DRAINAGE REPORT

For

TPG Development and Construction

Gas Station and Convenience Store
75 Quinsigamond Avenue
City of Worcester, Massachusetts
Worcester County

Prepared by:

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I. EXECUTIVE SUMMARY

This report examines the changes in drainage that can be expected as the result of the development of a gas station and convenience store located at 75 Quinsigamond Avenue in the City of Worcester, Massachusetts. The site, which contains approximately 1.54 acres of land, contains existing gravel, paved and concrete areas.

The proposed project includes the construction of a new gas station and 5,785± square-foot convenience store along with 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 Proposed Site Plan Documents 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.

On-Site Soil Information

The soils at the site are mapped as Urban land. Based off the data presented in the Geotechnical Engineering Report prepared by Paul B. Aldinger & Associates, Inc., the site was modeled with Hydraulic Soil Group (HSG) A. Refer to **Appendix C** for additional information.

Design Point Descriptions

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at one (1) "design point" where stormwater runoff currently drains to under existing conditions.

Design Point #1 (DP1) is the existing roadway located on the westerly side of the site (Quinsigamond Avenue). It appears that all stormwater from this site ultimately flows to the drainage system within Quinsigamond Avenue. Under existing conditions, this design point receives stormwater flows from approximately 1.54 acres of land, designated as watershed "E1". This watershed includes areas of pavement and gravel. This area has a calculated curve number of 97 and an assumed time of concentration of 6 minutes.

For the purposes of this analysis the pre- and post-development drainage conditions were analyzed at one (1) "design point" where stormwater runoff currently drains to under existing conditions. These design points are described in further detail in Section 2 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.

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
DP1	4.68	2.54	**-2.14**	7.17	4.98	**-2.19**	9.09	6.97	**-2.12**	13.04	11.11	**-1.93**

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

II. EXISTING SITE CONDITIONS

Existing Site Description

The site consists of approximately 1.54 acres of land located at 75 Quinsigamond Avenue in the City of Worcester, Massachusetts. The current site contains existing paved, concrete, and gravel areas.

Existing Collection and Conveyance

The entirety of the site ultimately drains to the roadway to the west (Quinsigamond Avenue). Slopes on the site range from 1%-50%, however, the majority of the site is a consistent 3% gravel lot. On-site elevations range from 448 feet at the northeast corner to 445 feet at the southwest corner.

The site was modeled as one (1) catchment for the existing conditions as described below. The time of concentration for this area is assumed as 6 minutes (0.1 hr) to be conservative.

Subcatchment E1 in total is 1.54 acres pavement and gravel areas. This area ultimately flows to the drainage system within Quinsigamond Avenue.

III. PROPOSED SITE CONDITIONS

Proposed Development Site Conditions

The proposed project includes the construction of a new gas station and 5,785± square-foot convenience store along with new paved parking areas, landscaping, storm water management components, and associated utilities. A portion of 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 stormwater runoff, via an underground pipe system, to a propriety treatment unit prior to discharging to the existing drainage system within Quinsigamond Avenue. Roof runoff will also be relocated via a gutter system and conveyed to the proposed drainage system. The remaining area will sheet flow overland and ultimately flow to the existing drainage system within Quinsigamond Avenue.

The proposed drainage system has been designed to provide at least 80% removal of total suspended solids (TSS) in accordance with the Massachusetts DEP Stormwater Handbook. 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.

Proposed Development Collection and Conveyance

Deep sump hooded catch basins are proposed to collect and route runoff from the paved parking areas and roof to the existing drainage system within Quinsigamond Avenue. Pipes have been designed for the 25-year storm using the Rational Method. Pipe sizing calculations are included in **Appendix F**.

The best management practices (BMPs) incorporated into the proposed stormwater management system have been designed to meet the TSS removal requirements as set forth in the Massachusetts Department of Environmental Protection Stormwater Handbook standards. Refer to **Appendix F** for calculations. In addition, a Stormwater Operation and Maintenance (O&M) Plan, attached in **Appendix G**, has been developed, which includes scheduled maintenance and periodic inspections of stormwater management structures.

The site was subdivided into one (1) subcatchment for the proposed conditions as described below. The minimum time of concentration for the proposed area is calculated as 6 minutes (0.1 hr).

Subcatchment P1 consists of 1.54 acres of area consisting of rooftop, pavement and lawn area. This area ultimately drains to the existing drainage system within Quinsigmond Avenue. A time of concentration of 6 minutes was used.

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 Cornell University. Refer to **Appendix F** for more information.

Table 4.1: Rainfall Intensities

Frequency	2 year	10 year	25 year	100 year
Rainfall* (inches)	3.26	4.92	6.21	8.87

*Values derived from Cornell University Atlas of Precipitation Extremes for the Northeastern United States and Southern Canada

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 proposed project has been designed so that proposed impervious areas (including the building roof and paved parking/driveway areas) shall be collected and passed through the proposed drainage system for treatment.

Standard #2: Peak Rate Attenuation

As outlined in **Tables 1.1, 2.1, 3.1, and 5.1**, the development of the site and the proposed stormwater management system, have been designed so that post-development peak rates of runoff as well as volume are below pre-development conditions for the 2-, 10-, 25- and 100-year storm events at Design Point DP1.

Standard #3: Recharge

The proposed project is a redevelopment and results in a significant decrease of impervious area. Thus, no recharge is required. However, on-site recharge will be increased due to the increase in pervious landscaped areas.

Standard #4: Water Quality

Water quality treatment is provided via deep sump catch basins and a proprietary treatment unit. TSS removal calculations are included in **Appendix F** of this report. 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

The proposed project involves a "Land Use with Higher Potential Pollutant Loads". Accordingly, the stormwater management system includes an oil-grit separator water quality unit prior to discharge and will treat the runoff flow associated with the 1.0 inch water quality depth, as further illustrated in **Appendix F** of this report.

Standard #6: Critical Areas

Not Applicable for this project.

Standard #7: Redevelopment

The project is a redevelopment and has been designed in accordance with the Massachusetts Stormwater Management regulations to meet all the standards to the maximum extent practicable.

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.

Standard #10: Prohibition of Illicit Discharges

The proposed stormwater system will only convey allowable non-stormwater discharges (firefighting waters, irrigation, air conditioning condensation, 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 and volumes 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 peak discharge rates comparisons are contained in **Table 5.1** below:

Table 5.1: 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
DP1	4.68	2.54	**-2.14**	7.17	4.98	**-2.19**	9.09	6.97	**-2.12**	13.04	11.11	**-1.93**

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

As outlined in the tables 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.

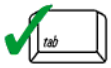
APPENDIX A: MASSACHUSETTS STORMWATER MANAGEMENT CHECKLIST

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

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

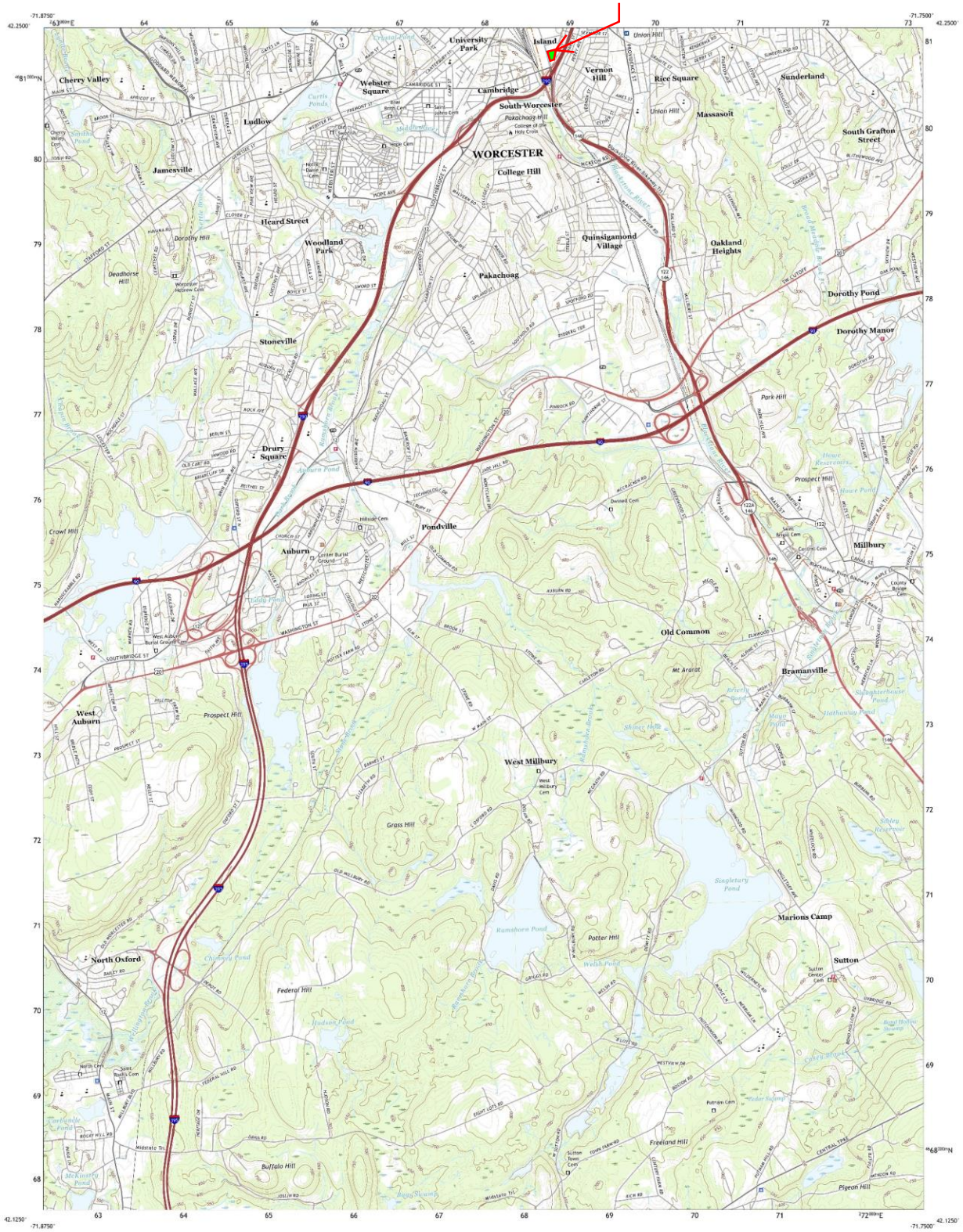
- *USGS MAP*
- *FEMA FIRMETTE*

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map US Topo

WORCESTER SOUTH QUADRANGLE
MASSACHUSETTS - WORCESTER COUNTY
7.5-MINUTE SERIES

SITE



Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and 1 000-meter grid:Universal Transverse Mercator, Zone 19T

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery.....NAIP, July 2016 - September 2016
Roads.....U.S. Census Bureau, 2018
Names.....GNIS, 1974 - 2018
Hydrography.....National Hydrography Dataset, 2004
Contours.....National Elevation Dataset, 1998 - 2012
Boundaries.....Multiple sources; see metadata file 2016 - 2017

Wetlands.....FWS National Wetlands Inventory 2008

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

QUADRANGLE LOCATION

1 Paxton
2 Worcester North
3 Shrewsbury
4 Leicester
5 Grafton
6 Webster
7 Oxford
8 Uxbridge

ADJOINING QUADRANGLES

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

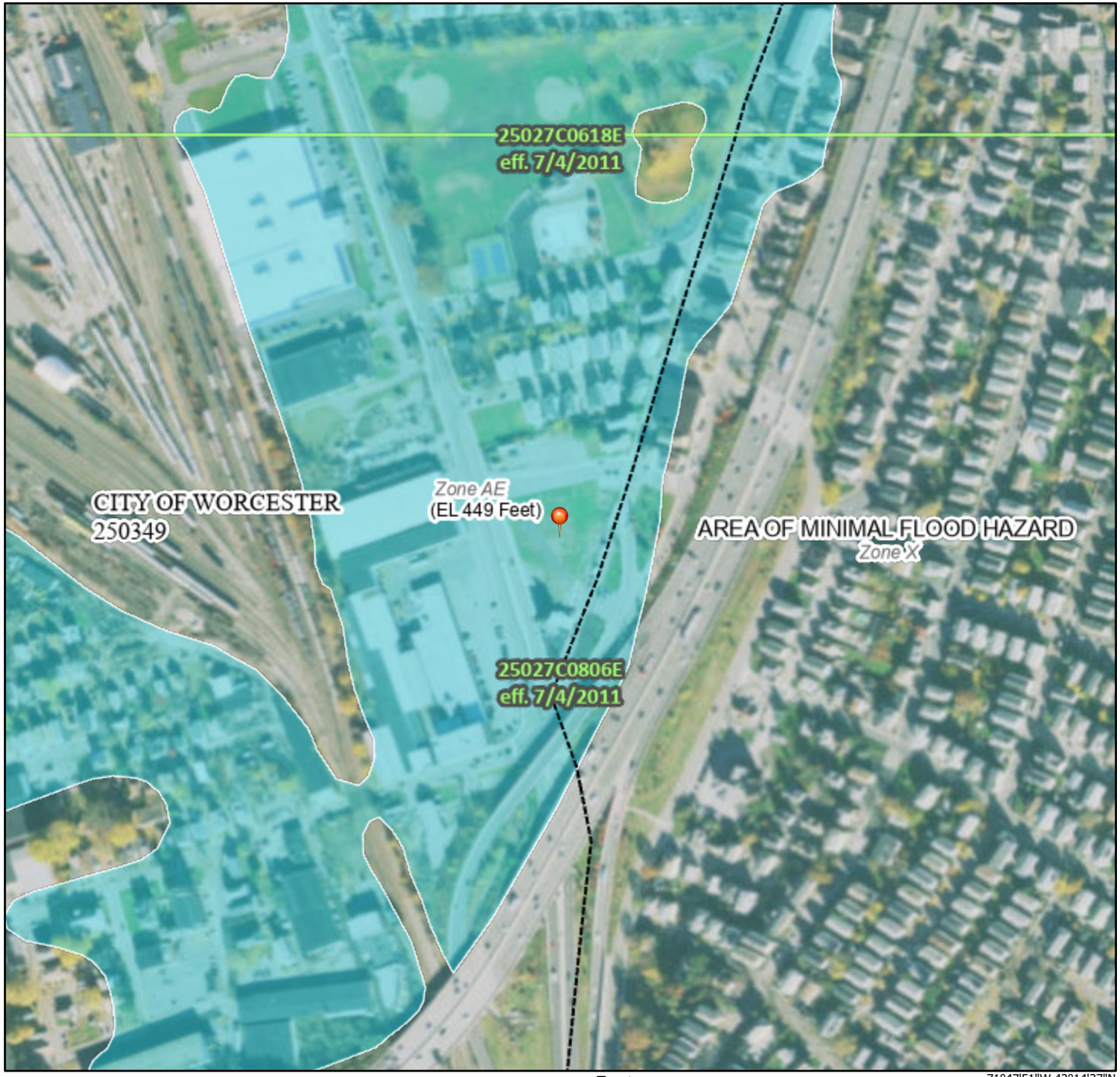
WORCESTER SOUTH, MA
2021

NSN
NGA REF NO. USGS X24498873

National Flood Hazard Layer FIRMette

FEMA

71°48'29"W 42°15'3"N



71°47'51"W 42°14'37"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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

- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 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 8/5/2021 at 10:30 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*
- *SOIL TESTING RESULTS*

Map Scale: 1:1,330 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

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 15, Jun 10, 2020

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

Date(s) aerial images were photographed: Jul 26, 2019—Oct 5, 2019

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	9.2	100.0%
Totals for Area of Interest		**9.2**	**100.0%**

LEGEND:

B-1 APPROXIMATE LOCATION OF TEST BORING PERFORMED BY NEW ENGLAND BORING CONTRACTORS OF TAUNTON, MA ON ######, 2021.

NOTE:

DEVELOPED FROM A PLAN TITLED "CONCEPTUAL LAYOUT PLAN," DATED MARCH 10, 2021, DEVELOPED BY BOHLER ENGINEERING OF SOUTHBOROUGH, MA, RECEIVED ELECTRONICALLY ON APRIL 6, 2020.

Paul B. Aldinger & Associates, Inc.
Geotechnical Engineering and Hydrogeology
860A Waterman Avenue, Suite 9
East Providence, RI 02914
Phone: (401) 435-5570 Fax: (401) 435-5569

75 QUINSIGAMOND AVENUE SERVICE STATION

75 Quinsigamond Avenue
Worcester, Massachusetts

SUBSURFACE EXPLORATION PLAN

PBA JOB NO.: 21005	DRAWN BY: TGL
DATE: APRIL 2021	DESIGNED BY:
SCALE: 1" = 40'	CHECKED BY: PBA

Figure No: 2

APPENDIX A

LIMITATIONS

APPENDIX A

LIMITATIONS

A. Explorations

1. The analyses and recommendations submitted in this report are based in part upon the data obtained from subsurface explorations. The nature and extent of variations between these explorations may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

2. The generalized soil profiles described in the text and shown on the figures are intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized and have been developed by interpretations of widely spaced explorations and samples; actual soil transitions are probably more erratic. For specific information, refer to the boring logs.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. These data have been reviewed and interpretations have been made in the text of this report; however, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, tide and other factors occurring since the time measurements were made.

B. Review

1. In the event that any changes in the nature, design, or location of the proposed structures are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report are modified or verified in writing by Paul B. Aldinger & Associates, Inc. It is recommended that this firm be provided the opportunity for a general review of final design and specifications, in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications.

C. Construction

1. It is recommended that this firm be retained to provide soil engineering services during construction of the excavation and foundation phases of the work. This is to observe compliance with the design concepts, specifications, or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

D. Use of Report

1. This report has been prepared for the exclusive use of the **Procaccianti Companies, Inc.** for specific application to the proposed **75 Quinsigamond Avenue Service Station in Worcester, Massachusetts** in accordance with generally accepted soil and foundation engineering practices. No warranty, express or implied, is made.

