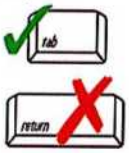
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

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.

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[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.

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Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

2-26-2024

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☒ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

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Stormwater Management Standard #1
Computations to show that discharges will not cause scour or erosion

All captured stormwater runoff at this site will be directed through a CDS stormwater filtration unit and then into the infiltration structure under the parking lot and playground area. That structure will have four discharge pipes, two 10" HDPE pipes and two 15" HDPE pipes that, in the 25 year storm will discharge 14.75 cfs.

From the Connecticut Drainage Manual, attached, using an equivalent single pipe size of 30"diameter (which has slightly more cross-sectional area than those 4 pipes added together) and using Tale 11-12.1, we are prescribed a riprap apron 15 feet long and that is the length of riprap apron we are providing after the stone lined scour hole immediately below the headwall outlet.

11.13 Outlet Protection

11.13.1 Assessment of Erosion Potential

A field investigation of all proposed outlet locations or existing outlets to be used in a drainage design of a proposed project should be conducted to determine the erosion resistance of the soils at the outlet, the character of the downstream flow path, and any other site constraints that must be addressed by the proposed design.

Barring any unusual conditions, as determined during the field investigation, the criteria outlined in this section should be used to determine the level of outlet protection required. When severe conditions are present, it is the responsibility of the designer to provide outlet protection as needed to safeguard against erosion damage.

Pipe outlets are points of critical erosion potential. Stormwater which is transported through closed conveyance systems at design capacity generally reaches a velocity which exceeds the permissible or erosion resistant velocity of the receiving channel or overland area. To prevent scour at stormwater system outlets, a flow transition structure is needed which will absorb the initial impact of the flow and reduce the flow velocity to a level which will not erode the receiving channel or overland area.

11.13.2 Types of Outlet Protection

The most commonly used device for outlet protection is a riprap lined apron. Where practical, they are constructed at a zero grade or minimum slope to slow the outlet velocity. The type and length of the riprap lined apron is related to the outlet flow rate and the tailwater level and whether there is a defined channel downstream.

If the tailwater depth is less than half the outlet pipe rise, it shall be classified as a **Minimum Tailwater Condition**. If the tailwater depth is greater than or equal to half the outlet pipe rise, it shall be classified as a **Maximum Tailwater Condition**.

There are three types of riprap aprons to be used for outlet protection. They are designated as Type A, B and C. Type A riprap aprons would be used under minimum tailwater conditions while Type B riprap aprons would be used for maximum tailwater conditions as defined above, where the pipe outlets overland with no defined channel. Type C riprap aprons would be used when there is a well defined channel downstream of the outlet. The use of a Type C riprap apron on channels that are designated as watercourses or wetlands is discouraged due to potential wetland and fisheries impacts. See Section 11.13.3, Design Criteria, and Section 11.13.5 for the design of riprap aprons.

Where the flow rate proves to be excessive for the economical or practical use of an apron, preformed scour holes may be used. There are two types of preformed scour holes. Type 1 preformed scour holes are depressed one-half the pipe rise and Type 2 preformed scour holes are depressed the full pipe rise. See Section 11.13.3, Design Criteria and Section 11.13.6 for the design of preformed scour holes.

In most cases, a riprap apron or preformed scour hole will provide adequate outlet protection, however where design and site conditions warrant, structurally lined outlet protection or energy dissipators can be investigated. In such instances, coordination with the Hydraulics and Drainage Section early in the design phase is recommended. The design of energy dissipators is presented in HEC-14, "Hydraulic Design of Energy Dissipators For Culverts and Channels."

11.13.3 Design Criteria

The design of riprap outlet protection applies to the immediate area or reach downstream of the pipe outlet and does not apply to continuous rock linings of channels or streams. For pipe outlets at the top of exit slopes or on slopes greater than 10%, the designer should assure that suitable safeguards are provided beyond the limits of the localized outlet protection to counter the highly erosive velocities caused by the reconcentration of flow beyond the initial riprap apron. Outlet protection shall be designed according to the following criteria:

- Riprap outlet protection shall be used at all outlets not flowing over exposed rock or into deep watercourses and ponds.
- In situations not covered by the above noted criteria and where the exit velocity is ≤ 4.27 mps (14 fps), a riprap apron shall also be used. For Type A and B riprap aprons, the type of riprap specified is dependent on the outlet velocity (see Section 11.13.6) and can be determined from Table 11.5. For Type C aprons, the type of riprap specified is determined by the procedures in HEC-15 and HEC-11 depending on the design discharge. See Chapter 7, Channels.
- The type of riprap apron and dimensions are determined by the guidelines outlined in Sections 11.13.2 and 11.13.5, respectively.
- When the outlet velocity is > 4.27 mps (14 fps), the designer should first investigate methods to reduce the outlet velocity. This may be accomplished by any one or combination of the following: increasing the pipe roughness, increasing the pipe size and/or decreasing the culvert slope. When this is not possible or economical, a number of outlet protection or energy dissipation design options are available. These are presented in detail in HEC-14. In most instances, however, a preformed scour hole design should be used, as it generally can provide the necessary degree of protection at an economical cost. The design of a preformed scour hole is presented in Section 11.13.6.

