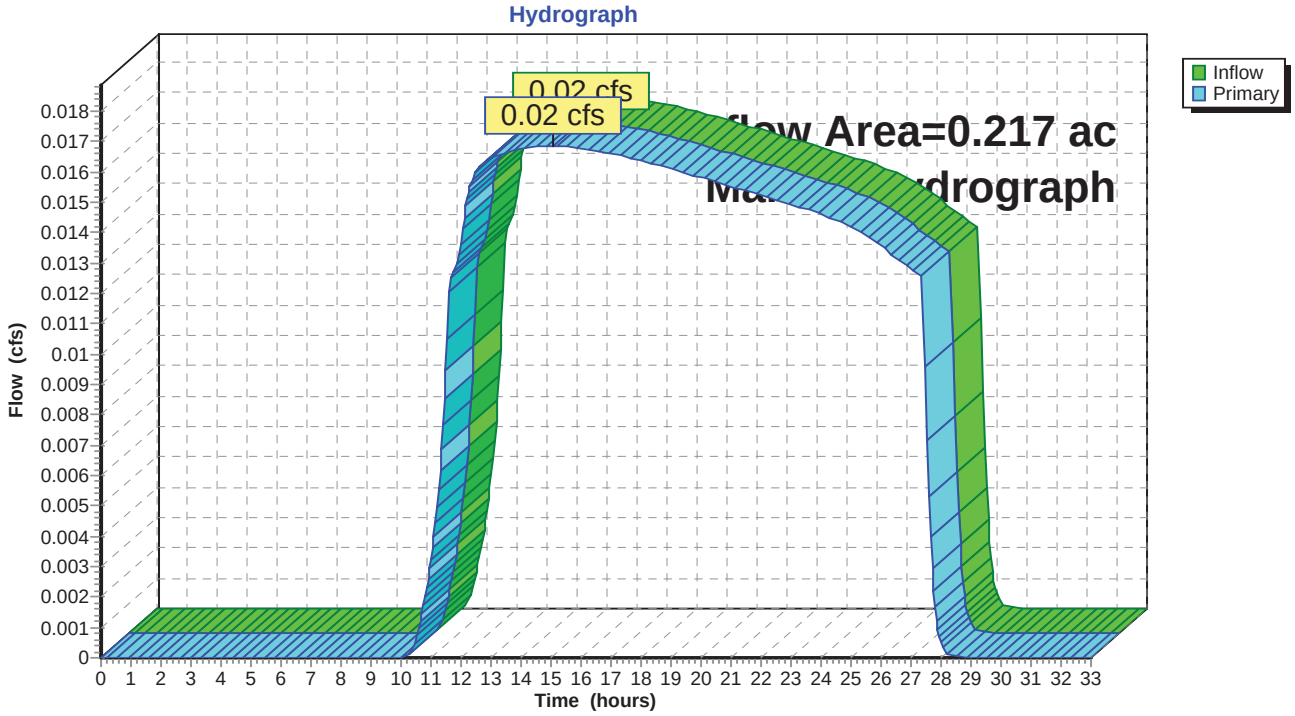
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth = 1.15" for 2-YEAR EVENT event
Inflow = 0.02 cfs @ 15.06 hrs, Volume= 0.021 af
Primary = 0.02 cfs @ 15.06 hrs, Volume= 0.021 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs

Constant Inflow= 0.00 cfs

Link 2L: POA



Time span=0.00-33.00 hrs, dt=0.05 hrs, 661 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post development Runoff Area=9,440 sf 62.22% Impervious Runoff Depth=2.45"
Flow Length=68' Tc=5.0 min CN=76 Runoff=0.62 cfs 0.044 af

Pond 1P: Cultec Recharge R330 Peak Elev=496.60' Storage=911 cf Inflow=0.62 cfs 0.044 af
Outflow=0.07 cfs 0.042 af

Link 2L: POA Manual Hydrograph Inflow=0.07 cfs 0.042 af
Primary=0.07 cfs 0.042 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.044 af Average Runoff Depth = 2.45"
37.78% Pervious = 0.082 ac 62.22% Impervious = 0.135 ac