2. This report may contain comparative cost estimates for the purpose of evaluating alternative construction schemes. These estimates may also involve approximate quantity evaluations. It should be noted that quantity estimates may not be accurate enough for construction bids. Since Paul B. Aldinger & Associates, Inc. has no control over labor and materials cost and design, the estimates of construction costs have been made on the basis of experience. We cannot guarantee the accuracy of cost estimates as compared to contractors' bids for construction costs.

APPENDIX B

TEST BORING LOGS

BORING CONTRACTOR: New England Boring Contractors Taunton, MA LOG PREPARED BY: PBA TGL	**PAUL B. ALDINGER & ASSOCIATES, INC.** 860A WATERMAN AVENUE, SUITE 9 EAST PROVIDENCE, RI **BORING LOG** PROJECT NAME: 75 Quinsigamond Avenue TOWN, STATE Worcester, MA PBA NO.: 21005 OFFICE: Procaccianti Companies	SHEET 1 OF 1 LOCATION: Refer to Fig. 2 HOLE NO.: B-1 BORING TYPE: Cased LINE & STA.: OFFSET:

GROUND WATER OBSERVATIONS								
AT 2 FT AFTER 0 HRS		AUGER	CASING	SAMPLER	CORE BAR.	SURFACE ELEV.:	
AT 10.2 FT AFTER 5 HRS	TYPE	---	HW	S/S	---	DATE STARTED:	06/14/21
10.4 6/21/21	SIZE, I.D.	---	4"	1 3/8"	---	DATE FINISHED:	06/14/21
	HAMMER WT.		140#	140#	BIT	FOREMAN:	G. Twombly Jr.
	HAMMER FALL		30"	30"		INSPECTOR:	T. Leidner

LOCATION OF BORING: Refer to Figure 2, Subsurface Exploration Plan

DEPTH BELOW SURFACE	CASING BLOWS/ FOOT	SAMPLE DEPTH FROM - TO	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER FROM-TO 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL & ROCK INCL. COLOR, LOSS OF WASH WATER, JOINTS IN ROCK, ETC.	SAMPLE NO.	PEN.	REC.
		0'-2'	D	2	4	4	4		Dry, loose, brown/black fine to coarse SAND, little Gravel, little Silt, trace roots, asphalt, brick (Fill)	1	24	14
		2'-4'	D	2	2	5	5		Dry, loose, black fine to coarse SAND, little Gravel, trace Silt, gaseous odor (Fill)	2	24	6
5		4'-6'	D	5	4	2	2		*No Recovery, 3" spoon used for sample	3	24	0
									Moist, loose, brown fine to coarse SAND, some Gravel, trace Silt, trace brick, glass (Fill)			
		8'-10'	D	5	3	7	9	9'	Moist, dark brown fine to coarse SAND, little Silt, trace Gravel, trace roots (Fill)	4	24	14
10		10'-12'	D	6	7	6	5		Moist, medium dense, gray fine SAND, little Silt, trace roots	5	24	14
								14'	Moist, gray SILT, trace fine Sand			
		13'-15'	D	3	4	16	35	15'	Moist, gray/brown fine to coarse SAND, some Gravel, little Silt	6	24	11
15									Bottom of Exploration at 15 feet			
20												
25												
30												
35												
40												

GROUND SURFACE TO 13 FT., USED 4 " CASING:

THEN split spoon sample

TYPE OF SAMPLE

D=DRY W=WASHED C=CORED

TP=TEST PIT A=AUGER V=VANE TEST

UP=UNDISTURBED, PISTON

US=UNDISTURBED, SHELBY

PROPORTIONS USED:

TRACE=0-10%

LITTLE=10-20%

SOME=20-35%

AND=35-50%

COHESIONLESS DENSITY:

0-4 VERY LOOSE

5-9 LOOSE

10-29 MED. DENSE

30-49 DENSE

50 + VERY DENSE

FOOTAGE IN EARTH:	15
FOOTAGE IN ROCK:	---
WELL FOOTAGE:	15
NO. OF SAMPLES:	6
HOLE NO.:	B-1
TYPE:	Cased

BORING CONTRACTOR: New England Boring Contractors	PAUL B. ALDINGER & ASSOCIATES, INC.	SHEET 1 OF 1
Taunton, MA	860A WATERMAN AVENUE, SUITE 9 EAST PROVIDENCE, RI	LOCATION: Refer to Fig. 2
LOG PREPARED BY:	**BORING LOG**	HOLE NO.: B-2
PBA TGL	PROJECT NAME: 75 Quinsigamond Avenue	BORING TYPE: Cased
	TOWN, STATE Worcester, MA	LINE & STA.:
	PBA NO.: 21005 OFFICE: Procaccianti Companies	OFFSET:

GROUND WATER OBSERVATIONS
AT 6.6 FT AFTER 0 HRS
AT ____ FT AFTER ___ HRS

	AUGER	CASING	SAMPLER	CORE BAR.
TYPE	---	NW	S/S	---
SIZE, I.D.	---	3"	1 3/8"	---
HAMMER WT.		140#	140#	BIT
HAMMER FALL		30"	30"	

SURFACE ELEV.:
DATE STARTED: 06/14/21
DATE FINISHED: 06/14/21
FOREMAN: G. Twombly Jr.
INSPECTOR: T. Leidner

LOCATION OF BORING: Refer to Figure 2, Subsurface Exploration Plan

DEPTH BELOW SURFACE	CASING BLOWS/ FOOT	SAMPLE DEPTH FROM - TO	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER FROM-TO 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL & ROCK INCL. COLOR, LOSS OF WASH WATER, JOINTS IN ROCK, ETC.	SAMPLE NO.	PEN.	REC.
		0'-2'	D	5	26	31	22		Dry, brown fine to coarse SAND AND GRAVEL, trace Silt, trace concrete (Fill)	1	24	15
		2'-2'11"	D	23	100/5"				Dry, brown fine to coarse SAND AND GRAVEL, trace Silt, trace concrete (Fill)	2	11	8
5		5'-7'	D	3	3	2	2		Moist, loose, gray/brown fine to coarse SAND AND GRAVEL, trace Silt, trace asphalt, concrete (Fill)	3	24	5
		8'-10'	D	5	8	10	11	9'		4	24	11
10									Moist, medium dense, gray fine SAND, some Silt, trace roots			
		13'-15'	D	4	6	6	6		Moist, medium dense, gray fine SAND, trace Silt	5	24	10
15								15'	Bottom of Exploration at 15 feet			
20												
25												
30												
35												
40												

GROUND SURFACE TO 13 FT., USED 3 " CASING:
THEN split spoon sample

TYPE OF SAMPLE
D=DRY W=WASHED C=CORED
TP=TEST PIT A=AUGER V=VANE TEST
UP=UNDISTURBED, PISTON
US=UNDISTURBED, SHELBY

PROPORTIONS USED:
TRACE=0-10%
LITTLE=10-20%
SOME=20-35%
AND=35-50%

COHESIONLESS DENSITY:
0-4 VERY LOOSE
5-9 LOOSE
10-29 MED. DENSE
30-49 DENSE
50 + VERY DENSE

FOOTAGE IN EARTH: 15
FOOTAGE IN ROCK: ---
WELL FOOTAGE: ---
NO. OF SAMPLES: 5
HOLE NO.: B-2
TYPE: Cased

BORING CONTRACTOR: New England Boring Contractors	PAUL B. ALDINGER & ASSOCIATES, INC.	SHEET 1 OF 1
Taunton, MA	860A WATERMAN AVENUE, SUITE 9 EAST PROVIDENCE, RI	LOCATION: Refer to Fig. 2
LOG PREPARED BY:	**BORING LOG**	HOLE NO.: B-3
PBA TGL	PROJECT NAME: 75 Quinsigamond Avenue	BORING TYPE: Cased
	TOWN, STATE Worcester, MA	LINE & STA.:
	PBA NO.: 21005 OFFICE: Procaccianti Companies	OFFSET:

GROUND WATER OBSERVATIONS
AT 5 FT AFTER 0 HRS
AT ___ FT AFTER ___ HRS

	AUGER	CASING	SAMPLER	CORE BAR.
TYPE	---	NW	S/S	---
SIZE, I.D.	---	3"	1 3/8"	---
HAMMER WT.		140#	140#	BIT
HAMMER FALL		30"	30"	

SURFACE ELEV.:
DATE STARTED: 06/14/21
DATE FINISHED: 06/14/21
FOREMAN: G. Twombly Jr.
INSPECTOR: T. Leidner

LOCATION OF BORING: Refer to Figure 2, Subsurface Exploration Plan

DEPTH BELOW SURFACE	CASING BLOWS/ FOOT	SAMPLE DEPTH FROM - TO	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER FROM-TO 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL & ROCK INCL. COLOR, LOSS OF WASH WATER, JOINTS IN ROCK, ETC.	SAMPLE NO.	PEN.	REC.
		0'-2'	D	5	5	5	6		Dry, medium dense, brown/red GRAVEL, some fine to coarse Sand, trace Silt, trace brick (Fill)	1	24	
		2'-4'	D	6	5	5	6		Dry, medium dense, brown/red fine to coarse SAND, some Gravel, trace Silt, trace brick (Fill)	2	24	
5		4'-6'	D	6	4	4	4		Moist, loose, gray fine to coarse SAND AND GRAVEL, trace Silt, trace concrete (Fill)	3	24	8
		8'-10'	D	7	6	7	7	9'	Moist, medium dense, gray GRAVEL, little fine to coarse Sand, trace silt, trace concrete (Fill)	4	24	2
10		10'-12'	D	5	5	5	6		Moist, medium dense, gray fine SAND, some Silt	5	24	12
		13'-15'	D	4	3	4	4	15'	Wet, loose, gray SILT AND fine SAND	6	24	11
15									Bottom of Exploration at 15 feet			
20												
25												
30												
35												
40												

GROUND SURFACE TO 13 FT., USED 3 " CASING:
THEN split spoon sample

TYPE OF SAMPLE
D=DRY W=WASHED C=CORED
TP=TEST PIT A=AUGER V=VANE TEST
UP=UNDISTURBED, PISTON
US=UNDISTURBED, SHELBY

PROPORTIONS USED:
TRACE=0-10%
LITTLE=10-20%
SOME=20-35%
AND=35-50%

COHESIONLESS DENSITY:
0-4 VERY LOOSE
5-9 LOOSE
10-29 MED. DENSE
30-49 DENSE
50 + VERY DENSE

FOOTAGE IN EARTH: 15
FOOTAGE IN ROCK: ---
WELL FOOTAGE: ---
NO. OF SAMPLES: 6
HOLE NO.: B-3
TYPE: Cased

BORING CONTRACTOR: New England Boring Contractors

Taunton, MA

LOG PREPARED BY: PBA TGL

PAUL B. ALDINGER & ASSOCIATES, INC.

860A WATERMAN AVENUE, SUITE 9 EAST PROVIDENCE, RI

BORING LOG

PROJECT NAME: 75 Quinsigamond Avenue
TOWN, STATE: Worcester, MA
PBA NO.: 21005 OFFICE: Procaccianti Companies

SHEET 1 OF 1
LOCATION: Refer to Fig. 2
HOLE NO.: B-4
BORING TYPE: Cased
LINE & STA.:
OFFSET:

GROUND WATER OBSERVATIONS
AT 6 FT AFTER 0 HRS
AT ___ FT AFTER ___ HRS

	AUGER	CASING	SAMPLER	CORE BAR.
TYPE	---	NW	S/S	---
SIZE, I.D.	---	3"	1 3/8"	---
HAMMER WT.		140#	140#	BIT
HAMMER FALL		30"	30"	

SURFACE ELEV.:
DATE STARTED: 06/14/21
DATE FINISHED: 06/14/21
FOREMAN: G. Twombly Jr.
INSPECTOR: T. Leidner

LOCATION OF BORING: Refer to Figure 2, Subsurface Exploration Plan

DEPTH BELOW SURFACE	CASING BLOWS/ FOOT	SAMPLE DEPTH FROM - TO	TYPE OF SAMPLE	BLOWS PER 6" ON SAMPLER FROM-TO 0-6	6-12	12-18	18-24	STRATA CHANGE DEPTH	FIELD IDENTIFICATION OF SOIL & ROCK INCL. COLOR, LOSS OF WASH WATER, JOINTS IN ROCK, ETC.	SAMPLE NO.	PEN.	REC.
		0'-2'	D	3	9	12	7		Dry, medium dense, dark brown/black fine to coarse SAND, some Gravel, little Silt, trace roots/asphalt (Fill)	1	24	14
		3'-5'	D	4	2	3	6		Moist, dark brown fine to coarse SAND, some Gravel, little Silt, trace asphalt, brick (Fill)	2	24	6
5								7.5'				
		8'-10'	D	2	4	7	6	9.5'	Moist, black, fine SAND AND SILT, trace roots	3	24	16
10									Moist, gray fine SAND, some silt, trace roots			
		13'-15'	D	4	4	5	5	15'	Wet, loose, gray fine SAND, little Silt, trace roots	4	24	13
15									Bottom of Exploration at 15 feet			
20												
25												
30												
35												
40												

GROUND SURFACE TO 13 FT., USED 3 " CASING:
THEN split spoon sample

TYPE OF SAMPLE
D=DRY W=WASHED C=CORED
TP=TEST PIT A=AUGER V=VANE TEST
UP=UNDISTURBED, PISTON
US=UNDISTURBED, SHELBY

PROPORTIONS USED:
TRACE=0-10%
LITTLE=10-20%
SOME=20-35%
AND=35-50%

COHESIONLESS DENSITY:
0-4 VERY LOOSE
5-9 LOOSE
10-29 MED. DENSE
30-49 DENSE
50 + VERY DENSE

FOOTAGE IN EARTH: 15
FOOTAGE IN ROCK: ---
WELL FOOTAGE: ---
NO. OF SAMPLES: 4
HOLE NO.: B-4
TYPE: Cased

APPENDIX C

LABORATORY TESTING

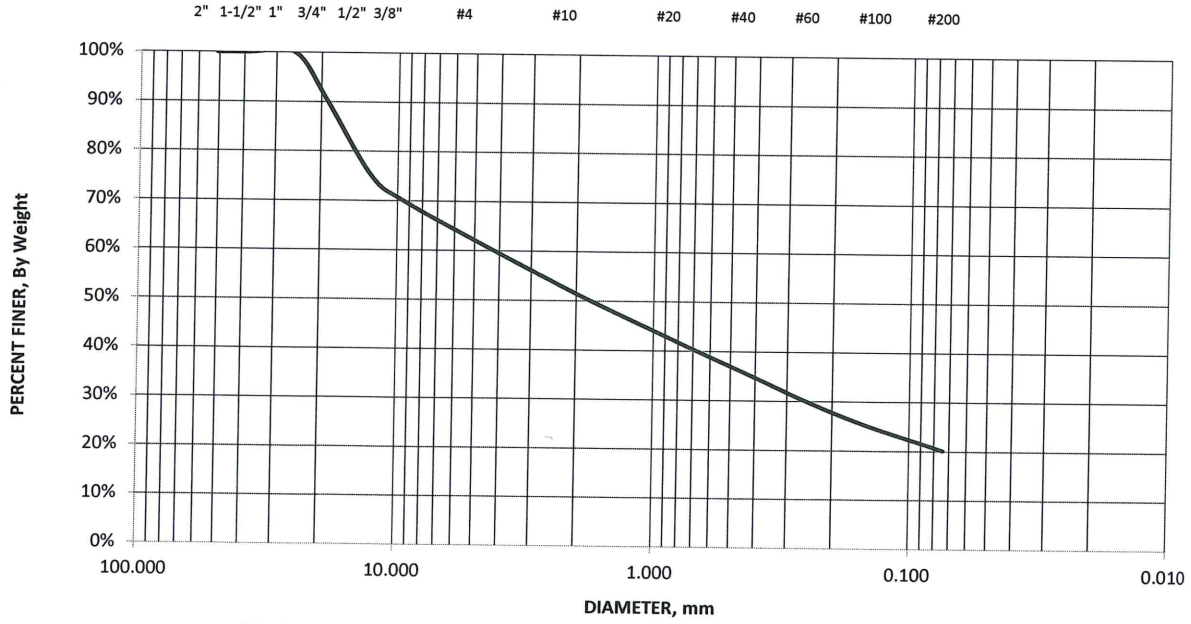
SIEVE ANALYSIS

DESCRIPTION:	Fine to coarse SAND AND GRAVEL, some Silt (Fill)	PROJ:	75 Quinsigamond Ave. Svc Sta
		LOCATION:	Worcester, MA
		JOB #:	21005
Sample Location:	Refer to Figure 2, Subsurface Exploration Plan	DATE:	6/25/2021
		CONTAINER #:	58
USCS:	SM	CONT.+ WET SOIL:	276.14
TEST BORING NO.:	B-1	CONT.+ DRY SOIL:	224.80
DEPTH:	4'-6'	WGT WATER:	51.34
SAMPLE #:	S-3	CONT WGT:	85.81
WASH SIEVE	yes	DRY SOIL:	138.99
		% MOIST:	36.94%

SIEVE	OPENING (MM)	WEIGHT RETAINED	ACCUM. RETAINED	PERCENT RETAINED	TOTAL % FINER/WGT	PROJECT SPEC.
3"	76.2	0.00	0.00	0.00%	100.00%	
2"	50.800	0.00	0.00	0.00%	100.00%	
1 ½"	37.500	0.00	0.00	0.00%	100.00%	
1"	25.400	0.00	0.00	0.00%	100.00%	
3/4"	19.100	13.11	13.11	9.43%	90.57%	
1/2"	12.700	21.43	34.54	24.85%	75.15%	
3/8"	9.525	7.03	41.57	29.91%	70.09%	
4	4.750	11.92	53.49	38.48%	61.52%	
10	2.000	13.98	67.47	48.54%	51.46%	
20	0.840	12.87	80.34	57.80%	42.20%	
40	0.420	9.72	90.06	64.80%	35.20%	
60	0.250	7.49	97.55	70.18%	29.82%	
100	0.149	6.36	103.91	74.76%	25.24%	
200	0.074	7.12	111.03	79.88%	20.12%	
Pan	0.000	1.45	112.48	80.93%	19.07%	
TOTAL DRY WT.			138.99			