The design criteria of this section should be applicable to most outlet situations. However, recognizing that design and site conditions can vary significantly depending on the project or location on a particular project, it is the responsibility of the designer to ensure that the criteria is suitable to the site or to provide an alternate design which will adequately protect the outlet area from scour and erosion. These situations should be documented in the drainage design report.

Table 11.11 Allowable Outlet Velocities for Type A and B Riprap Aprons

Outlet Velocity - mps (fps)	Riprap Specification
0-2.44 (0-8)	Modified
2.44-3.05 (8-10)	Intermediate
3.05-4.27 (10-14)	Standard

11.13.4 Tailwater Depth

The depth of tailwater immediately at the pipe outlet is required for the design of outlet protection and must be determined for the design flow rate. Manning's equation may be used to determine tailwater depth. See Sections 8.3.5 and 8.3.6 for additional information on how to determine the tailwater depth.

11.13.5 Apron Dimensions

Length

The length of an apron (L_a) is determined using the following empirical relationships (Equations 11.9 and 11.10) that were developed for the U.S. Environmental Protection Agency (1976) and modified by ConnDOT for use in Connecticut. Tables 11-12 and 11-13 show the various lengths of Type A, B and C riprap aprons based on discharge and pipe size. The tables also show the minimum and maximum lengths of aprons to be computed using Equations 11.31 and 11.32. When the table indicates that the required apron length would exceed the maximum shown, a preformed scour hole should be used in lieu of the riprap apron. As previously stated, the design of a preformed scour hole is presented in Section 11.13.6.

Type A Riprap Apron (Minimum Tailwater Condition) TW < 0.5 R_p

$$L_a = \frac{3.26(Q-0.142)}{S_P^{1.5}} + 3.05 \qquad \left(L_a = \frac{1.80(Q-5)}{S_P^{1.5}} + 10 \right) \tag{11.31}$$

Type B Apron (Maximum Tailwater Condition) TW ≥ 0.5 R_p

$$L_a = \frac{5.44(Q-0.142)}{S_P^{1.5}} + 3.05 \qquad \left(L_a = \frac{3.0(Q-5)}{S_P^{1.5}} + 10 \right) \tag{11.32}$$

Type C Riprap Apron - The length of a Type C Riprap Apron shall be determined using the formula for a Type B Riprap Apron.

L_a = length of apron, m (ft)
S_p = inside diameter for circular sections or maximum inside pipe span for non-circular sections, m (ft)
Q = pipe (design) discharge, cms (cfs)
TW = tailwater depth, m (ft)
R_p = maximum inside pipe rise, m (ft)
Note: $S_p = R_p$ = inside diameter for circular sections

Width

For Type A or B Riprap Aprons, when there is no well defined channel downstream of the apron, the width of the apron at the pipe outlet, W_1, should be at least three times the maximum inside pipe span and the width, W_2 of the outlet end of the apron, as shown in Figure 11-13, should be as follows:

Type A Riprap Apron (Minimum Tailwater Condition)

$W_1 = 3S_p$ (min.)

$W_2 = 3S_p + 0.7L_a$ for TW < 0.5 R_p (11.33)

and

Type B Riprap Apron (Maximum Tailwater Condition)

$W_1 = 3S_p$ (min.)
$W_2 = 3S_p + 0.4L_a$ for $TW \geq 0.5\ R_p$ **(11.34)**

W_1 =width of apron at pipe outlet or upstream apron limit
W_2 =width of apron at terminus or downstream apron limit

Type C Riprap Apron

For a Type C Riprap Apron when there is a well defined channel downstream of the outlet, the bottom width of the apron should be at least equal to the bottom width of the channel and the lining should extend on the channel side slopes at least 0.3m (1 ft) above the tailwater depth (TW) or at least two-thirds of the vertical conduit dimension (0.7 R_p) above the invert, whichever is greater. (In all cases, the overall width of the apron shall be a minimum of $3S_p$). See Figure 11-13.

Additional guidelines:

- The type of apron to be used and length should be called out on the construction plans.
- The side slopes of the Type C riprap apron should be 2H:1V or flatter.
- The bottom grade should be level or minimum slope, where practical, for energy dissipation. Where the use of a flat apron is impractical, a preformed scour hole should be considered.
- Granular fill shall be placed between the riprap and the underlying soil to prevent soil movement into and through the riprap. Additionally, an appropriately sized geotextile (separation) can be used when field conditions dictate as determined by the engineer.
- The location of outlets and outlet protection should be carefully considered to minimize rights-of-way and wetland impacts.