Summary for Subcatchment 1S: Post development

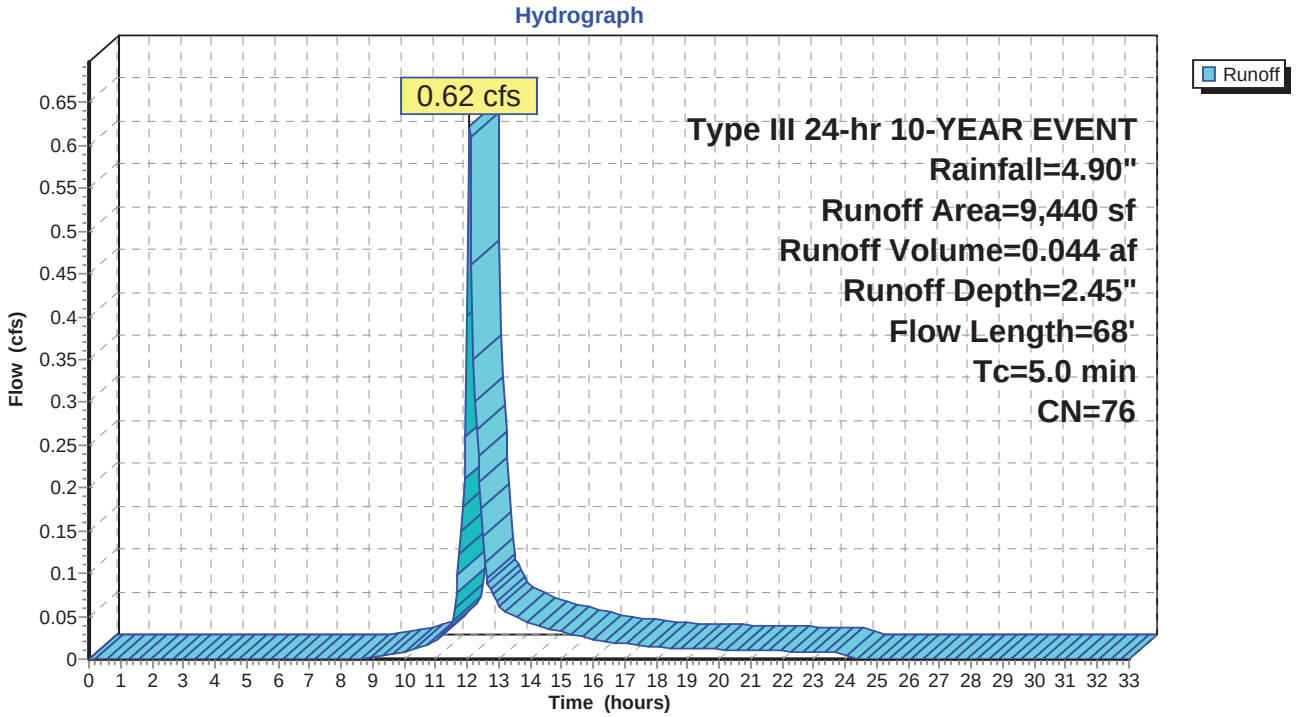
Runoff = 0.62 cfs @ 12.08 hrs, Volume= 0.044 af, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-YEAR EVENT Rainfall=4.90"

	Area (sf)	CN	Description
*	2,232	98	Building
*	2,990	98	Paved Parking lot
*	652	98	Walkways
*	266	49	Grass Pavers
	3,300	39	>75% Grass cover, Good, HSG A
	9,440	76	Weighted Average
	3,566		Pervious Area
	5,874		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	68		0.23		**Direct Entry,**

Subcatchment 1S: Post development



Summary for Pond 1P: Cultec Recharge R330

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth = 2.45" for 10-YEAR EVENT event
Inflow = 0.62 cfs @ 12.08 hrs, Volume= 0.044 af
Outflow = 0.07 cfs @ 12.87 hrs, Volume= 0.042 af, Atten= 88%, Lag= 47.4 min
Primary = 0.07 cfs @ 12.87 hrs, Volume= 0.042 af

Routing by Stor-Ind method, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Peak Elev= 496.60' @ 12.87 hrs Surf.Area= 883 sf Storage= 911 cf

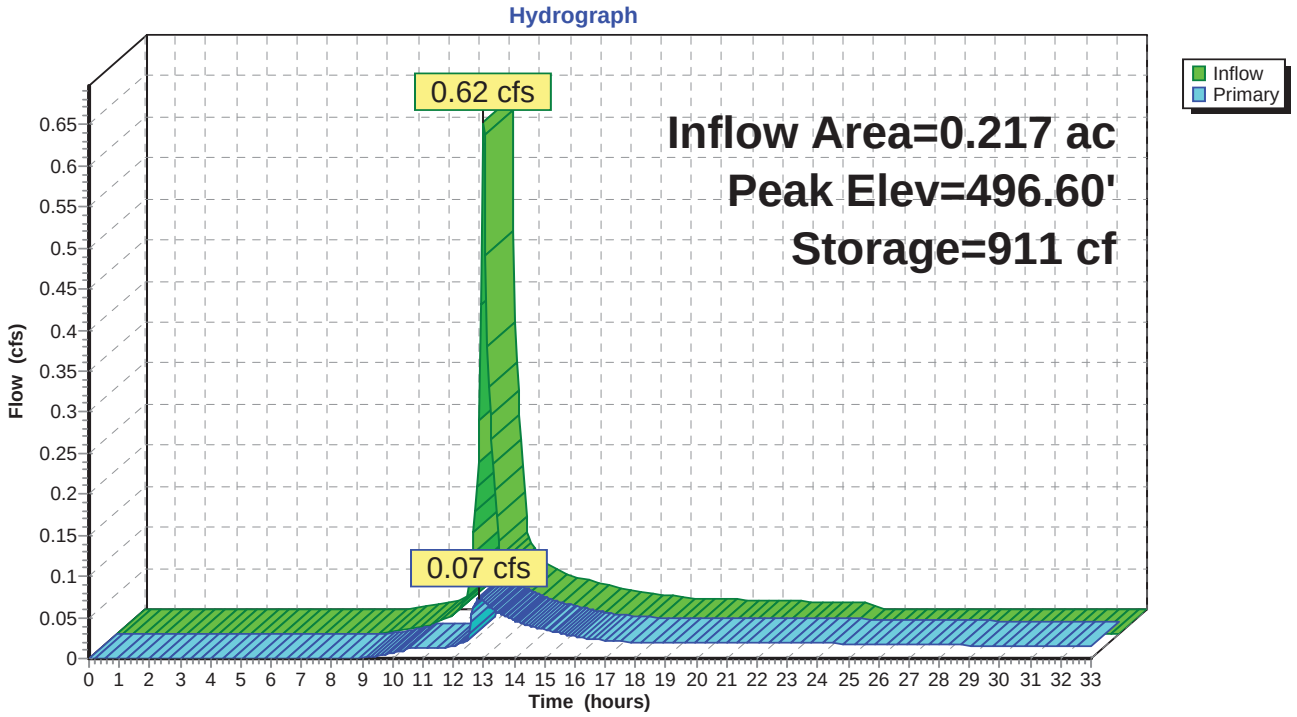
Plug-Flow detention time= 388.6 min calculated for 0.042 af (94% of inflow)
Center-of-Mass det. time= 356.5 min (1,188.8 - 832.3)