	% GRAVEL	% SAND	% SILT & CLAY
TOTAL	38.5%	41.4%	20.1%
COARSE	0.0%	10.1%	
MEDIUM		16.3%	
FINE	38.5%	15.1%	

SIEVE ANALYSIS



GRAVEL		SAND			SILT
COARSE	FINE	COARSE	MEDIUM	FINE	

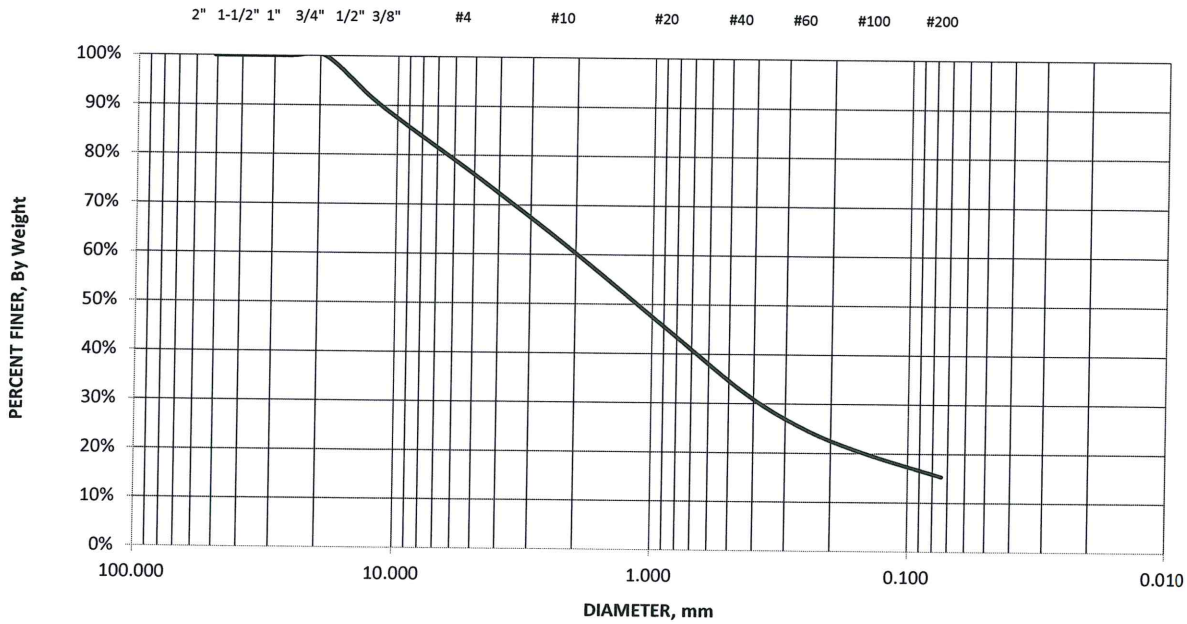
SIEVE ANALYSIS

DESCRIPTION:	Fine to coarse SAND, some Gravel, little Silt (Fill)	PROJ:	75 Quinsigamond Ave. Svc Sta
		LOCATION:	Worcester, MA
		JOB #:	21005
Sample Location:	Refer to Figure 2, Subsurface Exploration Plan	DATE:	6/25/2021
		CONTAINER #:	101
USCS:	SM	CONT.+ WET SOIL:	308.46
TEST BORING NO.:	B-2	CONT.+ DRY SOIL:	295.37
DEPTH:	2'-2'11"	WGT WATER:	13.09
SAMPLE #:	S-2	CONT WGT:	109.76
WASH SIEVE	yes	DRY SOIL:	185.61
		% MOIST:	7.05%

SIEVE	OPENING (MM)	WEIGHT RETAINED	ACCUM. RETAINED	PERCENT RETAINED	TOTAL % FINER/WGT	PROJECT SPEC.
3"	76.2	0.00	0.00	0.00%	100.00%	
2"	50.800	0.00	0.00	0.00%	100.00%	
1 ½"	37.500	0.00	0.00	0.00%	100.00%	
1"	25.400	0.00	0.00	0.00%	100.00%	
3/4"	19.100	0.00	0.00	0.00%	100.00%	
1/2"	12.700	15.39	15.39	8.29%	91.71%	
3/8"	9.525	9.39	24.78	13.35%	86.65%	
4	4.750	21.12	45.90	24.73%	75.27%	
10	2.000	27.78	73.68	39.70%	60.30%	
20	0.840	29.87	103.55	55.79%	44.21%	
40	0.420	23.40	126.95	68.40%	31.60%	
60	0.250	12.81	139.76	75.30%	24.70%	
100	0.149	8.71	148.47	79.99%	20.01%	
200	0.074	8.77	157.24	84.72%	15.28%	
Pan	0.000	1.22	158.46	85.37%	14.63%	
TOTAL DRY WT.			185.61			

	% GRAVEL	% SAND	% SILT & CLAY
TOTAL	24.7%	60.0%	15.3%
COARSE	0.0%	15.0%	
MEDIUM		28.7%	
FINE	24.7%	16.3%	

SIEVE ANALYSIS



GRAVEL		SAND			SILT
COARSE	FINE	COARSE	MEDIUM	FINE	

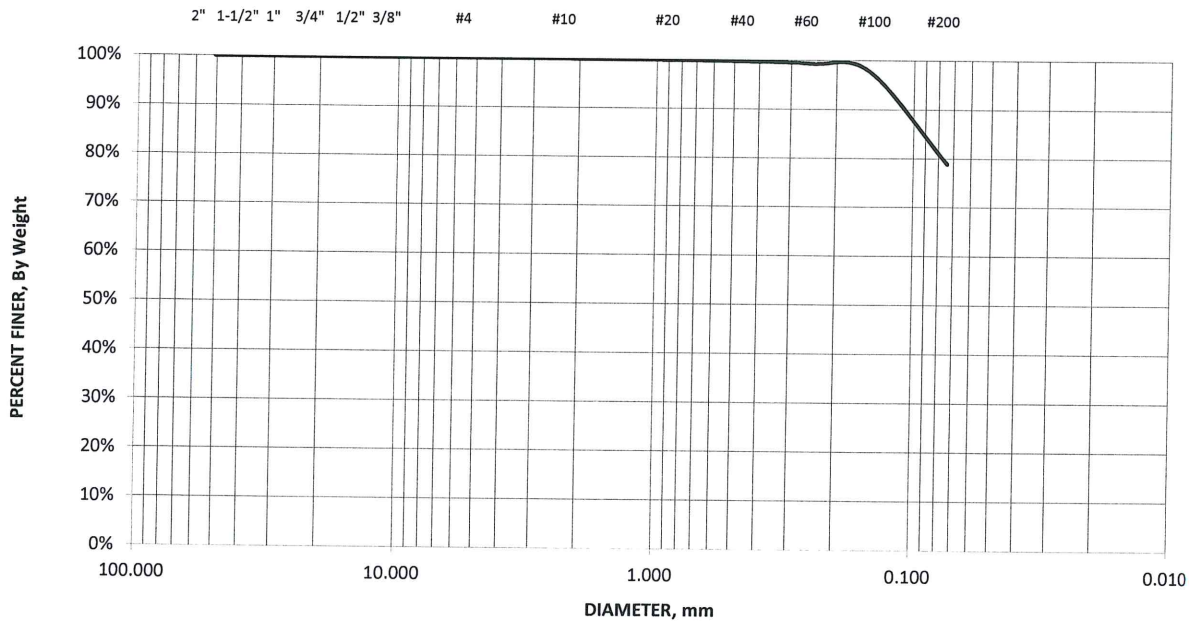
SIEVE ANALYSIS

DESCRIPTION:	Gray SILT, little fine Sand	PROJ:	75 Quinsigamond Ave. Svc Sta
		LOCATION:	Worcester, MA
		JOB #:	21005
Sample Location:	Refer to Figure 2	DATE:	6/24/2021
		CONTAINER #:	101
USCS:	ML	CONT.+ WET SOIL:	397.63
TEST BORING NO.:	B-3	CONT.+ DRY SOIL:	334.00
DEPTH:	13'-15'	WGT WATER:	63.63
SAMPLE #:	S-6	CONT WGT:	109.71
WASH SIEVE	yes	DRY SOIL:	224.29
		% MOIST:	28.37%

SIEVE	OPENING (MM)	WEIGHT RETAINED	ACCUM. RETAINED	PERCENT RETAINED	TOTAL % FINER/WGT	PROJECT SPEC.
3"	76.2	0.00	0.00	0.00%	100.00%	
2"	50.800	0.00	0.00	0.00%	100.00%	
1 ½"	37.500	0.00	0.00	0.00%	100.00%	
1"	25.400	0.00	0.00	0.00%	100.00%	
3/4"	19.100	0.00	0.00	0.00%	100.00%	
1/2"	12.700	0.00	0.00	0.00%	100.00%	
3/8"	9.525	0.00	0.00	0.00%	100.00%	
4	4.750	0.00	0.00	0.00%	100.00%	
10	2.000	0.09	0.09	0.04%	99.96%	
20	0.840	0.18	0.27	0.12%	99.88%	
40	0.420	0.43	0.70	0.31%	99.69%	
60	0.250	0.79	1.49	0.66%	99.34%	
100	0.149	3.55	5.04	2.25%	97.75%	
200	0.074	42.38	47.42	21.14%	78.86%	
Pan	0.000	112.74	160.16	71.41%	28.59%	
TOTAL DRY WT.			160.16			

	% GRAVEL	% SAND	% SILT & CLAY
TOTAL	0.0%	21.1%	78.9%
COARSE	0.0%	0.0%	
MEDIUM		0.3%	
FINE	0.0%	20.8%	

SIEVE ANALYSIS



GRAVEL		SAND			SILT
COARSE	FINE	COARSE	MEDIUM	FINE	

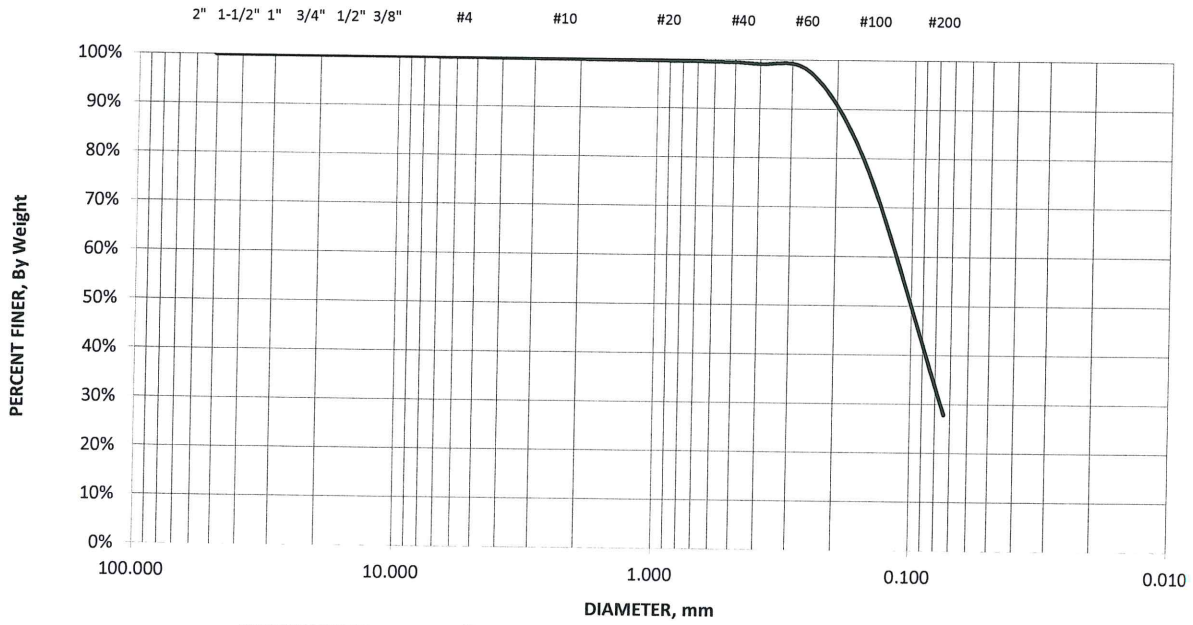
SIEVE ANALYSIS

DESCRIPTION:	Gray FINE SAND, some Silt	PROJ:	75 Quinsigamond Ave. Svc Sta
		LOCATION:	Worcester, MA
		JOB #:	21005
Sample Location:	Refer to Figure 2	DATE:	6/24/2021
		CONTAINER #:	101
USCS:	SM	CONT.+ WET SOIL:	397.63
TEST BORING NO.:	B-4	CONT.+ DRY SOIL:	334.00
DEPTH:	13'-15'	WGT WATER:	63.63
SAMPLE #:	S-4	CONT WGT:	109.71
WASH SIEVE	yes	DRY SOIL:	224.29
		% MOIST:	28.37%

SIEVE	OPENING (MM)	WEIGHT RETAINED	ACCUM. RETAINED	PERCENT RETAINED	TOTAL % FINER/WGT	PROJECT SPEC.
3"	76.2	0.00	0.00	0.00%	100.00%	
2"	50.800	0.00	0.00	0.00%	100.00%	
1 ½"	37.500	0.00	0.00	0.00%	100.00%	
1"	25.400	0.00	0.00	0.00%	100.00%	
3/4"	19.100	0.00	0.00	0.00%	100.00%	
1/2"	12.700	0.00	0.00	0.00%	100.00%	
3/8"	9.525	0.00	0.00	0.00%	100.00%	
4	4.750	0.24	0.24	0.11%	99.89%	
10	2.000	0.27	0.51	0.23%	99.77%	
20	0.840	0.36	0.87	0.39%	99.61%	
40	0.420	0.90	1.77	0.79%	99.21%	
60	0.250	4.77	6.54	2.92%	97.08%	
100	0.149	44.81	51.35	22.89%	77.11%	
200	0.074	110.64	161.99	72.22%	27.78%	
Pan	0.000	62.30	224.29	100.00%	0.00%	
TOTAL DRY WT.			231.79			

	% GRAVEL	% SAND	% SILT & CLAY
TOTAL	0.1%	72.1%	27.8%
COARSE	0.0%	0.1%	
MEDIUM		0.6%	
FINE	0.1%	71.4%	

SIEVE ANALYSIS



GRAVEL		SAND			SILT
COARSE	FINE	COARSE	MEDIUM	FINE	

APPENDIX D: EXISTING CONDITIONS HYDROLOGIC ANALYSIS

- *EXISTING CONDITIONS HYDROCAD COMPUTATIONS*

NOTE: TIME OF CONCENTRATION (TC)
SHALL BE 6 MINUTES

E1

AREA=66,910 SF

HSG A

DP1

HARDING STREET
(PUBLIC - VARIABLE WIDTH)

ARWICK AVENUE
(PUBLIC - VARIABLE WIDTH)
(2004 ALTERATION - LAYOUT #7761)

QUINSIGAMOND AVENUE
(PUBLIC - VARIABLE WIDTH)
(2004 ALTERATION - LAYOUT #7761)
(ASPHALT ROADWAY)

TBM-A

1 STORY FRAME BUILDING

2 STORY MASONRY BUILDING
"HADDAD AUTO DETAIL"
BFPM=2,322± SF

CONCRETE RAMP

PAVERS

METAL STEPS

LIGHT BASE

LSA

BOHLER

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

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REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	10/25/21	ZBA AND PLANNING BOARD SUBMISSION	NPD / RMM

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.:	W211067
DRAWN BY:	NPD
CHECKED BY:	RMM
DATE:	08/20/2021
CAD I.D.:	W211067-CVL-0

PROJECT:

PROPOSED SITE PLAN DOCUMENTS

FOR

TPG DEVELOPMENT AND CONSTRUCTION

PROPOSED
GAS STATION AND
CONVENIENCE STORE
MAP #5, BLOCK #23,
LOTS #68-70, 72, 76, 93
75 QUINSIGAMOND AVENUE
CITY OF WORCESTER
WORCESTER COUNTY,
MASSACHUSETTS

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SOUTHBOROUGH, MA 01772
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RHODE ISLAND LICENSE No. 11425

SHEET TITLE:

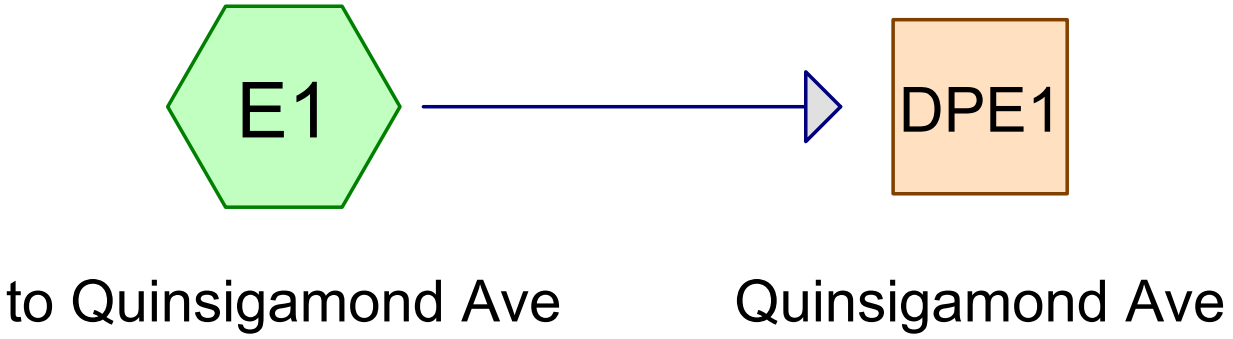
EXISTING CONDITIONS WATERSHED MAP

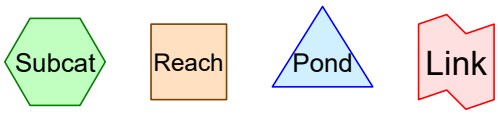
SHEET NUMBER:

WS-EX

REVISION 1 - 10/25/21

\\BOHLERENG.NET\SHARE\MA-PROJECTS\W211067\DRAWINGS\PLAN SET\REV1\W211067-CVL-1 ---- LAYOUT: WS-EX-EXIST. DRAIN MAP





Routing Diagram for W211067 Model
Prepared by {enter your company name here}, Printed 8/18/2021
HydroCAD® 10.00-21 s/n 08311 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.022	96	Gravel surface, HSG A (E1)
0.514	98	Paved parking, HSG A (E1)
1.536	**97**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.536	HSG A	E1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.536		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
1.022	0.000	0.000	0.000	0.000	1.022	Gravel surface	E1
0.514	0.000	0.000	0.000	0.000	0.514	Paved parking	E1
1.536	**0.000**	**0.000**	**0.000**	**0.000**	**1.536**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentE1: to QuinsigamondAve Runoff Area=66,910 sf 33.47% Impervious Runoff Depth>2.91"
Tc=6.0 min CN=97 Runoff=4.68 cfs 0.373 af

Reach DPE1: QuinsigamondAve Inflow=4.68 cfs 0.373 af
Outflow=4.68 cfs 0.373 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.373 af Average Runoff Depth = 2.91"
66.53% Pervious = 1.022 ac 33.47% Impervious = 0.514 ac

Summary for Subcatchment E1: to Quinsigamond Ave

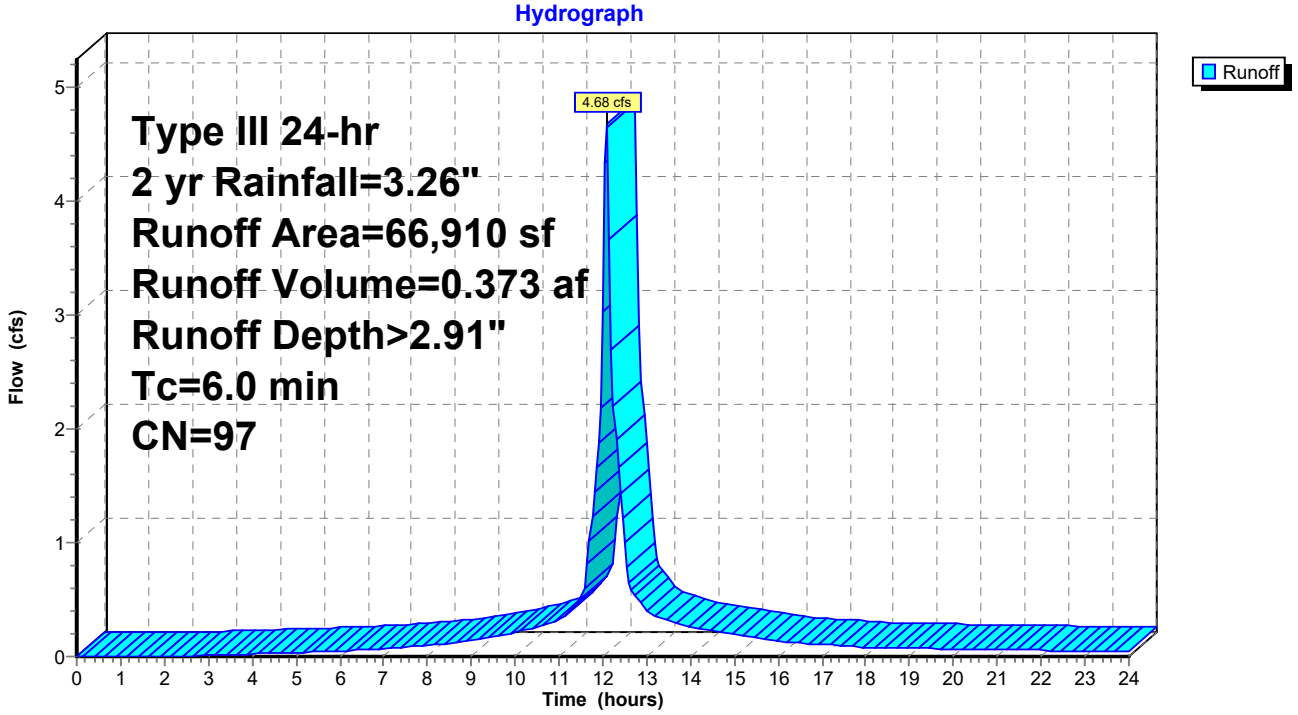
Runoff = 4.68 cfs @ 12.09 hrs, Volume= 0.373 af, Depth> 2.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.26"

Area (sf)	CN	Description
22,395	98	Paved parking, HSG A
44,515	96	Gravel surface, HSG A
66,910	97	Weighted Average
44,515		66.53% Pervious Area
22,395		33.47% Impervious Area

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

Subcatchment E1: to Quinsigamond Ave



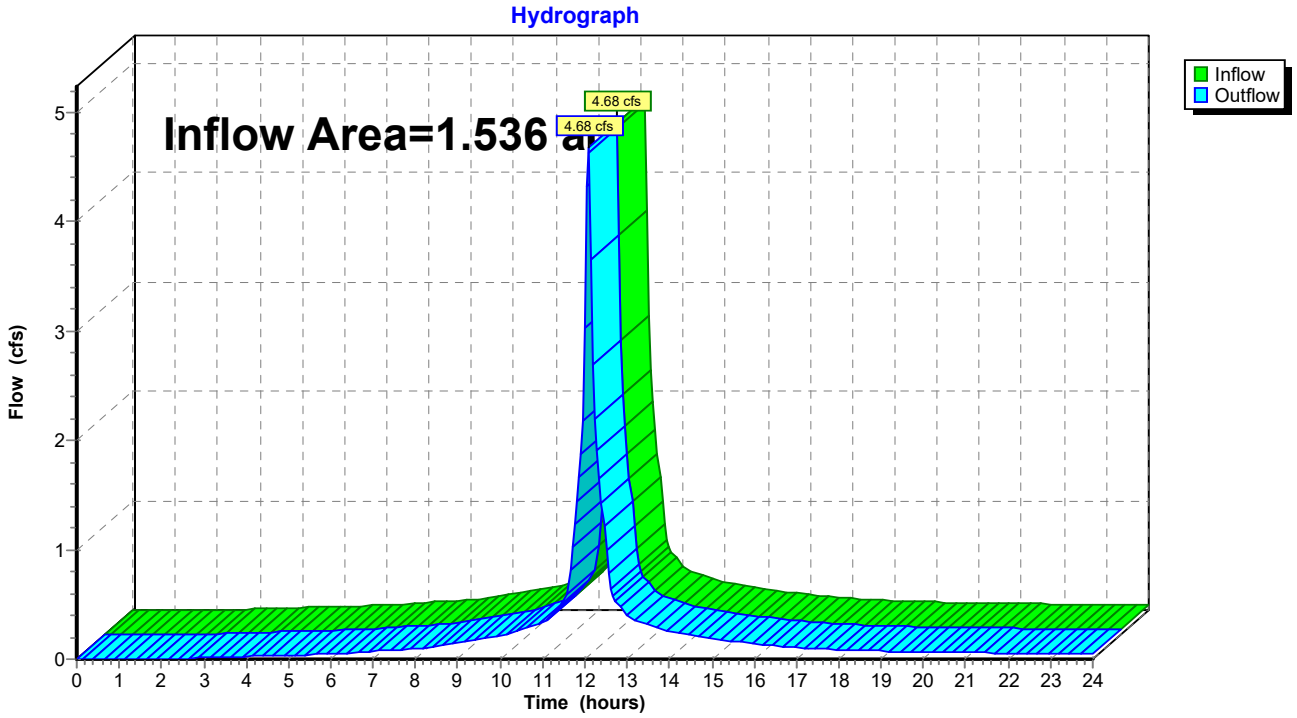
Summary for Reach DPE1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 33.47% Impervious, Inflow Depth > 2.91" for 2 yr event
Inflow = 4.68 cfs @ 12.09 hrs, Volume= 0.373 af
Outflow = 4.68 cfs @ 12.09 hrs, Volume= 0.373 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPE1: Quinsigamond Ave



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentE1: to QuinsigamondAve Runoff Area=66,910 sf 33.47% Impervious Runoff Depth>4.56"
Tc=6.0 min CN=97 Runoff=7.17 cfs 0.584 af

Reach DPE1: QuinsigamondAve Inflow=7.17 cfs 0.584 af
Outflow=7.17 cfs 0.584 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.584 af Average Runoff Depth = 4.56"
66.53% Pervious = 1.022 ac 33.47% Impervious = 0.514 ac

Summary for Subcatchment E1: to Quinsigamond Ave

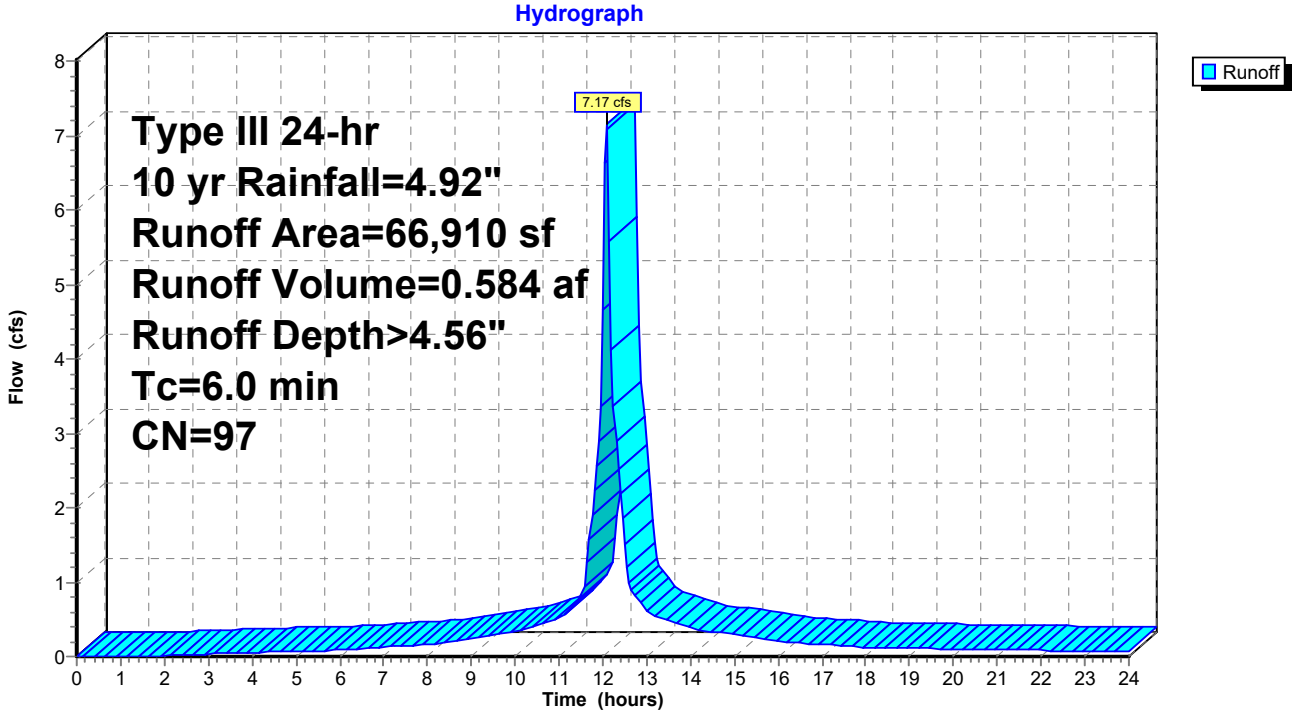
Runoff = 7.17 cfs @ 12.09 hrs, Volume= 0.584 af, Depth> 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.92"

Area (sf)	CN	Description
22,395	98	Paved parking, HSG A
44,515	96	Gravel surface, HSG A
66,910	97	Weighted Average
44,515		66.53% Pervious Area
22,395		33.47% Impervious Area

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

Subcatchment E1: to Quinsigamond Ave



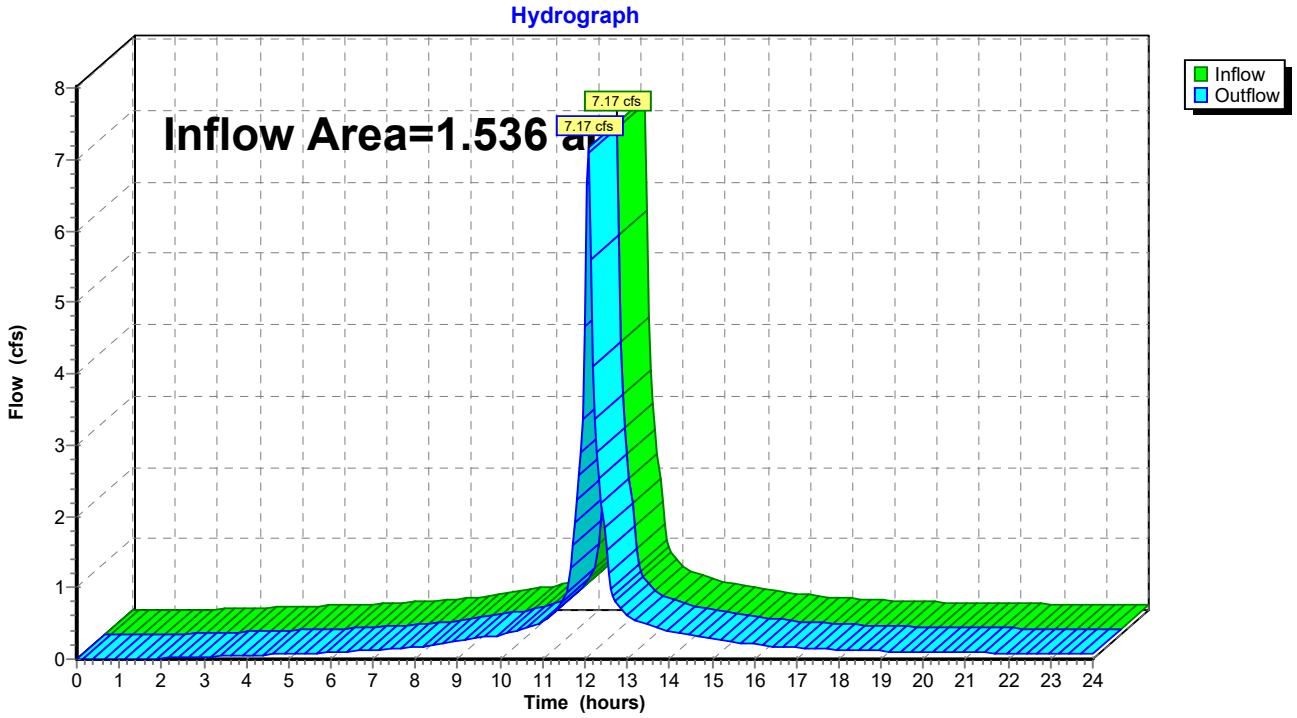
Summary for Reach DPE1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 33.47% Impervious, Inflow Depth > 4.56" for 10 yr event
Inflow = 7.17 cfs @ 12.09 hrs, Volume= 0.584 af
Outflow = 7.17 cfs @ 12.09 hrs, Volume= 0.584 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPE1: Quinsigamond Ave



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentE1: to QuinsigamondAve Runoff Area=66,910 sf 33.47% Impervious Runoff Depth>5.85"
Tc=6.0 min CN=97 Runoff=9.09 cfs 0.749 af

Reach DPE1: QuinsigamondAve Inflow=9.09 cfs 0.749 af
Outflow=9.09 cfs 0.749 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.749 af Average Runoff Depth = 5.85"
66.53% Pervious = 1.022 ac 33.47% Impervious = 0.514 ac

Summary for Subcatchment E1: to Quinsigamond Ave

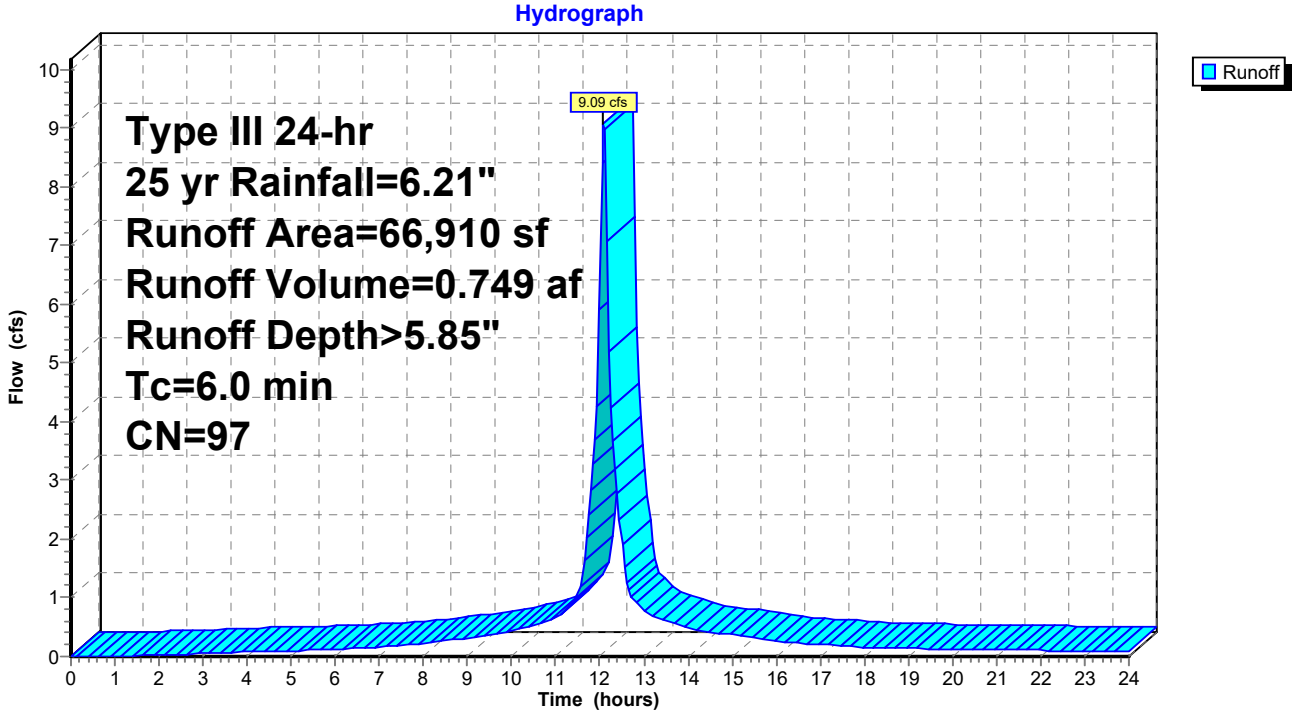
Runoff = 9.09 cfs @ 12.09 hrs, Volume= 0.749 af, Depth> 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=6.21"