11.13.6 Preformed Scour Hole

The preformed scour hole is an excavated hole or depression which is lined with rock riprap of a stable size to prevent scouring. The depression (F) provides both vertical and lateral expansion downstream of the culvert outlet to permit dissipation of excessive energy and turbulence. Equations 11.35 and 11.36 are used to determine the median stone size (d_{50}) required for the lining of the two types of preformed scour holes presented below. The first type, Type 1, represented by Equation 11.35, is depressed one-half the pipe rise and the second type, Type 2, represented by Equation 11.36, is depressed the full pipe rise. A significant reduction in stone size is achieved by the excavation. Therefore, the scour hole depressed the full pipe rise would require a smaller stone size, however the dimensions of the hole would be larger. The type that provides the most economical and practical design given the site conditions should be selected. The dimensions of a preformed scour hole are determined by the set of Equations 11.37 and Figure 11-15.

Empirical Preformed Scour Hole Equations:

Type 1: Scour Hole Depression = one-half pipe rise, m (ft)

$$d_{50} = (0.0276\ R_p^{\ 2}/TW)\ (Q/R_p^{\ 2.5})^{1.333} \quad (\ d_{50} = (0.0125 R_p^{\ 2}/TW)\ (Q/R_p^{\ 2.5})^{1.333}\ ) \qquad \textbf{(11.35)}$$

Type 2: Scour Hole Depression = full pipe rise, m (ft)

$$d_{50} = (0.0181\ R_p^{\ 2}/TW)\ (Q/R_p^{\ 2.5})^{1.333} \quad (d_{50} = (0.0082 R_p^{\ 2}/TW)\ (Q/R_p^{\ 2.5})^{1.333}) \qquad \textbf{(11.36)}$$

d_{50} = median stone size required, m (ft)

For variables S_p, R_p, TW and Q, see Section 11.13.5.

Type 1 and 2 preformed scour hole dimensions (See Figure 11-15)

$C = 3S_p + 6F$ Basin Length m (ft)
$B = 2S_p + 6F$ Basin Inlet and Outlet Width m (ft) **(11.37)**
$F = 0.5R_p$ (Type 1) or R_p (Type 2) Basin Depression m (ft)

Table 11-14 solves the above set of equations for Type 1 and 2 preformed scour holes for various pipe sizes.

The type of riprap required is as follows:

Modified	$d_{50} < 0.13$m (0.42 ft)
Intermediate	0.13m (0.42 ft) $< d_{50} <$ 0.20m (0.67 ft)
Standard	0.20m (0.67 ft) $< d_{50} <$ 0.38m (1.25 ft)
Special Design	0.38m (1.25 ft) $< d_{50}$

Reference: Report No. FHWA-RD-75-508 ("Culvert Outlet Protection Design: Computer Program Documentation")

OUTLET PROTECTION - OUTLET VELOCITY ≤ 4.27 meters/sec

DISCHARGE (cms)	OUTLET PIPE DIAMETER OR SPAN (mm)									
	300	375	450	600	750	900	1050	1200	1350	1500
0-0.142	***3.0***	***3.0***		***USE***						
0.170	3.6	3.4								
0.180		3.6	***3.5***							
0.190		3.7	3.6			***MINIMUM***				
0.210		4.0	3.8	***3.5***						
0.250		4.5	4.2	3.8						
0.275			4.5	4.0						
0.300			4.7	4.1				***LENGTH***		
0.325			5.0	4.3						
0.340				4.4	***4.0***					
0.350				4.5	4.1					
0.400		***USE***		4.8	4.3	***4.0***			***OUTLINED***	
0.450				5.2	4.6	4.2	***4.0***			
0.500				5.5	4.8	4.4	4.1			
0.550					5.0	4.6	4.3	***4.0***		
0.600					5.3	4.8	4.4	4.2		
0.650					5.5	4.9	4.6	4.3		
0.800			***PREFORMED***			5.5	5.0	4.6		
0.940						6.0	5.4	5.0		
1.000							5.6	5.1		
1.100							5.9	5.4	***5.0***	
1.250							6.3	5.7	5.3	***5.0***
1.300							6.5	5.9	5.4	5.1
1.500					***SCOUR***			6.3	5.8	5.4
1.700								6.8	6.2	5.7
1.900								7.3	6.6	6.1
2.200								8.0	7.2	6.6
2.500									7.8	7.1
2.850									8.5	7.7
3.250							***HOLE***			8.4
3.600										9.0

Table 11-12 - Length - L_a (meters)
Type A Riprap Apron

Notes: 1. Bold face outlined boxes indicate minimum L_a to be used for a given pipe diameter or span.
2. Rounding and interpolating are acceptable.