Volume	Invert	Avail.Storage	Storage Description
#1	494.34'	974 cf	**21.00'W x 25.00'L x 3.66'H Prismatoid Z=1.5** 2,993 cf Overall - 559 cf Embedded = 2,434 cf x 40.0% Voids
#2	494.84'	559 cf	**47.8"W x 30.0"H x 6.25'L Cultec R-330** x 12 Inside #1
		1,532 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	494.34'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	496.45'	**6.0" x 46.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 488.49' S= 0.1730 '/' Cc= 0.900 n= 0.011 PVC, smooth interior

Primary OutFlow Max=0.07 cfs @ 12.87 hrs HW=496.60' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)
└─**2=Culvert** (Inlet Controls 0.05 cfs @ 1.04 fps)

Pond 1P: Cultec Recharge R330



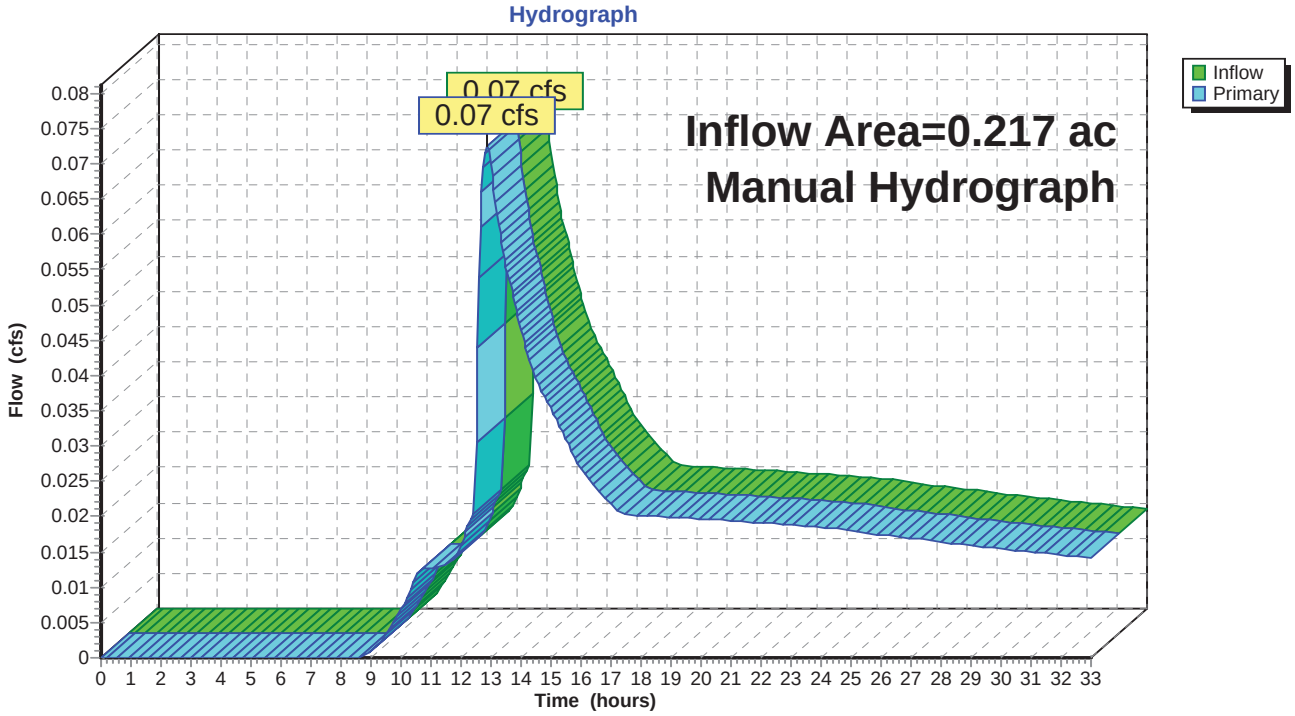
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth > 2.31" for 10-YEAR EVENT event
Inflow = 0.07 cfs @ 12.87 hrs, Volume= 0.042 af
Primary = 0.07 cfs @ 12.87 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs

Constant Inflow= 0.00 cfs

Link 2L: POA



Time span=0.00-33.00 hrs, dt=0.05 hrs, 661 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post development Runoff Area=9,440 sf 62.22% Impervious Runoff Depth=3.55"
Flow Length=68' Tc=5.0 min CN=76 Runoff=0.90 cfs 0.064 af

Pond 1P: Cultec Recharge R330 Peak Elev=496.88' Storage=1,043 cf Inflow=0.90 cfs 0.064 af
Outflow=0.34 cfs 0.060 af

Link 2L: POA Manual Hydrograph Inflow=0.34 cfs 0.060 af
Primary=0.34 cfs 0.060 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.064 af Average Runoff Depth = 3.55"
37.78% Pervious = 0.082 ac 62.22% Impervious = 0.135 ac

Summary for Subcatchment 1S: Post development

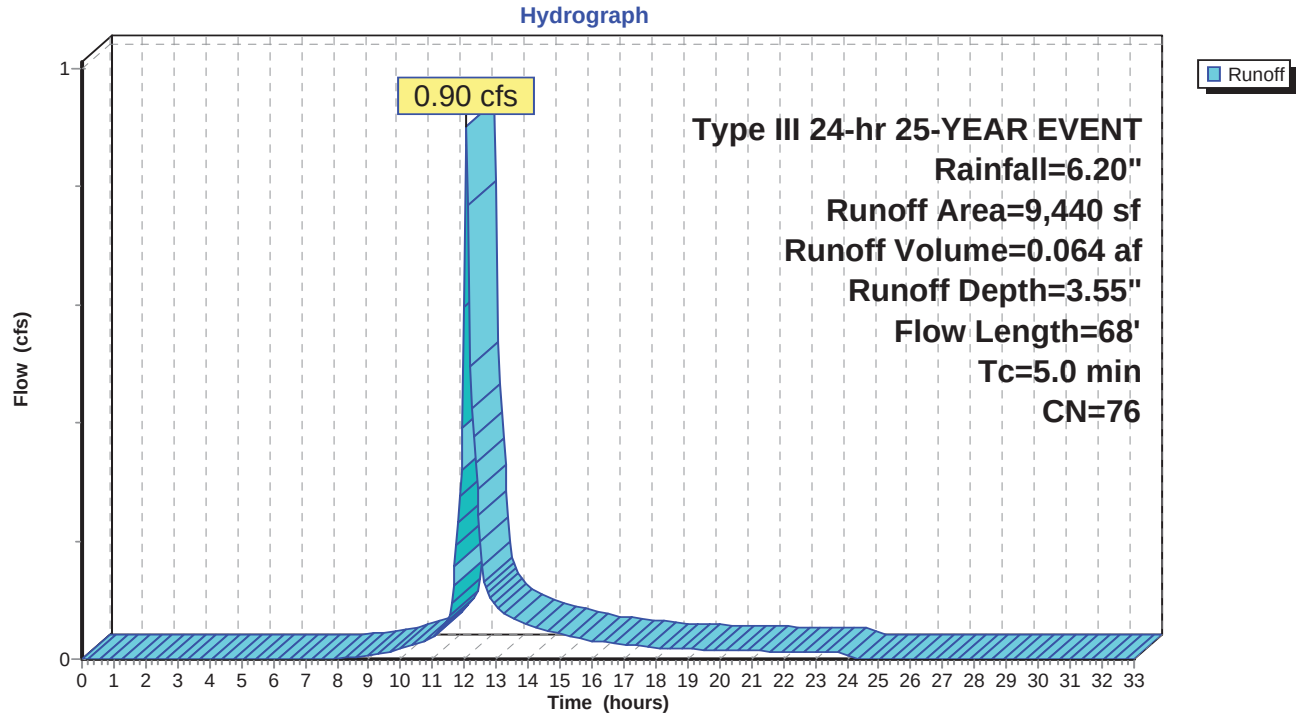
Runoff = 0.90 cfs @ 12.08 hrs, Volume= 0.064 af, Depth= 3.55"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Type III 24-hr 25-YEAR EVENT Rainfall=6.20"

	Area (sf)	CN	Description
*	2,232	98	Building
*	2,990	98	Paved Parking lot
*	652	98	Walkways
*	266	49	Grass Pavers
	3,300	39	>75% Grass cover, Good, HSG A
	9,440	76	Weighted Average
	3,566		Pervious Area
	5,874		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	68		0.23		**Direct Entry,**

Subcatchment 1S: Post development



Summary for Pond 1P: Cultec Recharge R330

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth = 3.55" for 25-YEAR EVENT event
Inflow = 0.90 cfs @ 12.08 hrs, Volume= 0.064 af
Outflow = 0.34 cfs @ 12.35 hrs, Volume= 0.060 af, Atten= 63%, Lag= 16.3 min
Primary = 0.34 cfs @ 12.35 hrs, Volume= 0.060 af