Area (sf)	CN	Description
22,395	98	Paved parking, HSG A
44,515	96	Gravel surface, HSG A
66,910	97	Weighted Average
44,515		66.53% Pervious Area
22,395		33.47% Impervious Area

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

Subcatchment E1: to Quinsigamond Ave



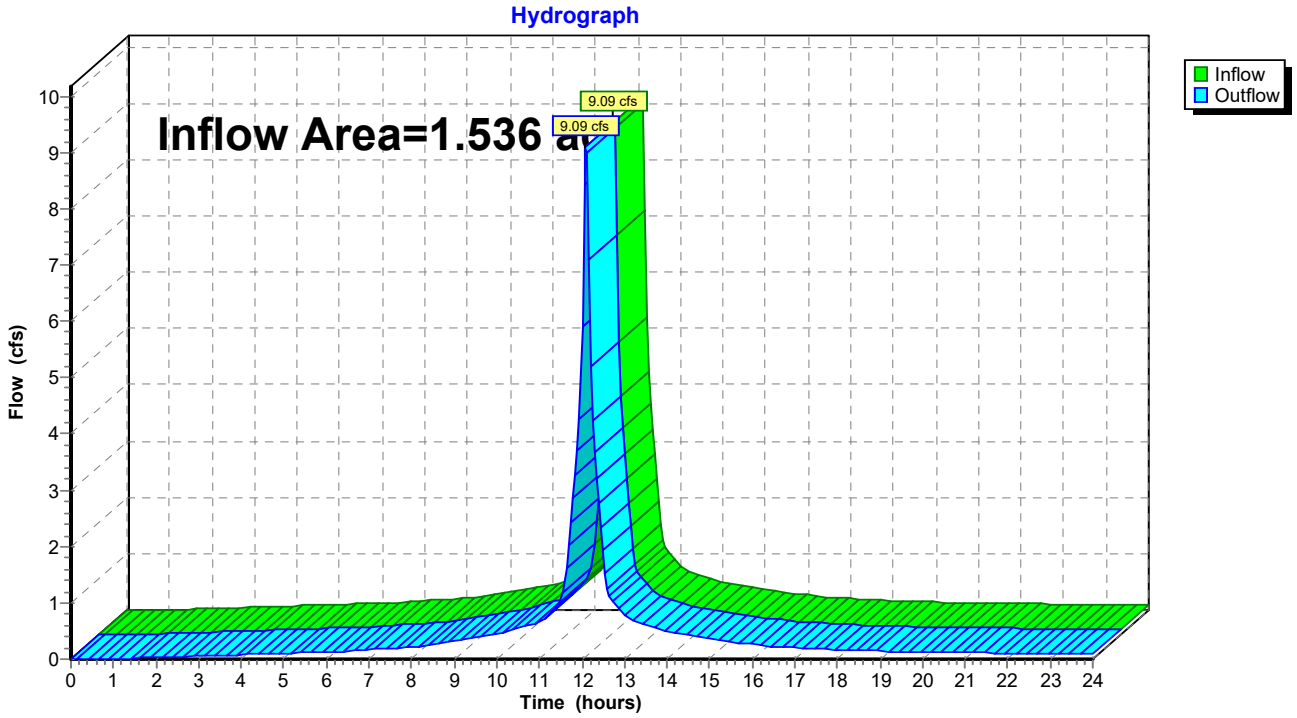
Summary for Reach DPE1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 33.47% Impervious, Inflow Depth > 5.85" for 25 yr event
Inflow = 9.09 cfs @ 12.09 hrs, Volume= 0.749 af
Outflow = 9.09 cfs @ 12.09 hrs, Volume= 0.749 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPE1: Quinsigamond Ave



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentE1: to QuinsigamondAve Runoff Area=66,910 sf 33.47% Impervious Runoff Depth>8.50"
Tc=6.0 min CN=97 Runoff=13.04 cfs 1.089 af

Reach DPE1: QuinsigamondAve Inflow=13.04 cfs 1.089 af
Outflow=13.04 cfs 1.089 af

Total Runoff Area = 1.536 ac Runoff Volume = 1.089 af Average Runoff Depth = 8.50"
66.53% Pervious = 1.022 ac 33.47% Impervious = 0.514 ac

Summary for Subcatchment E1: to Quinsigamond Ave

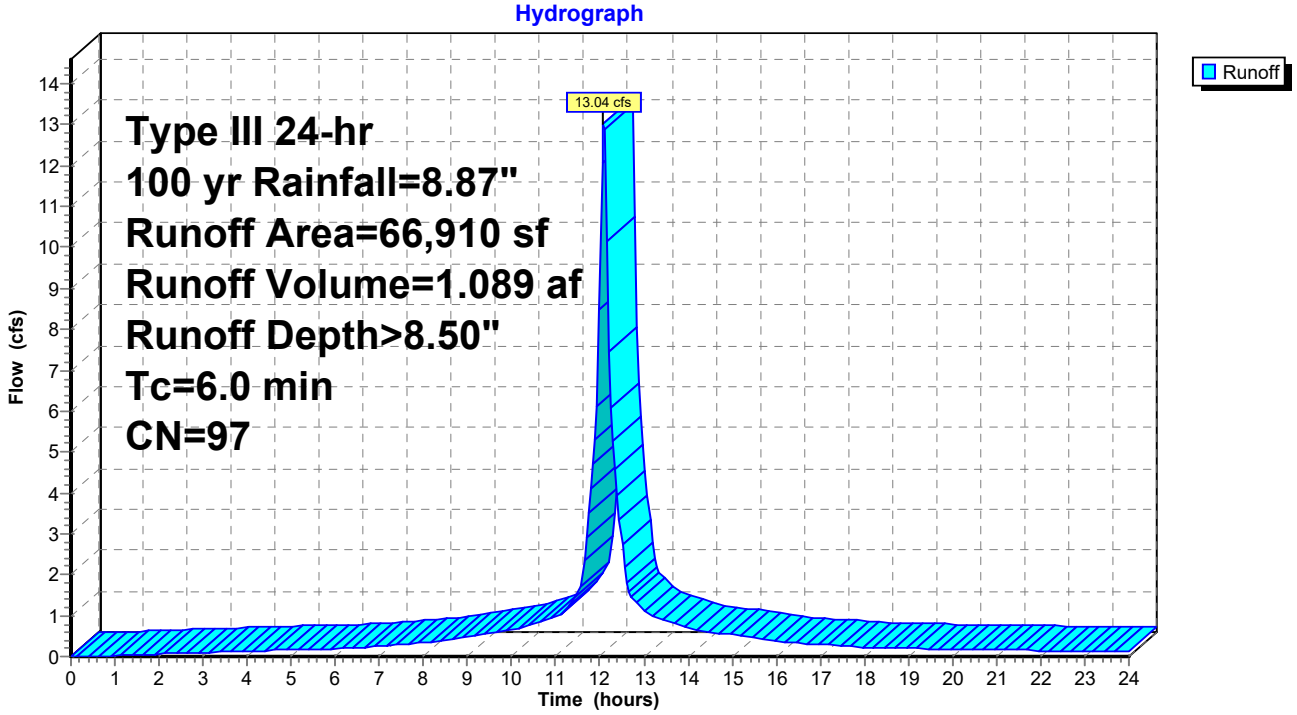
Runoff = 13.04 cfs @ 12.09 hrs, Volume= 1.089 af, Depth> 8.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=8.87"

Area (sf)	CN	Description
22,395	98	Paved parking, HSG A
44,515	96	Gravel surface, HSG A
66,910	97	Weighted Average
44,515		66.53% Pervious Area
22,395		33.47% Impervious Area

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

Subcatchment E1: to Quinsigamond Ave



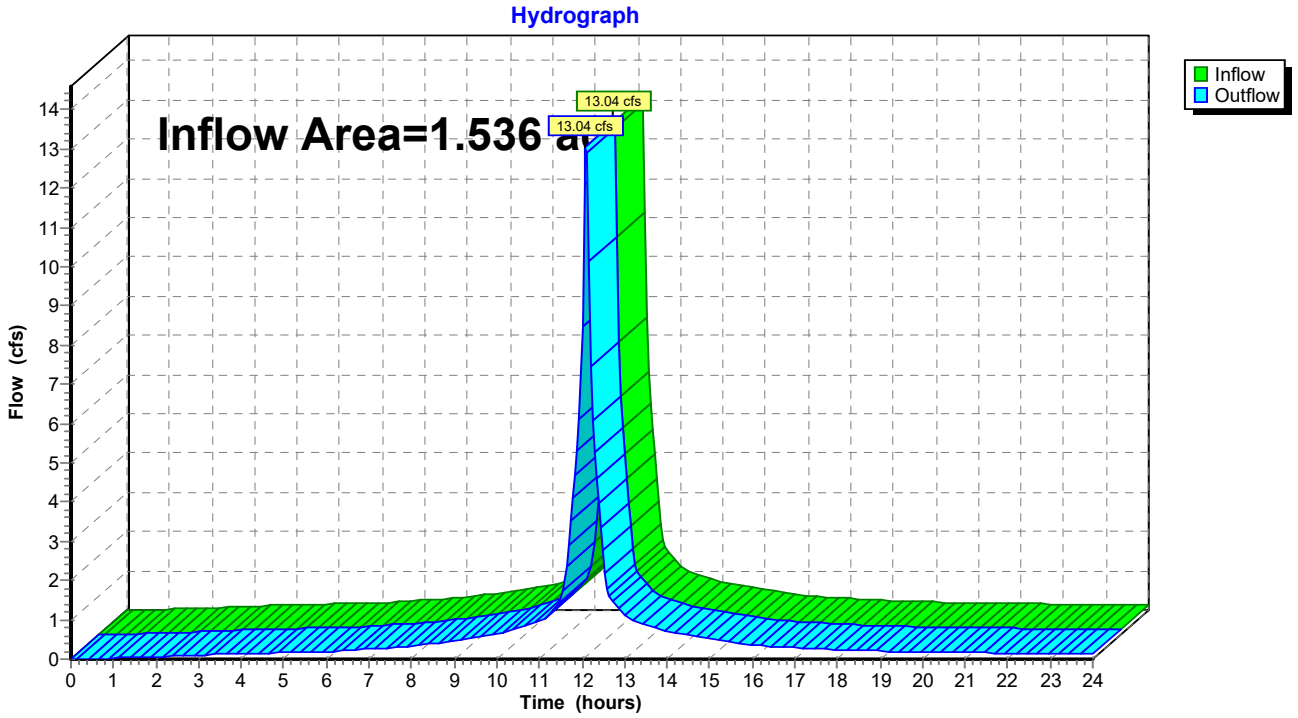
Summary for Reach DPE1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 33.47% Impervious, Inflow Depth > 8.50" for 100 yr event
Inflow = 13.04 cfs @ 12.09 hrs, Volume= 1.089 af
Outflow = 13.04 cfs @ 12.09 hrs, Volume= 1.089 af, Atten= 0%, Lag= 0.0 min

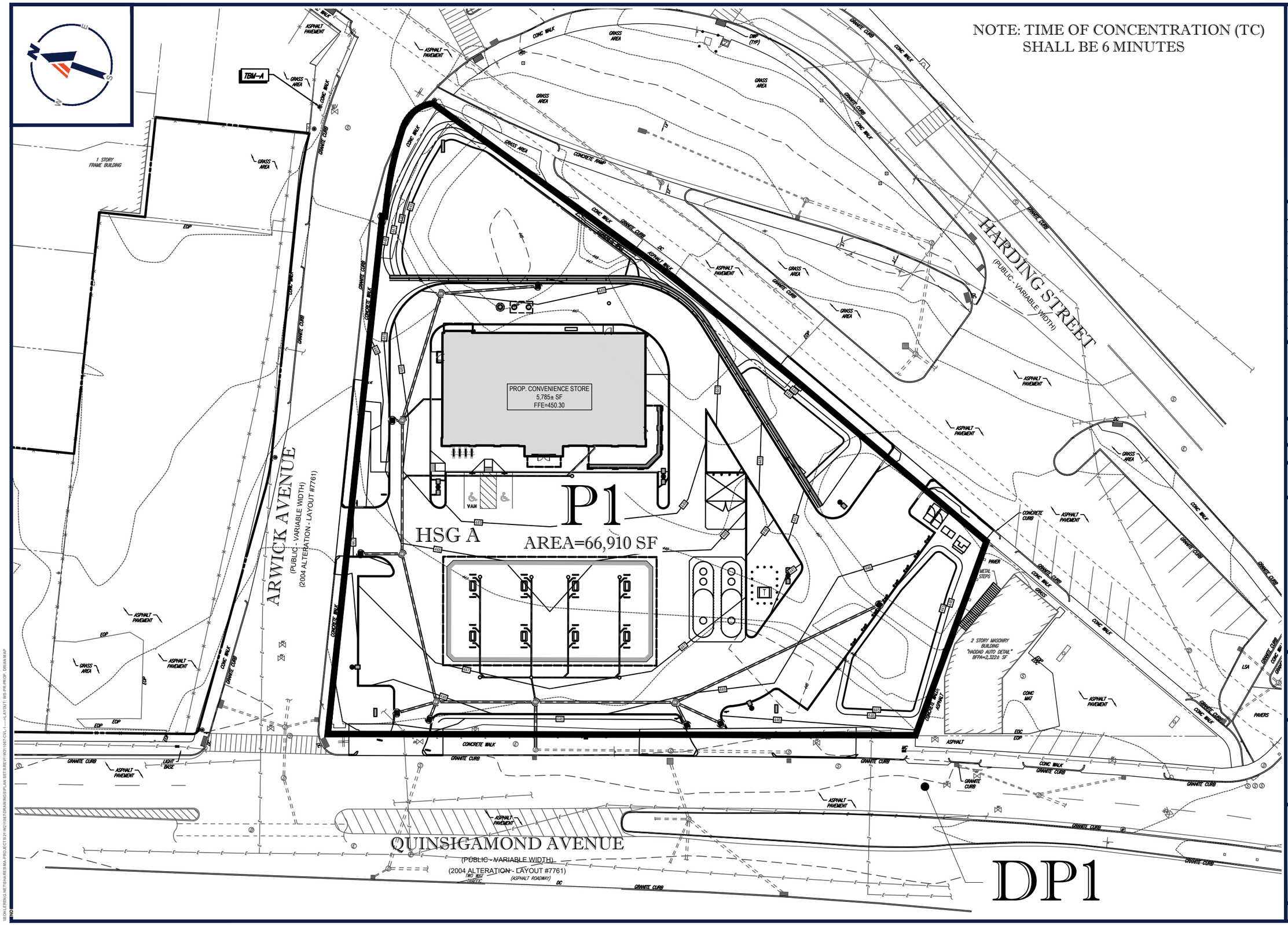
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPE1: Quinsigamond Ave



APPENDIX E: PROPOSED CONDITIONS HYDROLOGIC ANALYSIS

- *PROPOSED CONDITIONS HYDROCAD CALCULATIONS*



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REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	10/25/21	ZBA AND PLANNING BOARD SUBMISSION	NPD / RMM

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ALWAYS CALL 811

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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.:	W211067
DRAWN BY:	NPD
CHECKED BY:	RMM
DATE:	08/20/2021
CAD I.D.:	W211067-CVL-0

PROJECT:

PROPOSED SITE PLAN DOCUMENTS

FOR

TPG DEVELOPMENT AND CONSTRUCTION

PROPOSED
GAS STATION AND
CONVENIENCE STORE
MAP #5, BLOCK #23,
LOTS #68-70, 72, 76, 93
75 QUINSIGAMOND AVENUE
CITY OF WORCESTER
WORCESTER COUNTY,
MASSACHUSETTS

BOHLER
352 TURNPIKE ROAD
SOUTHBOROUGH, MA 01772
Phone: (508) 480-9900
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RHODE ISLAND LICENSE No. 11425

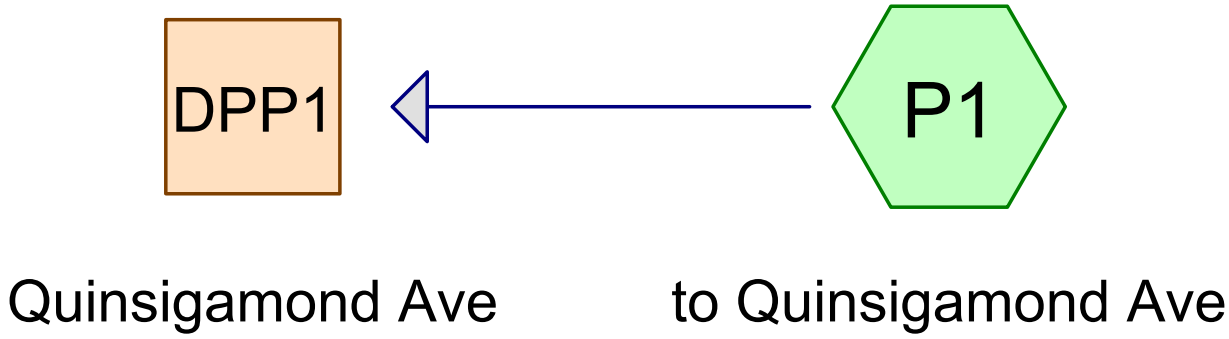
SHEET TITLE:

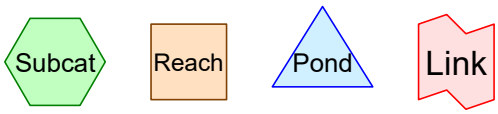
PROPOSED CONDITIONS WATERSHED MAP

SHEET NUMBER:

WS-PR

REVISION 1 - 10/25/21





Routing Diagram for W211067 Model
Prepared by {enter your company name here}, Printed 8/18/2021
HydroCAD® 10.00-21 s/n 08311 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.467	39	>75% Grass cover, Good, HSG A (P1)
0.936	98	Paved parking, HSG A (P1)
0.133	98	Roofs, HSG A (P1)
1.536	**80**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
1.536	HSG A	P1
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
1.536		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.467	0.000	0.000	0.000	0.000	0.467	>75% Grass cover, Good	P1
0.936	0.000	0.000	0.000	0.000	0.936	Paved parking	P1
0.133	0.000	0.000	0.000	0.000	0.133	Roofs	P1
1.536	**0.000**	**0.000**	**0.000**	**0.000**	**1.536**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentP1: to QuinsigamondAve Runoff Area=66,910 sf 69.59% Impervious Runoff Depth>1.45"
Tc=6.0 min CN=80 Runoff=2.54 cfs 0.185 af

Reach DPP1: QuinsigamondAve Inflow=2.54 cfs 0.185 af
Outflow=2.54 cfs 0.185 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.185 af Average Runoff Depth = 1.45"
30.41% Pervious = 0.467 ac 69.59% Impervious = 1.069 ac

Summary for Subcatchment P1: to Quinsigamond Ave

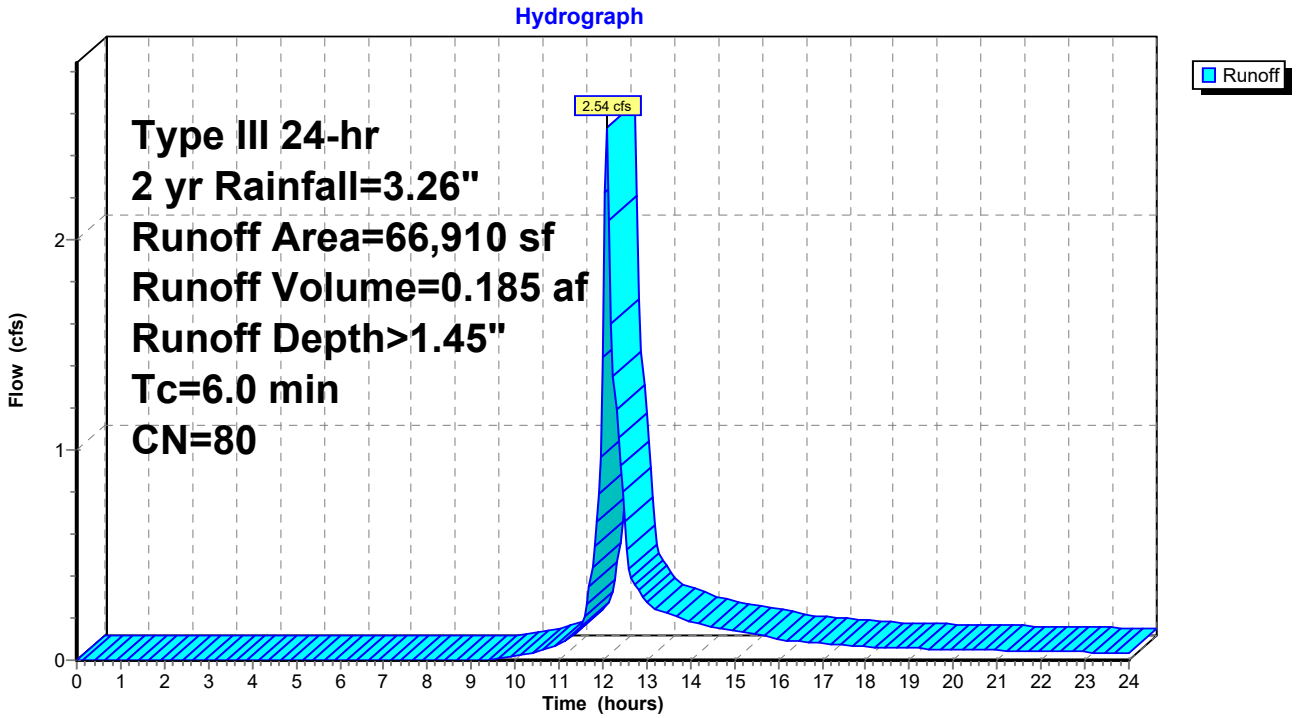
Runoff = 2.54 cfs @ 12.10 hrs, Volume= 0.185 af, Depth> 1.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 yr Rainfall=3.26"

Area (sf)	CN	Description
40,775	98	Paved parking, HSG A
20,350	39	>75% Grass cover, Good, HSG A
5,785	98	Roofs, HSG A
66,910	80	Weighted Average
20,350		30.41% Pervious Area
46,560		69.59% Impervious Area

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

Subcatchment P1: to Quinsigamond Ave



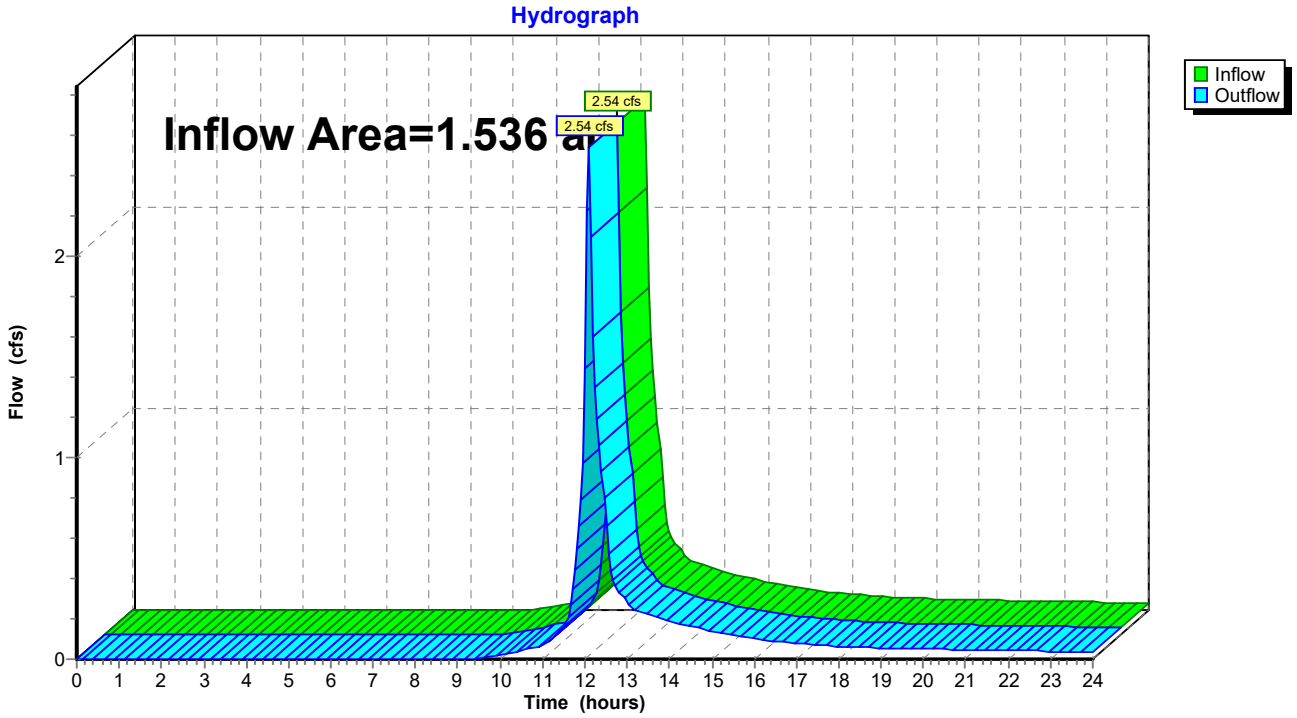
Summary for Reach DPP1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 69.59% Impervious, Inflow Depth > 1.45" for 2 yr event
Inflow = 2.54 cfs @ 12.10 hrs, Volume= 0.185 af
Outflow = 2.54 cfs @ 12.10 hrs, Volume= 0.185 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPP1: Quinsigamond Ave



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentP1: to QuinsigamondAve Runoff Area=66,910 sf 69.59% Impervious Runoff Depth>2.82"
Tc=6.0 min CN=80 Runoff=4.98 cfs 0.361 af

Reach DPP1: QuinsigamondAve Inflow=4.98 cfs 0.361 af
Outflow=4.98 cfs 0.361 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.361 af Average Runoff Depth = 2.82"
30.41% Pervious = 0.467 ac 69.59% Impervious = 1.069 ac

Summary for Subcatchment P1: to Quinsigamond Ave

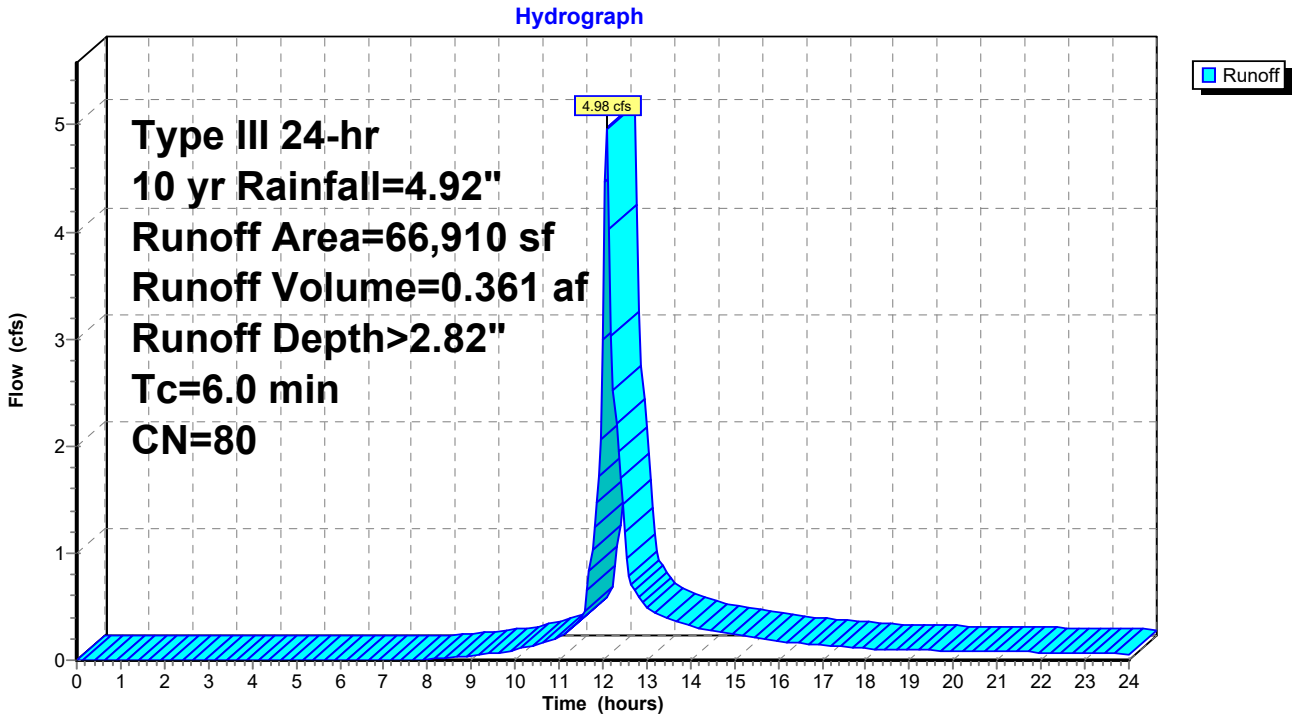
Runoff = 4.98 cfs @ 12.09 hrs, Volume= 0.361 af, Depth> 2.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 yr Rainfall=4.92"

Area (sf)	CN	Description
40,775	98	Paved parking, HSG A
20,350	39	>75% Grass cover, Good, HSG A
5,785	98	Roofs, HSG A
66,910	80	Weighted Average
20,350		30.41% Pervious Area
46,560		69.59% Impervious Area

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

Subcatchment P1: to Quinsigamond Ave



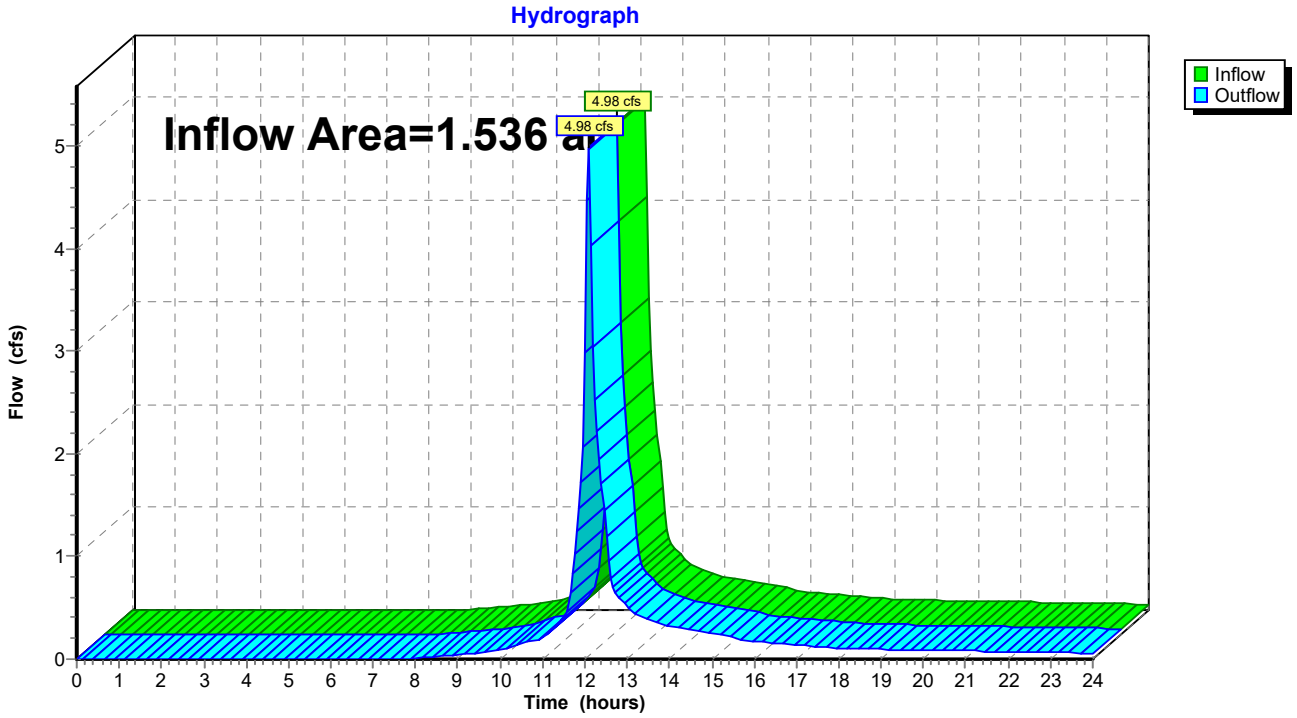
Summary for Reach DPP1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 69.59% Impervious, Inflow Depth > 2.82" for 10 yr event
Inflow = 4.98 cfs @ 12.09 hrs, Volume= 0.361 af
Outflow = 4.98 cfs @ 12.09 hrs, Volume= 0.361 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPP1: Quinsigamond Ave



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentP1: to QuinsigamondAve Runoff Area=66,910 sf 69.59% Impervious Runoff Depth>3.97"
Tc=6.0 min CN=80 Runoff=6.97 cfs 0.508 af

Reach DPP1: QuinsigamondAve Inflow=6.97 cfs 0.508 af
Outflow=6.97 cfs 0.508 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.508 af Average Runoff Depth = 3.97"
30.41% Pervious = 0.467 ac 69.59% Impervious = 1.069 ac