OUTLET PROTECTION - OUTLET VELOCITY ≤ 14 feet/sec

DISCHARGE (cfs)	OUTLET PIPE DIAMETER OR SPAN (in)									
	12	15	18	24	30	36	42	48	54	60
0-5	***10***	***10***		***USE***						
6	12	11								
7		13	***12***							
8		14	13	***12***		***MINIMUM***				
9			14	13						
10			15	13						
11			16	14				***LENGTH***		
12				14						
14				16	***14***					
16				17	15	***14***			***OUTLINED***	
18				18	16	15				
20					17	15	***14***			
22		***USE***			18	16	15			
24						17	15	***14***		
26						17	16	15		
28						18	16	15		
30						19	17	16		
35						20	18	17	***16***	
40			***PREFORMED***				20	18	17	***16***
45							21	19	18	16
50							22	20	18	17
55								21	19	18
60								22	20	19
65								24	21	20
70					***SCOUR***			25	22	20
75								26	23	21
80									24	22
90									26	24
100									28	25
110										27
125							***HOLE***			29
130										30

Table 11-12.1 - Length - L_a (feet)
Type A Riprap Apron

Notes: 1. Bold face outlined boxes indicate minimum L_a to be used for a given pipe diameter or span.
2. Rounding and interpolating are acceptable.

OUTLET PROTECTION - OUTLET VELOCITY ≤ 4.27 meters/sec

DISCHARGE (cms)	OUTLET PIPE DIAMETER OR SPAN (mm)									
	300	375	450	600	750	900	1050	1200	1350	1500
0-0.142	***3.0***	***3.0***			***USE***					
0.170	4.0	3.7	***3.5***							
0.180		3.9	3.7	***3.5***		***MINIMUM***				
0.190		4.2	3.9	3.6						
0.200		4.4	4.1	3.7	**3.5**					
0.205		4.5	4.2	3.8	3.6					
0.227			4.5	4.0	3.7			***LENGTH***		
0.250			5.0	4.3	3.9					
0.275				4.6	4.1					
0.300				4.9	4.3	***4.0***				
0.320				5.1	4.5	4.2			***OUTLINED***	
0.340				5.3	4.7	4.3	***4.0***			
0.360		***USE***		5.5	4.8	4.4	4.1			
0.380					5.0	4.5	4.2	***4.0***		
0.410					5.2	4.7	4.4	4.1		
0.440					5.5	4.9	4.5	4.3		
0.500						5.3	4.8	4.5		
0.560						5.7	5.1	4.7		
0.620			***PREFORMED***			6.0	5.4	5.0		
0.660							5.6	5.1		
0.730							6.0	5.4	***5.0***	
0.800							6.3	5.7	5.3	***5.0***
0.850							6.5	5.9	5.4	5.1
1.000								6.5	6.0	5.5
1.120					***SCOUR***			7.0	6.4	5.9
1.250								7.5	6.8	6.3
1.370								8.0	7.2	6.6
1.500									7.6	7.0
1.630									8.1	7.4
1.750									8.5	7.7
1.975							***HOLE***			8.4
2.200										9.0

Table 11-13 - Length - L_a (meters)
Type B or C Riprap Apron

Notes: 1. Bold face outlined boxes indicate minimum L_a to be used for a given pipe diameter or span.
2. Rounding and interpolating are acceptable.

OUTLET PROTECTION - OUTLET VELOCITY ≤ 14 feet/sec

DISCHARGE (cfs)	OUTLET PIPE DIAMETER OR SPAN (in)									
	12	15	18	24	30	36	42	48	54	60
0-5	***10***	***10***		***USE***						
5.5	12	11								
6		12	***12***			***MINIMUM***				
7		14	13	**12**						
8			15	13						
8.5			16	14				***LENGTH***		
9				14						
10				15	***14***					
11				16	15					
12				17	15	***14***			***OUTLINED***	
13				18	16	15				
14					17	15	***14***			
16		***USE***			18	16	15	***14***		
18						18	16	15		
20						19	17	16		
22						20	18	16		
24							19	17	***16***	
26							20	18	17	***16***
28			***PREFORMED***				21	19	17	16
30							21	19	18	17
32							22	20	18	17
35								21	19	18
40								23	21	19
45								25	23	21
48					***SCOUR***			26	24	22
50									24	22
55									26	23
60									27	25
63									28	26
65										26
75							***HOLE***			29
80										30

Table 11-13.1 - Length - L_a (feet)
Type B or C Riprap Apron

Notes: 1. Bold face outlined boxes indicate minimum L_a to be used for a given pipe diameter or span.
2. Rounding and interpolating are acceptable.