Routing by Stor-Ind method, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Peak Elev= 496.88' @ 12.35 hrs Surf.Area= 934 sf Storage= 1,043 cf

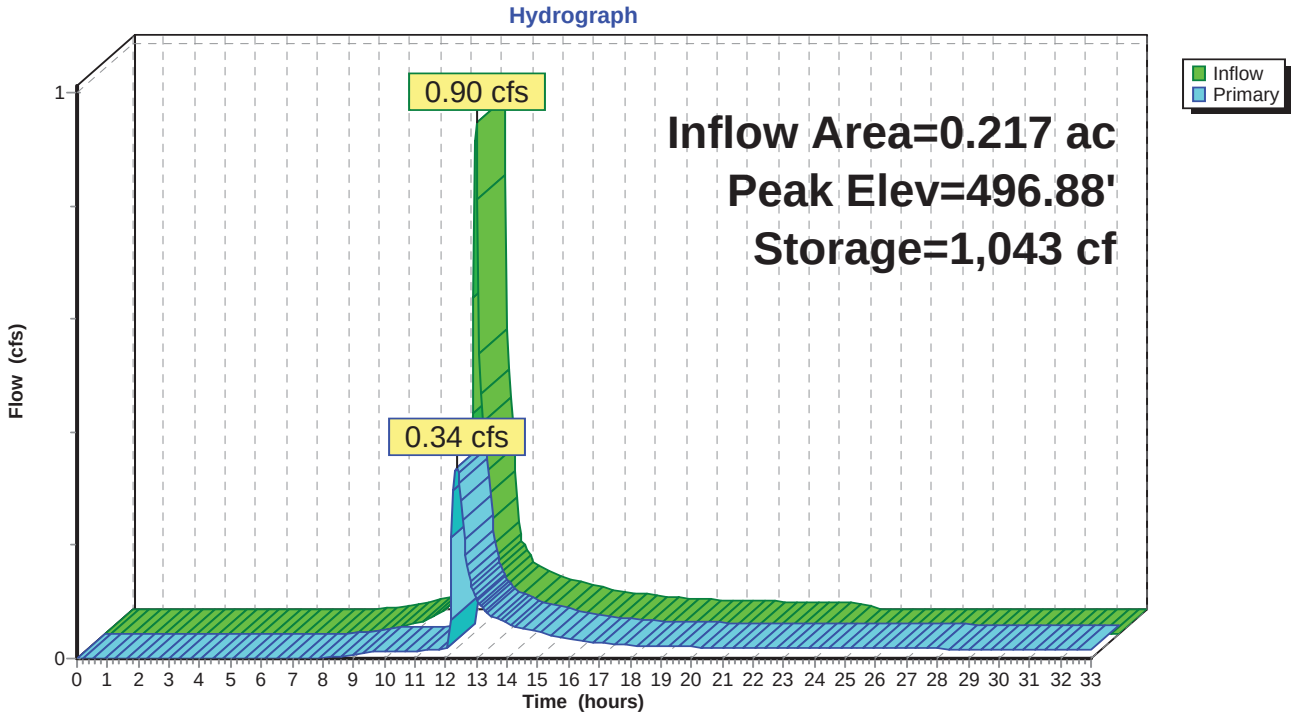
Plug-Flow detention time= 283.7 min calculated for 0.060 af (94% of inflow)
Center-of-Mass det. time= 249.4 min (1,071.1 - 821.7)

Volume	Invert	Avail.Storage	Storage Description
#1	494.34'	974 cf	**21.00'W x 25.00'L x 3.66'H Prismatoid Z=1.5** 2,993 cf Overall - 559 cf Embedded = 2,434 cf x 40.0% Voids
#2	494.84'	559 cf	**47.8"W x 30.0"H x 6.25'L Cultec R-330** x 12 Inside #1
		1,532 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	494.34'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	496.45'	**6.0" x 46.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 488.49' S= 0.1730 '/' Cc= 0.900 n= 0.011 PVC, smooth interior

Primary OutFlow Max=0.34 cfs @ 12.35 hrs HW=496.88' (Free Discharge)
└─**1=Exfiltration** (Exfiltration Controls 0.02 cfs)
└─**2=Culvert** (Inlet Controls 0.32 cfs @ 1.76 fps)