Summary for Subcatchment P1: to Quinsigamond Ave

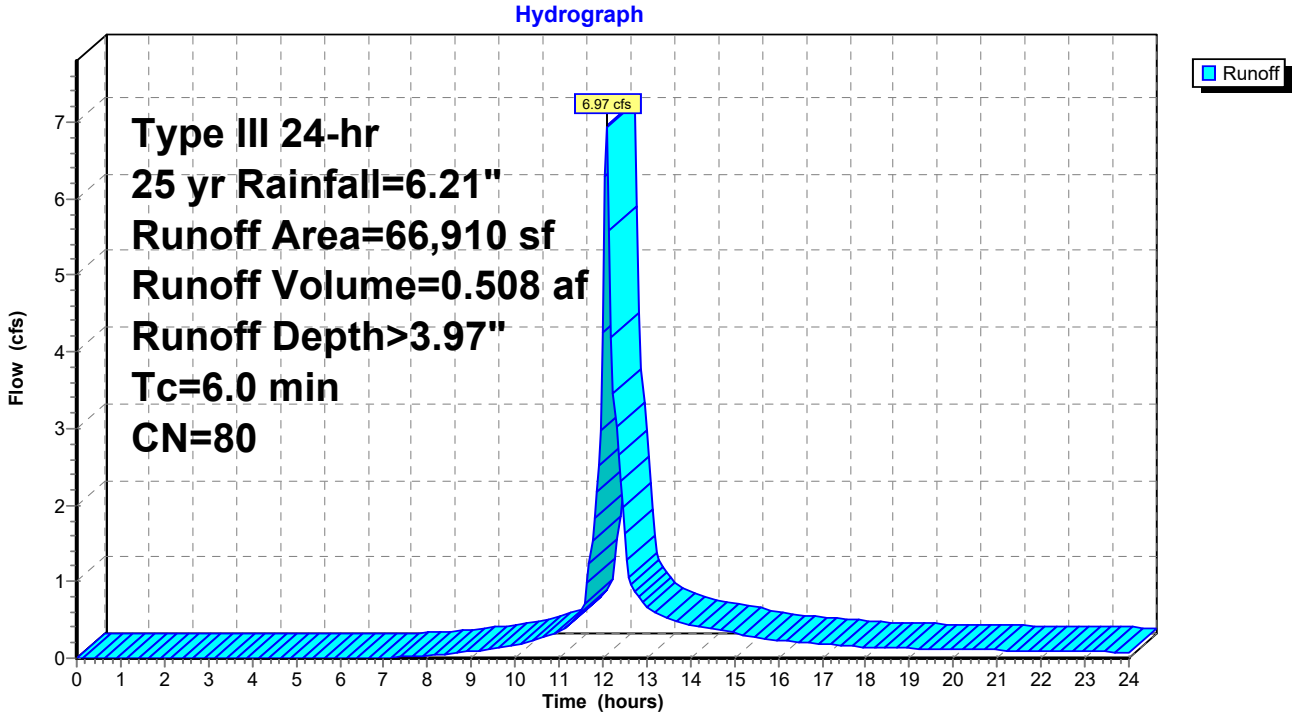
Runoff = 6.97 cfs @ 12.09 hrs, Volume= 0.508 af, Depth> 3.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 yr Rainfall=6.21"

Area (sf)	CN	Description
40,775	98	Paved parking, HSG A
20,350	39	>75% Grass cover, Good, HSG A
5,785	98	Roofs, HSG A
66,910	80	Weighted Average
20,350		30.41% Pervious Area
46,560		69.59% Impervious Area

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

Subcatchment P1: to Quinsigamond Ave



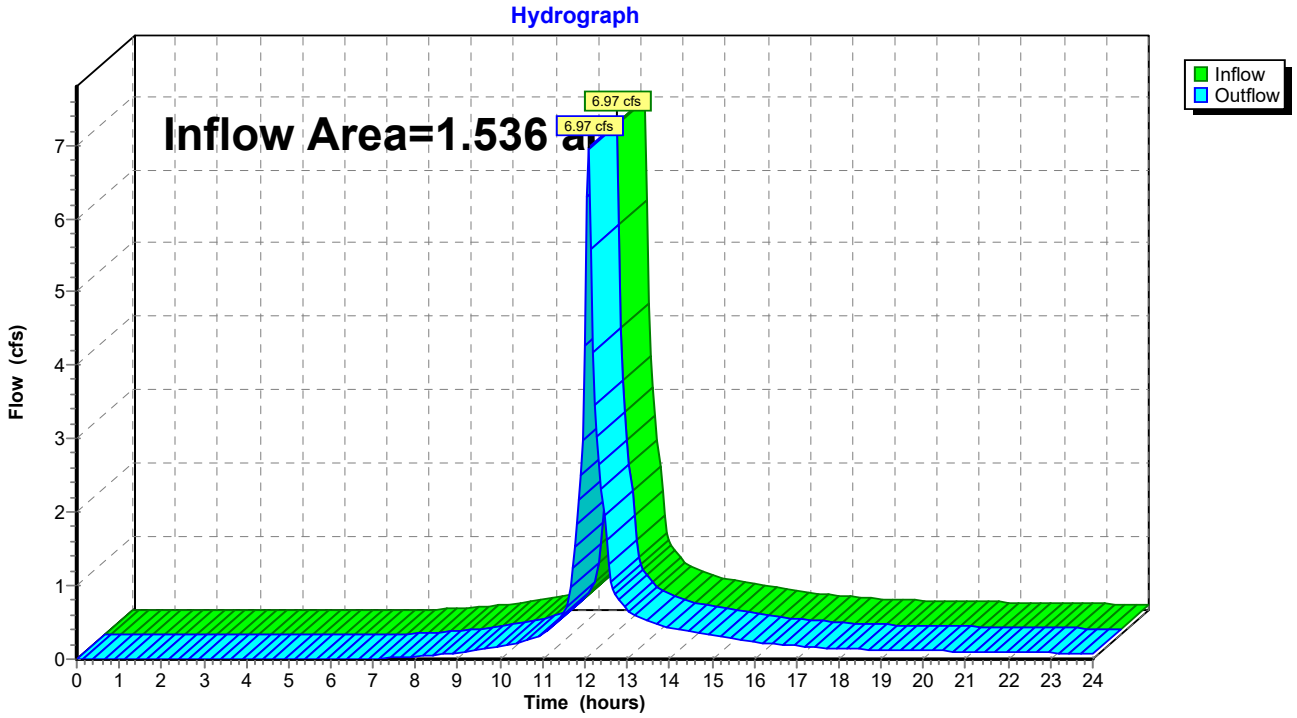
Summary for Reach DPP1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 69.59% Impervious, Inflow Depth > 3.97" for 25 yr event
Inflow = 6.97 cfs @ 12.09 hrs, Volume= 0.508 af
Outflow = 6.97 cfs @ 12.09 hrs, Volume= 0.508 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPP1: Quinsigamond Ave



Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

SubcatchmentP1: to QuinsigamondAve Runoff Area=66,910 sf 69.59% Impervious Runoff Depth>6.44"
Tc=6.0 min CN=80 Runoff=11.11 cfs 0.824 af

Reach DPP1: QuinsigamondAve Inflow=11.11 cfs 0.824 af
Outflow=11.11 cfs 0.824 af

Total Runoff Area = 1.536 ac Runoff Volume = 0.824 af Average Runoff Depth = 6.44"
30.41% Pervious = 0.467 ac 69.59% Impervious = 1.069 ac

Summary for Subcatchment P1: to Quinsigamond Ave

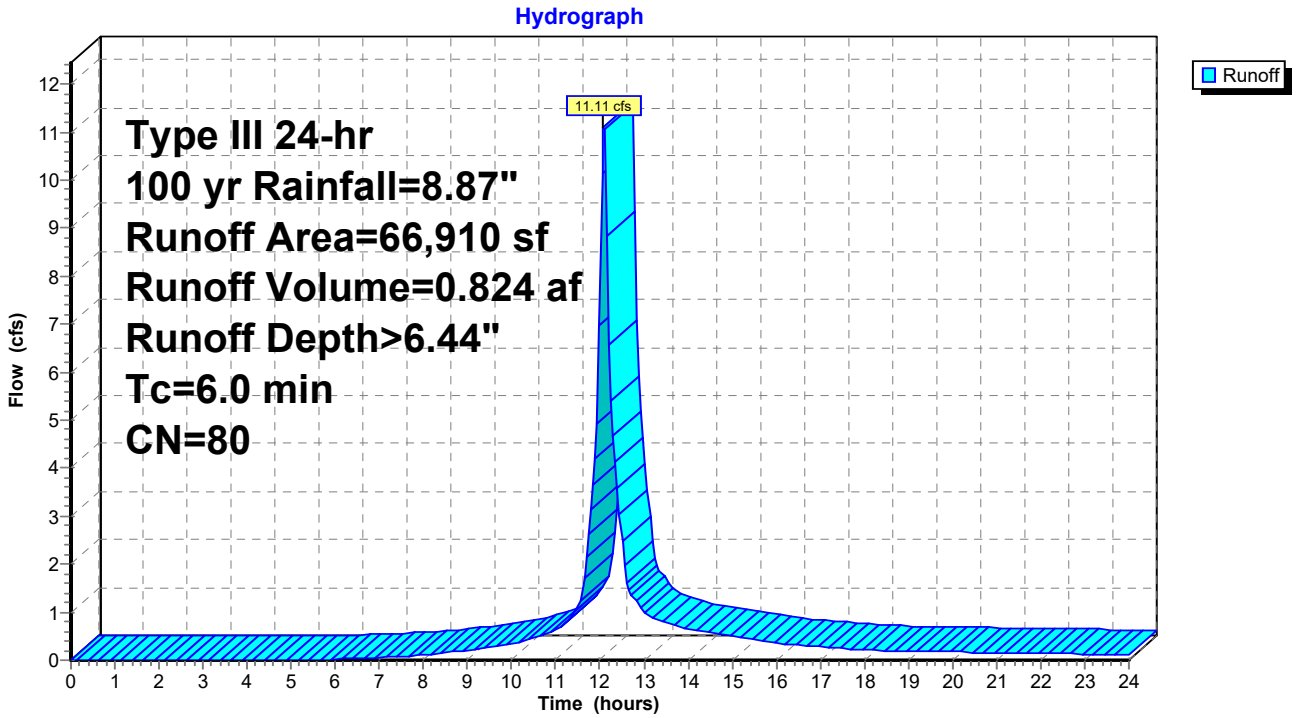
Runoff = 11.11 cfs @ 12.09 hrs, Volume= 0.824 af, Depth> 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 yr Rainfall=8.87"

Area (sf)	CN	Description
40,775	98	Paved parking, HSG A
20,350	39	>75% Grass cover, Good, HSG A
5,785	98	Roofs, HSG A
66,910	80	Weighted Average
20,350		30.41% Pervious Area
46,560		69.59% Impervious Area

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

Subcatchment P1: to Quinsigamond Ave



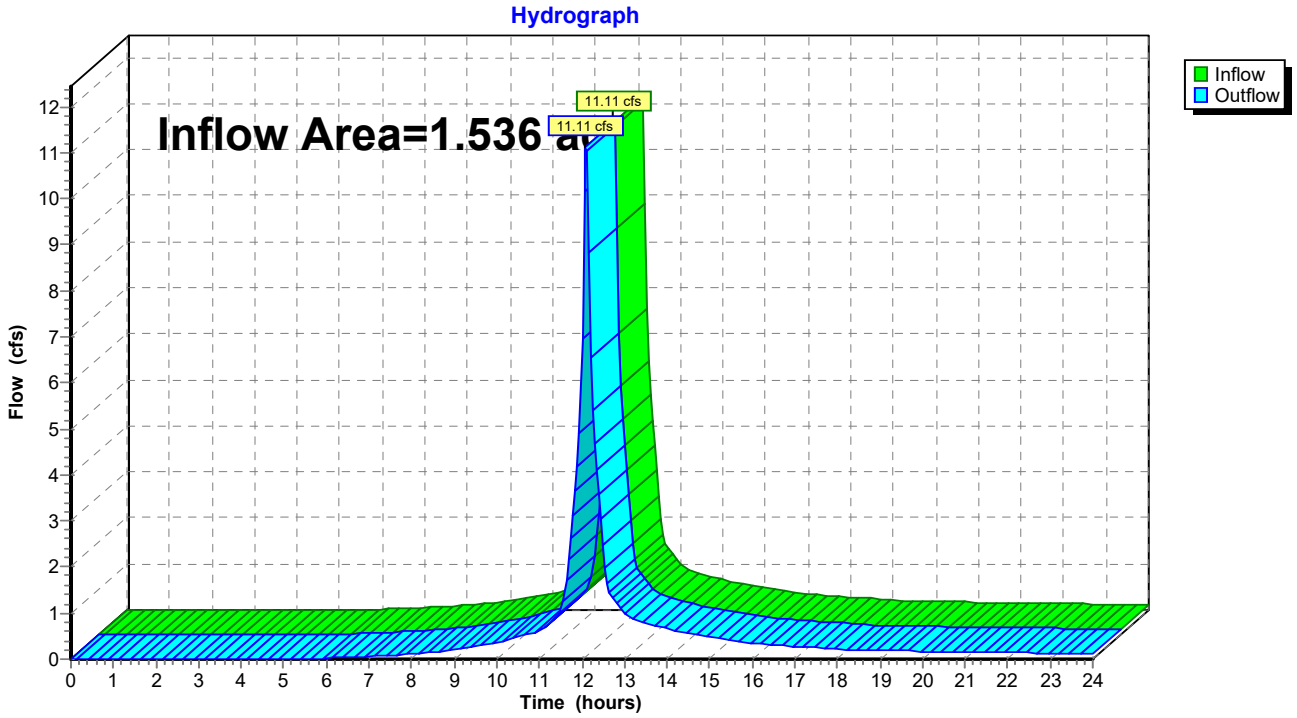
Summary for Reach DPP1: Quinsigamond Ave

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1.536 ac, 69.59% Impervious, Inflow Depth > 6.44" for 100 yr event
Inflow = 11.11 cfs @ 12.09 hrs, Volume= 0.824 af
Outflow = 11.11 cfs @ 12.09 hrs, Volume= 0.824 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Reach DPP1: Quinsigamond Ave



APPENDIX F: STORMWATER CALCULATIONS

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

Bohler Job #	W211067
Calc:	NPD
Date:	8/20/2021

1" Water Quality Volume to Flow Rate Calculation Sheet

This spreadsheet should be used to convert water quality volume to an equivalent water quality peak flow rate as outlined in the new MA DEP guidelines that take effect on October 15, 2013.

Glossary

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)

Compute Water Quality Flow with the following Equation

WQF = (qu)(A)(WQV)

Input Information (in colored cells only)

Site Plan Callout		Enter qu (from 1" - qu Table)	Enter Impervious Area (SF)	Ai (sq/mi)	WQV (inches)		WQF (cfs)	
DMH-6 (WQU)	=	774	39204	0.001406	1	=	**1.09**	CDS 2015 4

1" qu Sheet

	Tc (hours)	qu (csm/in)
	0.01	835
	0.03	835
	0.05	831
	0.067	814
5 Minutes	0.083	795
	0.1	774
	0.116	755
	0.133	736
	0.15	717
10 minutes	0.167	700
	0.183	685
	0.2	669
	0.217	654
	0.233	641
15 minutes	0.25	628
	0.3	593
	0.333	572
	0.35	563
	0.4	536
	0.416	528
	0.5	491
	0.583	460
	0.6	454
	0.667	433
	0.7	424
	0.8	398
	0.9	376
	1	356
	1.1	339
	1.2	323
	1.3	309
	1.4	296
	1.5	285
	1.6	274
	1.7	264
	1.8	255
	1.9	247
	2	239
	2.1	232
	2.2	225
	2.3	219
	2.4	213
	2.5	207
	2.6	202

Tc (hours)	qu (csm/in)
2.7	197
2.8	192
2.9	187
3	183
3.1	179
3.2	175
3.3	171
3.4	168
3.5	164
3.6	161
3.7	158
3.8	155
3.9	152
4	149
4.1	146
4.2	144
4.3	141
4.4	139
4.5	137
4.6	134
4.7	132
4.8	130
4.9	128
5	126
5.1	124
5.2	122
5.3	120
5.4	119
5.5	117
5.6	115
5.7	114
5.8	112
5.9	111
6	109
6.1	108
6.2	106
6.3	105
6.4	104
6.5	102
6.6	101
6.7	100
6.8	99
6.9	98
7	96

Tc (hours)	qu (csm/in)
7.1	95
7.2	94
7.3	93
7.4	92
7.5	91
7.6	90
7.7	89
7.8	88
7.9	87
8	86
8.1	85
8.2	84
8.3	84
8.4	83
8.5	82
8.6	81
8.7	80
8.8	79
8.9	79
9	78
9.1	77
9.2	76
9.3	76
9.4	75
9.5	74
9.6	74
9.7	73
9.8	72
9.9	72
10	71

*Table of qu values for Ia/P Curve =0.034, listed by Tc, for Type III Storm Distribution

http://www.mass.gov/eea/docs/dep/water/resources/07v5/13wqvwqf.pdf

Available Models

Model to be Used

CDS Model	Typical Internal MH Diameter or Equivalent ID[1] (ft)	Typical Depth[2] Below Pipe Invert (ft)	Treatment Capacity[3] (cfs)	Screen Diameter/ Height (ft)	Maximum Sediment Storage Capacity (CF)
2015_4	4	4.5	1.4	2.0/1.5	50
w/ 1' added sump	4	5.5	1.4	2.0/1.5	63
w/ 2' added sump	4	6.5	1.4	2.0/1.5	75
w/ 3' added sump	4	7.5	1.4	2.0/1.5	88
2015	5	4.7	1.4	2.0/1.5	79
w/ 1' added sump	5	5.7	1.4	2.0/1.5	98
w/ 2' added sump	5	6.7	1.4	2.0/1.5	118
2020	5	5.3	2.2	2.0/2.0	90
w/ 1' added sump	5	6.3	2.2	2.0/2.0	110
w/ 2' added sump	5	7.3	2.2	2.0/2.0	129
2025	5	5.6	3.2	2.0/2.5	97
w/ 1' added sump	5	6.6	3.2	2.0/2.5	117
w/ 2' added sump	5	7.6	3.2	2.0/2.5	136
3020	6	5.4	3.9	3.0/2.0	134
w/ 1' added sump	6	6.4	3.9	3.0/2.0	163
w/ 2' added sump	6	7.4	3.9	3.0/2.0	191
3030	6	6.2	6.1	3.0/3.0	157
w/ 1' added sump	6	7.2	6.1	3.0/3.0	185
w/ 2' added sump	6	8.2	6.1	3.0/3.0	213
4030	8	7.2	7.9	4.0/3.0	329
w/ 1' added sump	8	8.2	7.9	4.0/3.0	379
w/ 2' added sump	8	9.2	7.9	4.0/3.0	429
4040	8	8.3	12.4	4.0/4.0	381
w/ 1' added sump	8	9.3	12.4	4.0/4.0	431
w/ 2' added sump	8	10.3	12.4	4.0/4.0	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	Sediment Depth (in.)
2015_4	18"
2015	18"
2020	18"
2025	18"
3020	18"
3030	18"
4030	27"
4040	27"
Every 1' of added sump depth	Add 9"

* Based on 75% capacity of isolated sump.