OUTLET PROTECTION
OUTLET VELOCITY > 4.27 meters/sec or Length of Apron exceeds limits shown on Tables 11-12 and 11-13

Preformed Scour Hole										
(See Figure 11-15)	PIPE DIAMETER OR SPAN (mm)									
	300	375	450	600	750	900	1050	1200	1350	1500
Type 1										
B	1.5	1.9	2.3	3.0	3.8	4.6	5.3	6.1	6.9	7.6
C	1.8	2.3	2.7	3.7	4.6	5.5	6.4	7.3	8.2	9.1
d	Depends on riprap type (see Figure 11-15)									
$2S_p$	0.6	0.8	1.0	1.2	1.6	1.8	2.2	2.4	2.8	3.0
$F = 0.5\ S_p$	0.2	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.8
$3S_p$	0.9	1.2	1.5	1.8	2.4	2.7	3.3	3.6	4.2	4.5
Type 2										
B	2.4	3.0	3.7	4.9	6.1	7.3	8.5	9.8	11.0	12.2
C	2.7	3.4	4.1	5.5	6.9	8.2	9.6	11.0	12.3	13.7
d	Depends on riprap type (see Figure 11-15)									
$2S_p$	0.6	0.8	1.0	1.2	1.6	1.8	2.2	2.4	2.8	3.0
$F = S_p$	0.3	0.4	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5
$3S_p$	0.9	1.2	1.5	1.8	2.4	2.7	3.3	3.6	4.2	4.5

Table 11-14 - Dimensions of Preformed Scour Hole (Meters)

OUTLET PROTECTION
OUTLET VELOCITY > 14 feet/sec or Length of Apron exceeds limits shown on Tables 11-12.1 and 11-13.1

Preformed Scour Hole										
(See Figure 11-15)	PIPE DIAMETER OR SPAN (in)									
	12	15	18	24	30	36	42	48	54	60
Type 1										
B	5	6	8	10	13	15	18	20	23	25
C	6	8	9	12	15	18	21	24	27	30
d	Depends on riprap type(see Figure 11-15)									
$2S_p$	2.0	2.6	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
$3S_p$	3.0	3.9	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
$F = 0.5\ S_p$	0.5	0.625	0.75	1	1.25	1.5	1.75	2	2.25	2.5
Type 2										
B	8	10	12	16	20	24	28	32	36	40
C	9	11	14	18	23	27	32	36	41	45
d	Depends on riprap size (see Figure 11-15)									
$2S_p$	2.0	2.6	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
$3S_p$	3.0	3.9	4.5	6.0	7.5	9.0	10.5	12.0	13.5	15.0
$F = S_p$	1.0	1.3	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0

Table 11-14.1 - Dimensions of Preformed Scour Hole (Feet)

11.13.7 Design Procedure for Riprap Outlet Protection

Outlet protection consists of the construction of an erosion resistant section between a conduit outlet and a stable downstream channel. Erosion at an outlet is chiefly a function of soil type and the velocity of the conduit discharge. Therefore, in order to mitigate erosion, an adequate design must stabilize the area at the conduit outlet and reduce the outlet velocity to a velocity consistent with a stable condition in the downstream channel.

This section presents a generalized procedure for the design of riprap outlet protection. Although each project will be unique, the design outlined below will normally be applicable.

Step 1. Assess the Erosion Potential at the Outlet and other Critical Site Factors

For all proposed outlet locations including existing outlet locations to be used on the project:

A. A field investigation should be conducted to determine the erosion resistance of the soils at the outlet, the character of the downstream flow path, and any other site constraints that must be addressed by the proposed design.

B. Prepare a site description and a sketch (channel cross section, where appropriate) for the outlet location.

C. Ensure that field survey limits extend far enough to adequately show the proposed outlet protection design, downstream flow path, drainage right-of-way and any other important topographic features on the design plans

Step 2. Determine Tailwater Conditions at the Outlet

A. See Section 11.13.4 and Sections 8.3.5 and 8.3.6 for further information on how to determine the tailwater depth.

B. If the pipe outlet discharges into a well-defined channel, estimate the existing velocity in the receiving channel using Manning's Equation (Equation 7.6, Section 7.4.11). See Section 8.3.8 regarding Maximum Velocity.

Step 3. Calculate the Outlet Velocity for the Design Discharge

Culvert outlet velocity is one of the primary indicators of erosion potential and will serve in most instances to define the outlet protection required.

The continuity equation Q=AV (Equation 7.5, Section 7.4.11) can be utilized in all situations to compute the average velocity at any point within a conduit. For conduits flowing partly full, however, the location of the water surface and consequently the area of flow cannot always be easily determined.