Pond 1P: Cultec Recharge R330



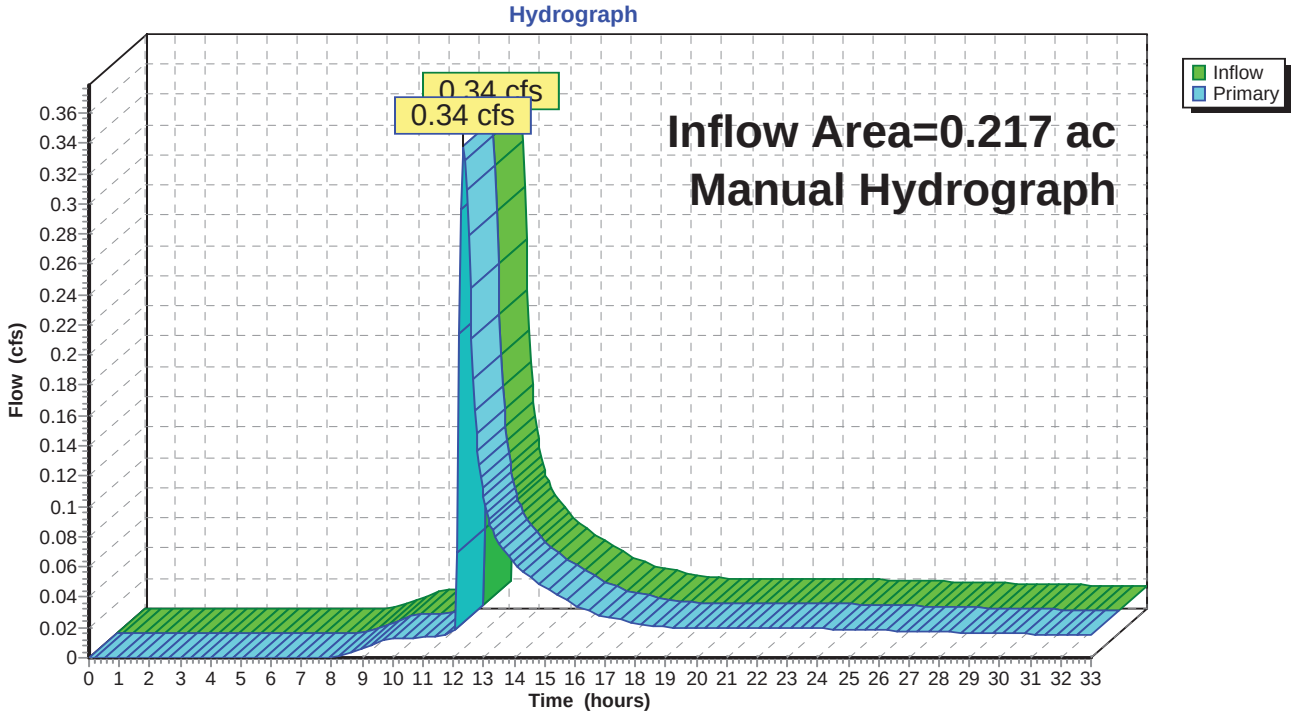
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth > 3.32" for 25-YEAR EVENT event
Inflow = 0.34 cfs @ 12.35 hrs, Volume= 0.060 af
Primary = 0.34 cfs @ 12.35 hrs, Volume= 0.060 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs

Constant Inflow= 0.00 cfs

Link 2L: POA



Time span=0.00-33.00 hrs, dt=0.05 hrs, 661 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post development Runoff Area=9,440 sf 62.22% Impervious Runoff Depth=5.98"
Flow Length=68' Tc=5.0 min CN=76 Runoff=1.51 cfs 0.108 af

Pond 1P: Cultec Recharge R330 Peak Elev=497.81' Storage=1,445 cf Inflow=1.51 cfs 0.108 af
Outflow=0.81 cfs 0.102 af

Link 2L: POA Manual Hydrograph Inflow=0.81 cfs 0.102 af
Primary=0.81 cfs 0.102 af

Total Runoff Area = 0.217 ac Runoff Volume = 0.108 af Average Runoff Depth = 5.98"
37.78% Pervious = 0.082 ac 62.22% Impervious = 0.135 ac

Summary for Subcatchment 1S: Post development

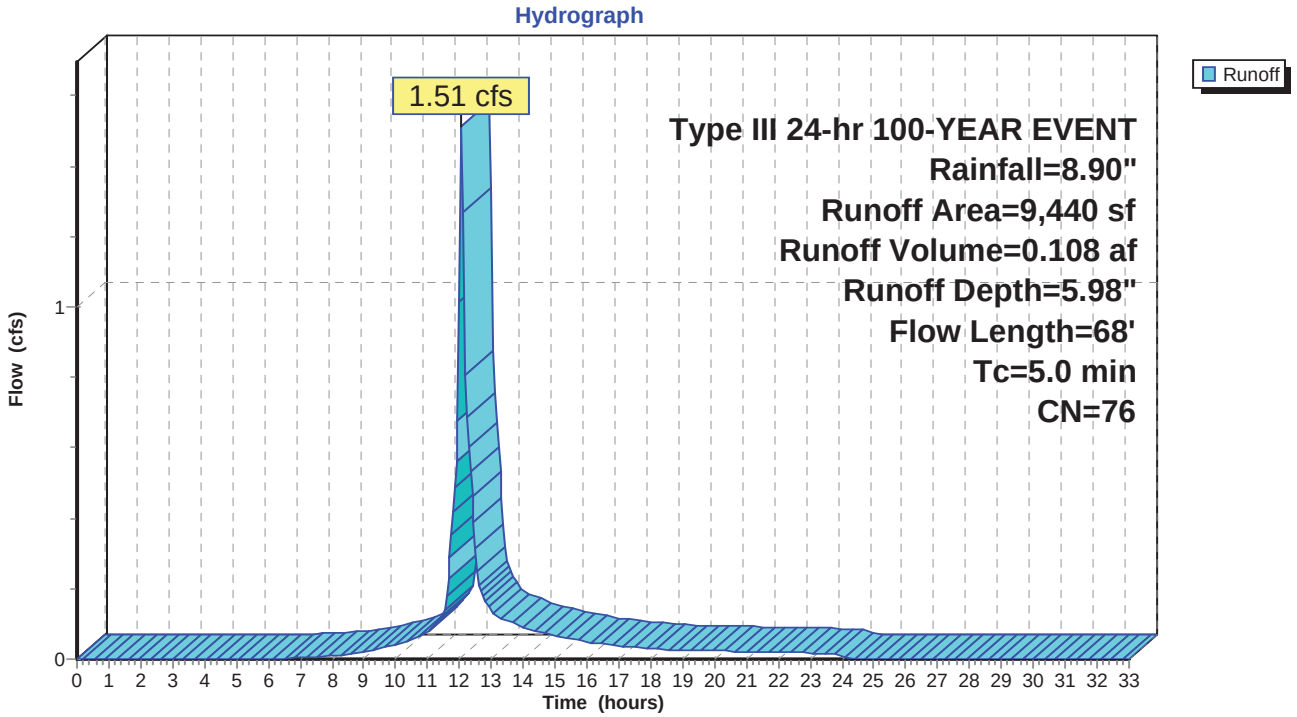
Runoff = 1.51 cfs @ 12.07 hrs, Volume= 0.108 af, Depth= 5.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-YEAR EVENT Rainfall=8.90"