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TSS Removal Calculation Worksheet

Location: to Existing Drainage System

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
CB (Deep Sump)	**0.25**	**1.00**	**0.25**	**0.75**
Water Quality Unit	**0.80**	**0.75**	**0.60**	**0.15**

Total TSS Removal = **85%**

Project: **75 Quinsigamond Avenue**
Prepared By: **Bohler**
Date: **8/20/2021**

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

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

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	71.799 degrees West
Latitude	42.256 degrees North
Elevation	0 feet
Date/Time	Mon, 21 Jun 2021 12:06:03 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.27	0.42	0.52	0.68	0.85	1.08	**1yr**	0.74	1.06	1.26	1.61	2.06	2.66	2.89	**1yr**	2.36	2.78	3.19	3.89	4.49	**1yr**
2yr	0.35	0.53	0.67	0.88	1.10	1.40	**2yr**	0.95	1.27	1.62	2.04	2.58	3.26	3.50	**2yr**	2.89	3.37	3.87	4.58	5.22	**2yr**
5yr	0.41	0.64	0.80	1.07	1.37	1.74	**5yr**	1.18	1.58	2.03	2.58	3.26	4.12	4.45	**5yr**	3.65	4.28	4.90	5.74	6.46	**5yr**
10yr	0.46	0.72	0.91	1.24	1.61	2.07	**10yr**	1.39	1.86	2.42	3.08	3.89	4.92	5.34	**10yr**	4.35	5.13	5.87	6.81	7.59	**10yr**
25yr	0.54	0.85	1.09	1.50	1.99	2.59	**25yr**	1.72	2.31	3.04	3.88	4.93	6.21	6.79	**25yr**	5.50	6.53	7.44	8.54	9.40	**25yr**
50yr	0.60	0.96	1.24	1.73	2.34	3.08	**50yr**	2.02	2.72	3.64	4.65	5.90	7.42	8.16	**50yr**	6.57	7.85	8.91	10.13	11.06	**50yr**
100yr	0.69	1.11	1.43	2.03	2.76	3.65	**100yr**	2.38	3.21	4.32	5.55	7.04	8.87	9.81	**100yr**	7.85	9.43	10.68	12.03	13.00	**100yr**
200yr	0.77	1.26	1.64	2.35	3.25	4.34	**200yr**	2.80	3.79	5.15	6.63	8.42	10.60	11.79	**200yr**	9.38	11.34	12.80	14.29	15.29	**200yr**
500yr	0.92	1.52	1.98	2.88	4.04	5.45	**500yr**	3.49	4.71	6.49	8.39	10.67	13.43	15.07	**500yr**	11.89	14.49	16.27	17.95	18.97	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.20	0.31	0.38	0.51	0.63	0.96	**1yr**	0.54	0.94	1.10	1.46	1.90	2.40	2.52	**1yr**	2.12	2.42	2.94	3.56	4.16	**1yr**
2yr	0.34	0.53	0.65	0.88	1.08	1.26	**2yr**	0.93	1.23	1.44	1.89	2.43	3.15	3.39	**2yr**	2.79	3.26	3.72	4.43	5.05	**2yr**
5yr	0.38	0.59	0.73	1.00	1.28	1.50	**5yr**	1.10	1.47	1.71	2.24	2.86	3.78	4.10	**5yr**	3.35	3.95	4.51	5.29	5.94	**5yr**
10yr	0.42	0.65	0.81	1.13	1.45	1.71	**10yr**	1.26	1.68	1.94	2.54	3.23	4.32	4.72	**10yr**	3.82	4.54	5.19	6.04	6.70	**10yr**
25yr	0.49	0.74	0.93	1.32	1.74	2.04	**25yr**	1.50	2.00	2.30	3.01	3.82	5.14	5.68	**25yr**	4.55	5.47	6.22	7.19	7.86	**25yr**
50yr	0.54	0.83	1.03	1.48	2.00	2.33	**50yr**	1.72	2.27	2.62	3.42	4.33	5.86	6.53	**50yr**	5.18	6.28	7.12	8.20	8.87	**50yr**
100yr	0.61	0.92	1.15	1.67	2.29	2.65	**100yr**	1.97	2.59	2.98	3.89	4.92	6.64	7.50	**100yr**	5.88	7.22	8.14	9.34	9.99	**100yr**
200yr	0.68	1.03	1.30	1.88	2.62	3.04	**200yr**	2.26	2.97	3.39	4.44	5.60	7.55	8.61	**200yr**	6.68	8.28	9.30	10.62	11.25	**200yr**
500yr	0.80	1.19	1.53	2.22	3.15	3.64	**500yr**	2.72	3.56	4.03	5.30	6.67	8.91	10.29	**500yr**	7.89	9.90	11.06	12.61	13.15	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.31	0.47	0.58	0.78	0.96	1.18	**1yr**	0.83	1.15	1.37	1.74	2.29	2.92	3.14	**1yr**	2.59	3.02	3.55	4.17	4.82	**1yr**
2yr	0.36	0.56	0.68	0.93	1.14	1.34	**2yr**	0.99	1.31	1.54	2.01	2.57	3.41	3.65	**2yr**	3.02	3.51	4.05	4.77	5.44	**2yr**
5yr	0.44	0.67	0.83	1.14	1.46	1.75	**5yr**	1.26	1.71	2.01	2.57	3.24	4.46	4.84	**5yr**	3.95	4.66	5.31	6.23	7.09	**5yr**
10yr	0.51	0.78	0.97	1.36	1.75	2.13	**10yr**	1.51	2.09	2.45	3.10	3.87	5.50	6.03	**10yr**	4.87	5.80	6.60	7.66	8.67	**10yr**
25yr	0.63	0.96	1.19	1.70	2.24	2.78	**25yr**	1.94	2.72	3.18	3.94	4.89	7.28	8.08	**25yr**	6.44	7.77	8.79	10.05	11.32	**25yr**
50yr	0.74	1.12	1.40	2.01	2.71	3.40	**50yr**	2.34	3.32	3.89	4.75	5.83	9.01	10.10	**50yr**	7.98	9.72	10.94	12.37	13.87	**50yr**
100yr	0.87	1.32	1.65	2.38	3.27	4.16	**100yr**	2.82	4.06	4.76	5.72	6.97	11.17	12.66	**100yr**	9.89	12.17	13.63	15.24	17.00	**100yr**
200yr	1.03	1.55	1.96	2.83	3.95	5.09	**200yr**	3.41	4.98	5.83	6.88	8.32	13.86	15.88	**200yr**	12.27	15.27	16.98	18.79	20.86	**200yr**
500yr	1.28	1.91	2.46	3.57	5.07	6.66	**500yr**	4.38	6.51	7.62	8.79	10.50	18.42	21.47	**500yr**	16.30	20.65	22.73	24.80	27.37	**500yr**

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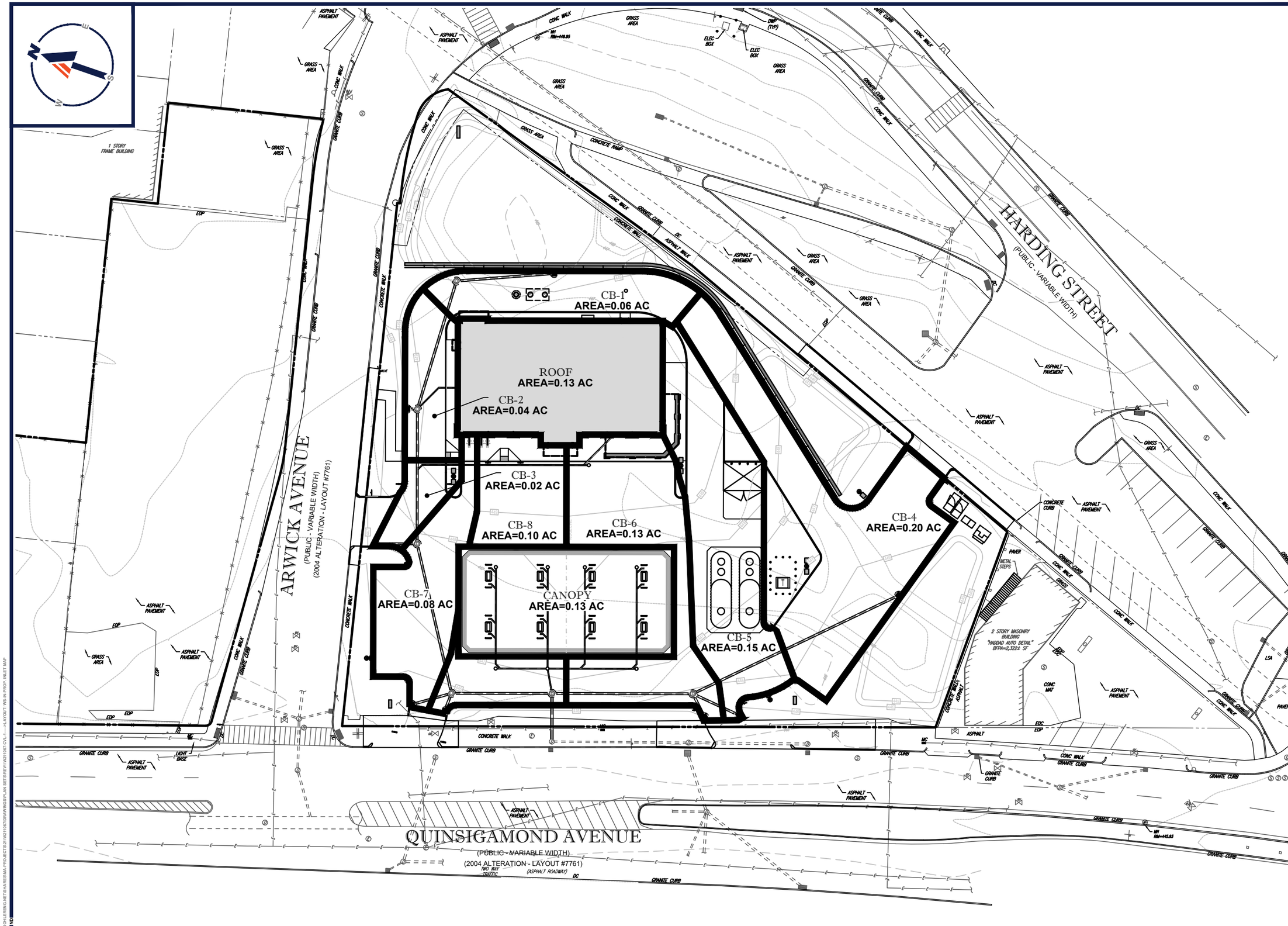
Northeast Regional Climate Center



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REVISIONS

REV	DATE	COMMENT	DRAWN BY / CHECKED BY
1	10/25/21	ZBA AND PLANNING BOARD SUBMISSION	NPD / RMM

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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.:	W211067
DRAWN BY:	NPD
CHECKED BY:	RMM
DATE:	08/20/2021
CAD I.D.:	W211067-CVL-0

PROJECT:

PROPOSED SITE PLAN DOCUMENTS

FOR

TPG DEVELOPMENT AND CONSTRUCTION

PROPOSED
GAS STATION AND
CONVENIENCE STORE

MAP #5, BLOCK #23,
LOTS #68-70, 72, 76, 93
75 QUINSIGAMOND AVENUE
CITY OF WORCESTER
WORCESTER COUNTY,
MASSACHUSETTS

BOHLER

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

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SHEET TITLE:

PROPOSED INLET WATERSHED MAP

SHEET NUMBER:

WS-IN

REVISION 1 - 10/25/21

\\BOHLERENG.NET\934\BESMA-PROJECTS\211067\DRAWING\PLAN SET\BRV\W211067-CVL-1----LAYOUT: WS-IN-PROP. INLET MAP

Gas Station and Convenience Store
75 Quinsigamond Avenue
Worcetser, MA
Bohler Job Number: W211067
October 25, 2021

Rational Pipe Sizing Calculations

Design Period Storm:		25	Year	Design Period Intensity*			6.2	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-1	DMH-1	0.06	0.95	0.06	0.00	0.30	0.00	0.06	6	6.2	0.35	12	0.005	HDPE	0.012	2.73	3.47
DMH-1	DMH-2	0.06	0.95	0.06	0.00	0.30	0.00	0.06	6	6.2	0.35	12	0.005	HDPE	0.012	2.73	3.47
CB-2	DMH-2	0.04	0.95	0.04	0.00	0.30	0.00	0.04	6	6.2	0.24	12	0.020	HDPE	0.012	5.46	6.95
ROOF	DMH-2	0.13	0.95	0.12	0.00	0.30	0.00	0.12	6	6.2	0.77	6	0.020	HDPE	0.012	0.86	4.38
DMH-2	DMH-3	0.23	0.95	0.22	0.00	0.30	0.00	0.22	6	6.2	1.35	12	0.005	HDPE	0.012	2.73	3.47
CB-3	DMH-3	0.02	0.95	0.02	0.00	0.30	0.00	0.02	6	6.2	0.12	12	0.005	HDPE	0.012	2.73	3.47
DMH-3	DMH-4	0.25	0.95	0.24	0.00	0.30	0.00	0.24	6	6.2	1.47	12	0.019	HDPE	0.012	5.32	6.77
CB-7	DMH-4	0.08	0.95	0.08	0.00	0.30	0.00	0.08	6	6.2	0.47	12	0.008	HDPE	0.012	3.45	4.40
CB-8	DMH-4	0.10	0.95	0.10	0.00	0.30	0.00	0.10	6	6.2	0.59	12	0.005	HDPE	0.012	2.73	3.47
DMH-4	DMH-6	0.43	0.95	0.41	0.00	0.30	0.00	0.41	6	6.2	2.53	12	0.006	HDPE	0.012	2.99	3.81
CANOPY	DMH-6	0.13	0.95	0.12	0.00	0.30	0.00	0.12	6	6.2	0.77	6	0.020	HDPE	0.012	0.86	4.38
CB-4	DMH-5	0.18	0.95	0.17	0.02	0.30	0.01	0.18	6	6.2	1.10	12	0.006	HDPE	0.012	2.99	3.81
CB-5	DMH-5	0.14	0.95	0.13	0.01	0.30	0.00	0.14	6	6.2	0.84	12	0.005	HDPE	0.012	2.73	3.47
CB-5	DMH-5	0.01	0.95	0.01	0.00	0.30	0.00	0.01	6	6.2	0.08	12	0.013	HDPE	0.012	4.40	5.60
DMH-5	DMH-6	0.33	0.95	0.32	0.03	0.30	0.01	0.33	6	6.2	2.02	12	0.005	HDPE	0.012	2.73	3.47
DMH-6	EXIST. DMH	0.89	0.95	0.85	0.03	0.30	0.01	0.86	6	6.2	5.32	15	0.009	HDPE	0.012	6.64	5.41

*Rainfall intensity provided by NOAA ATLAS

Prepared By:
Bohler Engineering
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*

STORMWATER OPERATION AND MAINTENANCE PLAN

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

RESPONSIBLE PARTY POST CONSTRUCTION:

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

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). 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 and on-site driveways: Sweep at least four (4) times per year and on a more frequent basis depending on sanding operations. All resulting sweepings shall be collected and properly disposed of off-site in accordance with MADEP and other applicable requirements.

2. Catch basins, area drains, manholes and piping: Inspect four (4) times per year and at the end of foliage and snow-removal seasons. These features shall be cleaned four (4) 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.

3. Water Quality Unit (Proprietary Separator): Follow manufacturer's recommendations (attached). The owner shall be provided with a copy of the approved Stormwater Operation and Maintenance Plan that shall include a copy of the manufacturers recommended maintenance procedures for the water quality unit

STORMWATER MANAGEMENT SYSTEM

POST-CONSTRUCTION INSPECTION REPORT

LOCATION:

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

RESPONSIBLE PARTY:

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

NAME OF INSPECTOR:	INSPECTION DATE:
Note Condition of the Following (sediment depth, debris, standing water, damage, etc.):	
Catch Basins:	
Discharge Points/ Flared End Sections / Rip Rap:	
Water Quality Units:	
Other:	
Note Recommended Actions to be taken on the Following (sediment and/or debris removal, repairs, etc.):	

Catch Basins:
Discharge Points / Rip Rap:
Water Quality Units:
Other:
Other:
Comments:

STORMWATER INSPECTION AND MAINTENANCE LOG FORM			
TPG Development and Construction ***75 Quinsigamond Avenue – Worcester, MA***			
Stormwater Management Practice	Responsible Party	Date	Maintenance Activity Performed

LONG-TERM POLLUTION PREVENTION PLAN

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

RESPONSIBLE PARTY DURING CONSTRUCTION:

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

RESPONSIBLE PARTY POST CONSTRUCTION:

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

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

- No outdoor maintenance or washing of vehicles allowed.
- 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 driveways 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.
- Trash and other debris shall be removed from all areas of the site at least twice yearly.
- In no case shall snow be disposed of or stored in resource areas (wetlands, floodplain, streams or other water bodies).
- If necessary, stockpiled snow will be removed from the Site and disposed of at an off-site location in accordance with all local, state and federal regulations.

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

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

TPG Development and Construction
75 Quinsigamond Avenue
Worcester, MA

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 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 Board of Health at (508) 799-8531 and the Conservation Commission.

4. Provide documentation from licensed contractor showing disposal and cleanup procedures were completed as well as details on chemicals that were spilled to the City of Worcester Board of Health 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 AGENCYPHONE: (888) 372-7341

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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.

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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.