The following procedure for the calculation of outlet velocity will produce results, which, though approximate, will be adequate for most design purposes.

A. Determine the design discharge for the conduit based on the design return frequency.

B. See Step 2 A. for the tailwater (TW) acting at the outlet pipe.

C. Calculate the outlet velocity.

Step 4. Evaluate the Outlet Velocity

If the outlet velocity is considered excessive for site conditions or exceeds 4.27 mps (14 fps), the designer should investigate methods to reduce the outlet velocity. These may include any one or combination of the following:

- increasing the pipe roughness
- increasing the pipe size
- decreasing the culvert slope

It should also be noted that the above methods may be employed at velocities less than 4.27 mps (14 fps) when it desired to reduce the size of riprap required at the outlet.

For instance, a 450-mm (18-inch) pipe has a design discharge of 0.3 cms (10 cfs) and an outlet velocity of 3.66 mps (12 fps). Table 11.11 indicates that standard riprap would be required at the outlet, however, it may be more practical to employ the above methods for reducing the exit velocity, so that modified or intermediate riprap can be used in lieu of standard riprap.

Step 5. Select an Appropriate Type of Outlet Protection Design

Review Section 11.13.2 describing the Types of Outlet Protection and the Design Criteria in Section 11.13.3, which will be used in the selection of the type and size of the outlet protection. The type of outlet protection and design criteria presented in these Sections are summarized below:

TYPE	OUTLET VELOCITY mps (fps)	TAILWATER DEPTH	COMMENT
Type A Riprap Apron	≤ 4.27 (14)	≤ ½ pipe rise (minimum condition)	Outlet has no well-defined channel downstream
Type B Riprap Apron	≤ 4.27 (14)	≥ ½ pipe rise (maximum condition)	Outlet has no well-defined channel downstream
Type C Riprap Apron	≤ 4.27 (14)	all	Outlet has a well-defined channel downstream
Preformed Scour Hole	≥ 4.27 (14)	all	May be used for lower exit velocities as dictated by Tables 8-6 and 8-7
Structurally Lined Energy Dissipaters	≥ 4.27 (14)	all	See HEC-14 To be used only with prior approval from Hydraulics and Drainage Section.

Table 11-15 Summary of Outlet Protection Types and Selection Criteria

A. If the outlet velocity, tailwater depth and site conditions indicate that a Type A, B or C Riprap Apron may be used, check Tables 11-12 and 11-13 to see if a Riprap Apron can be used based on the pipe size and discharge.

B. If a Riprap Apron is adequate, Tables 11-12 and 11-13 will specify the length of apron required. Proceed to **Step 6.**

C. If the Tables do not show an apron length, this indicates that the designer should proceed to **Step 7,** using a preformed scour hole design instead of a riprap apron.

For example, a project has two outlets.

Outlet No.1 is a 450-mm (18-inch) RCP with an outlet velocity of 2.74 mps (9 fps) and a design discharge of 0.275 cms (9.7 cfs) that outlets onto a flat area with a tailwater depth (TW) less than 200 mm (8 in).

Outlet No.2 is a 600-mm (24-inch) RCP with an outlet velocity of 3.35 mps (11 fps) and a design discharge of 0.500 cms (17.7 cfs) that outlets into a drainage channel with a tailwater depth (TW) of 500 mm (20 in).

Initially, the design parameters indicate that a Type A Riprap Apron and a Type C Riprap Apron would be appropriate for Outlet No. 1 and 2, respectively.

Next, Table 11-12 is checked for Outlet No. 1 with the design discharge and shows that a Type A Riprap Apron could be used with a required length of 4.5-m (15-ft.). Table 11-13 is checked for Outlet No. 2 and shows that the design discharge falls outside the limit for the use of a Type C Riprap Apron and that a preformed scour hole design should be used.

Step 6. Riprap Apron Dimensions

The designer has determined in **Step 5** that a riprap apron is appropriate at the outlet location. Riprap apron dimensions are discussed in Section 11.13.5 and are determined as follows:

A. The length of apron (L_a) is determined from Tables 11-12 and 11-13 or Equations 11.31 and 11.32. **It should be noted, however, that the Tables are required to determine the minimum and maximum length of apron that can be used for a given pipe size and discharge.** The length of apron is shown on Figures 11-13 and 11-14.

B. The width of the upstream (W_1) and downstream W_2) apron limit for the Type A and B Riprap Apron are computed using Equations 11.33 and 11.34, respectively, or as shown on Figure 11-13. The width of a Type C Riprap Apron (W_3) is determined as described in Section 11.13.5 or as shown on Figure 11-14.