	Area (sf)	CN	Description
*	2,232	98	Building
*	2,990	98	Paved Parking lot
*	652	98	Walkways
*	266	49	Grass Pavers
	3,300	39	>75% Grass cover, Good, HSG A
	9,440	76	Weighted Average
	3,566		Pervious Area
	5,874		Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	68		0.23		**Direct Entry,**

Subcatchment 1S: Post development



Summary for Pond 1P: Cultec Recharge R330

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth = 5.98" for 100-YEAR EVENT event
Inflow = 1.51 cfs @ 12.07 hrs, Volume= 0.108 af
Outflow = 0.81 cfs @ 12.21 hrs, Volume= 0.102 af, Atten= 46%, Lag= 8.1 min
Primary = 0.81 cfs @ 12.21 hrs, Volume= 0.102 af

Routing by Stor-Ind method, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs
Peak Elev= 497.81' @ 12.21 hrs Surf.Area= 1,111 sf Storage= 1,445 cf

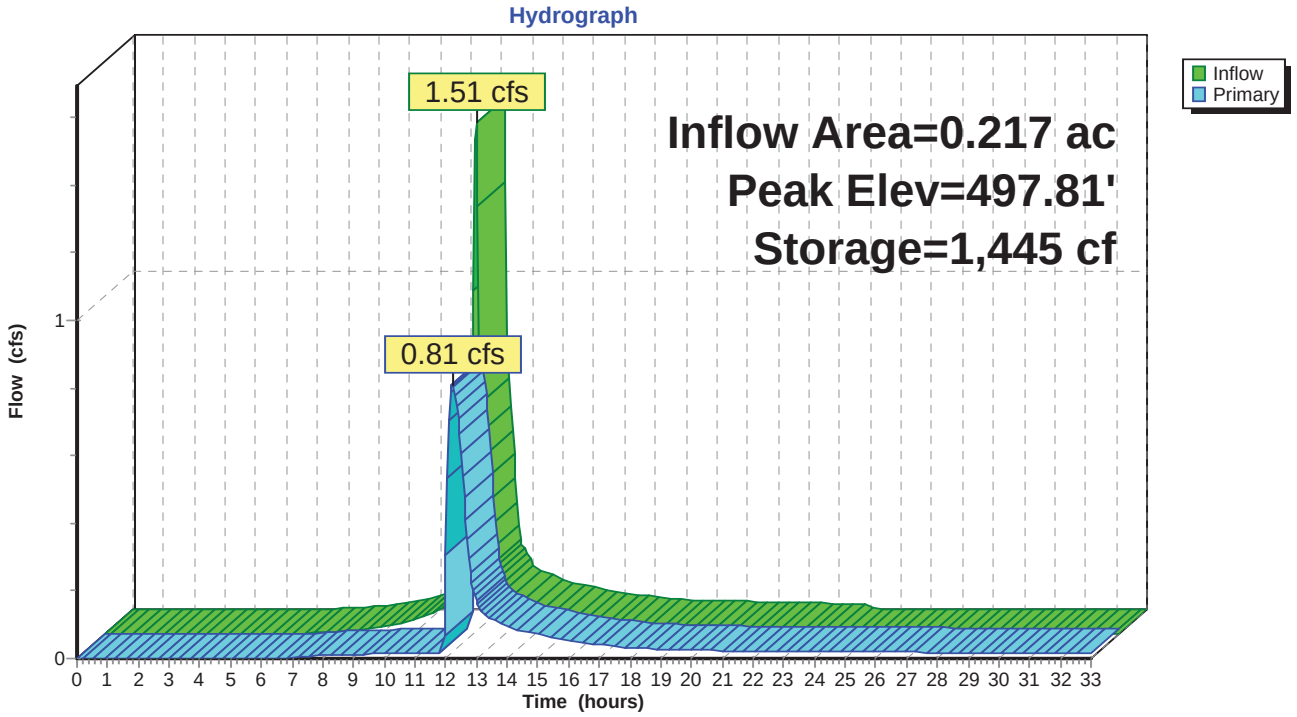
Plug-Flow detention time= 180.7 min calculated for 0.102 af (94% of inflow)
Center-of-Mass det. time= 151.5 min (958.3 - 806.8)

Volume	Invert	Avail.Storage	Storage Description
#1	494.34'	974 cf	**21.00'W x 25.00'L x 3.66'H Prismatoid Z=1.5** 2,993 cf Overall - 559 cf Embedded = 2,434 cf x 40.0% Voids
#2	494.84'	559 cf	**47.8"W x 30.0"H x 6.25'L Cultec R-330** x 12 Inside #1
		1,532 cf	Total Available Storage

Device	Routing	Invert	Outlet Devices
#1	Primary	494.34'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	496.45'	**6.0" x 46.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 488.49' S= 0.1730 '/' Cc= 0.900 n= 0.011 PVC, smooth interior

Primary OutFlow Max=0.81 cfs @ 12.21 hrs HW=497.80' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.03 cfs)
└**2=Culvert** (Inlet Controls 0.78 cfs @ 3.99 fps)

Pond 1P: Cultec Recharge R330



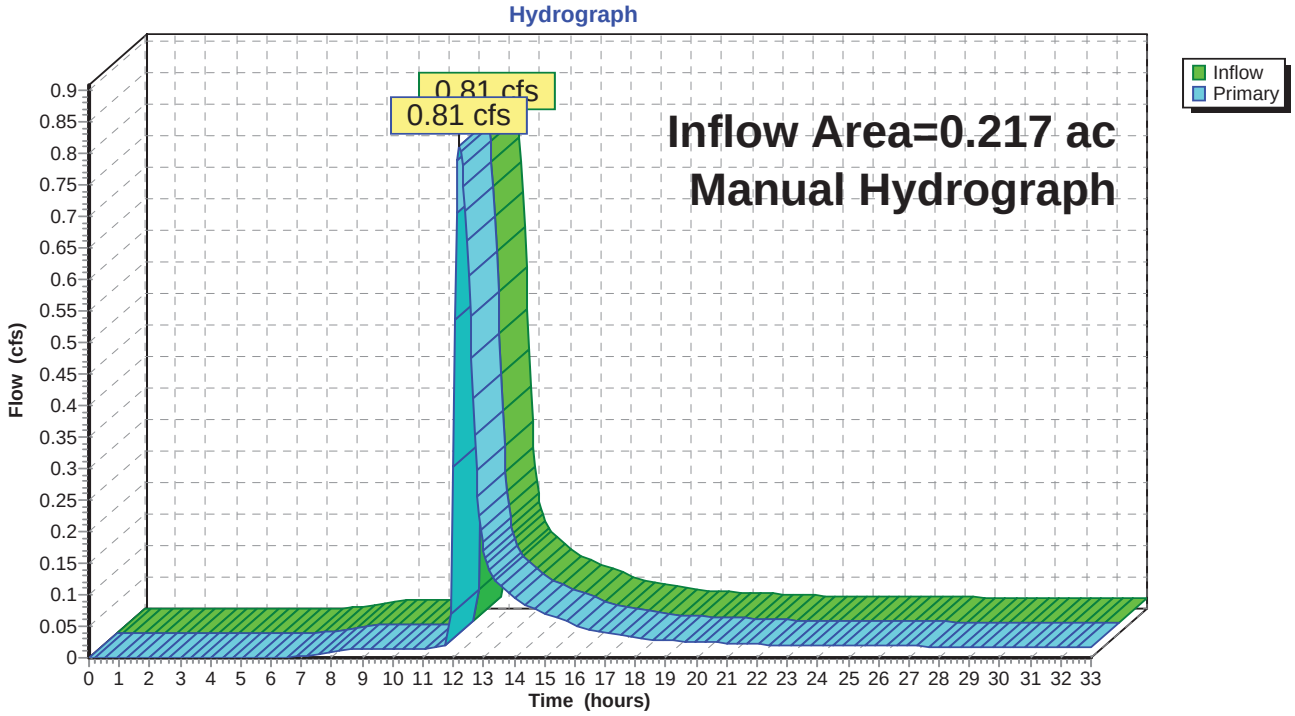
Summary for Link 2L: POA

Inflow Area = 0.217 ac, 62.22% Impervious, Inflow Depth > 5.65" for 100-YEAR EVENT event
Inflow = 0.81 cfs @ 12.21 hrs, Volume= 0.102 af
Primary = 0.81 cfs @ 12.21 hrs, Volume= 0.102 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-33.00 hrs, dt= 0.05 hrs

Constant Inflow= 0.00 cfs

Link 2L: POA



6- Site plan