Step 7. Preformed Scour Hole Design

The designer has determined in **Step 5** that the outlet velocity, Tables 11-12 and 11-13 or site conditions dictate that a preformed scour hole is required for outlet protection. The design is discussed in Section 11.13.6 and summarized as follows:

A. Compute the median stone size (d_{50}) required for both the Type 1 and 2 Preformed Scour Holes using Equations 11.35 and 11.36, respectively.

B. Compute the scour hole dimensions for both types using the set of equations labeled 11.37 or Figure 11-15.

C. Compare the values computed in Steps 7A and 7B for the two preformed scour hole types and select the one that provides the most economical and practical design given the site conditions.

Step 8. Special Design

In unusual cases where neither a riprap apron nor preformed scour hole can be used, and a special design is required, HEC-14 can be used to design an alternative energy dissipater. These designs, however, require prior approval from the Hydraulics and Drainage Section.

Step 9. Prepare Outlet Protection Computation Form

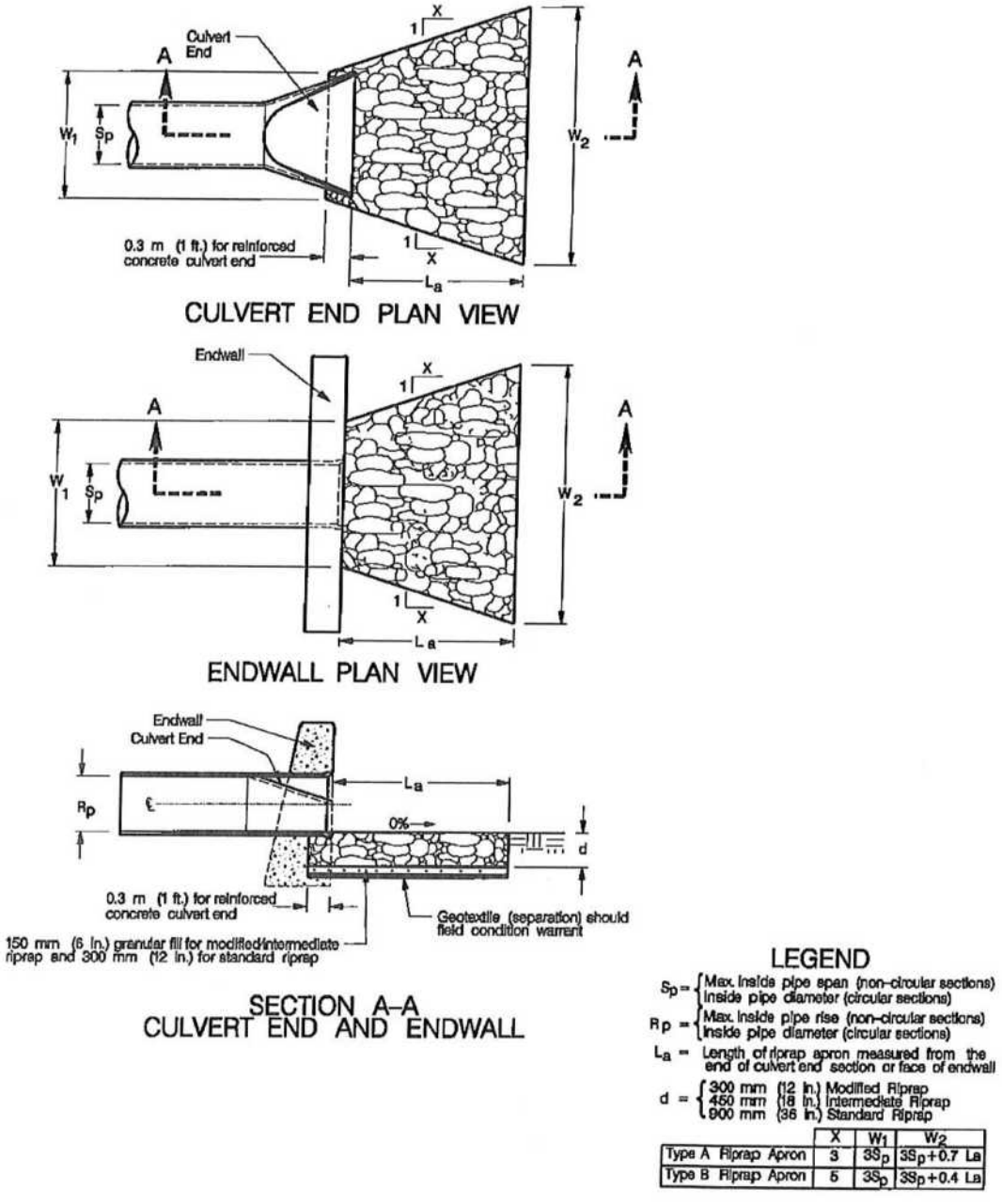
See Appendix A for form.

Step 10. Project Plans

The following information is required on the project plans for outlet protection:

TYPE	PLANS	DETAILS
Type A, B & C Riprap Apron	Call out apron type (A,B,C), riprap type & length of apron (L_a). Show apron limits.	Include detail(s) similar to Figures 11-13 & 11-14
Preformed Scour Hole Type 1 & Type 2	Call out type & riprap size. Show limits.	Include a detail similar to Figure 11-15.

Table 11-16 Outlet Protection Plan Requirements



	X	W_1	W_2
Type A Riprap Apron	3	$3S_p$	$3S_p+0.7$ La
Type B Riprap Apron	5	$3S_p$	$3S_p+0.4$ La

Figure 11-13 Type A and B Riprap Apron
(to be used where there is no defined channel downstream of the outlet)

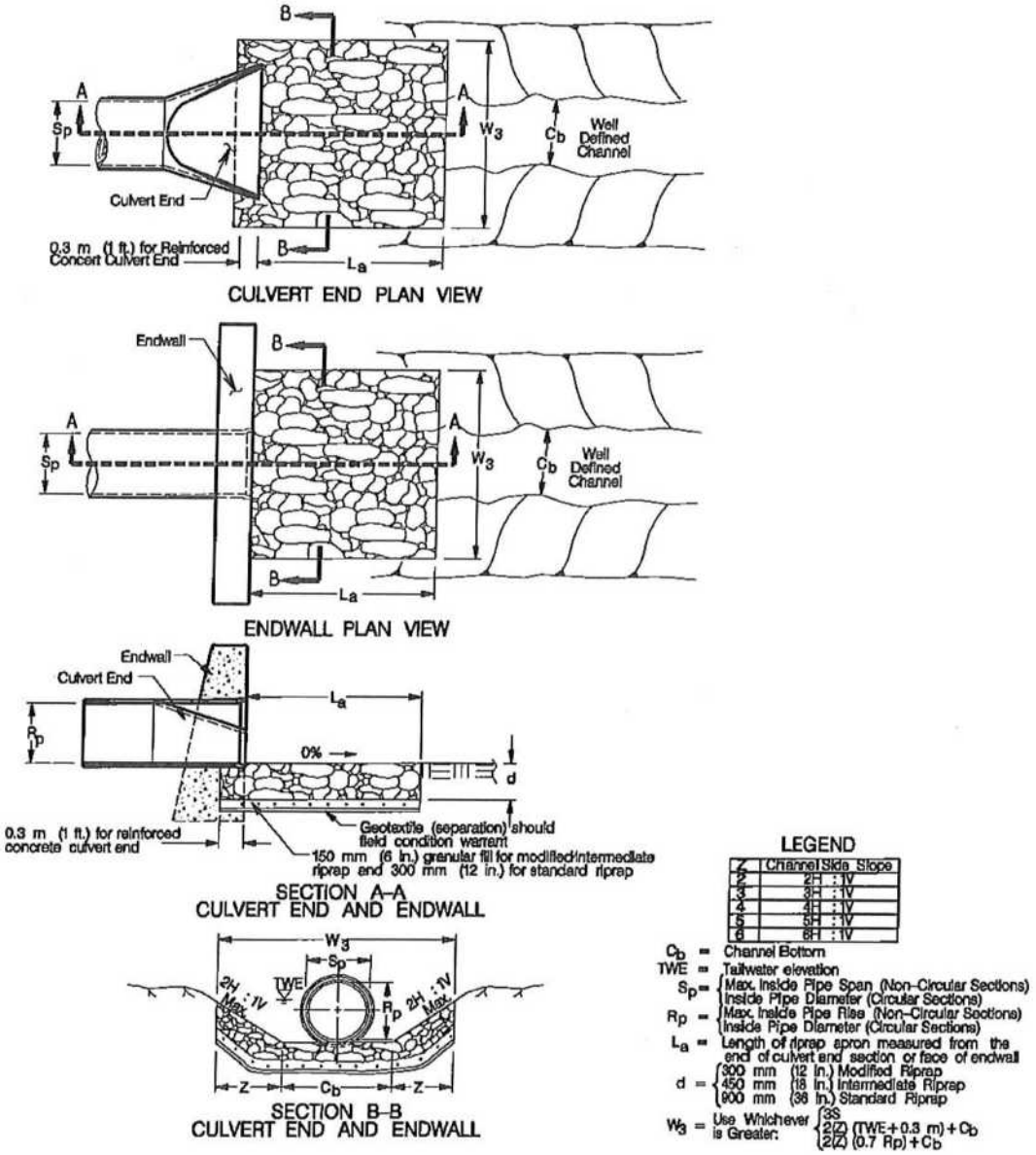
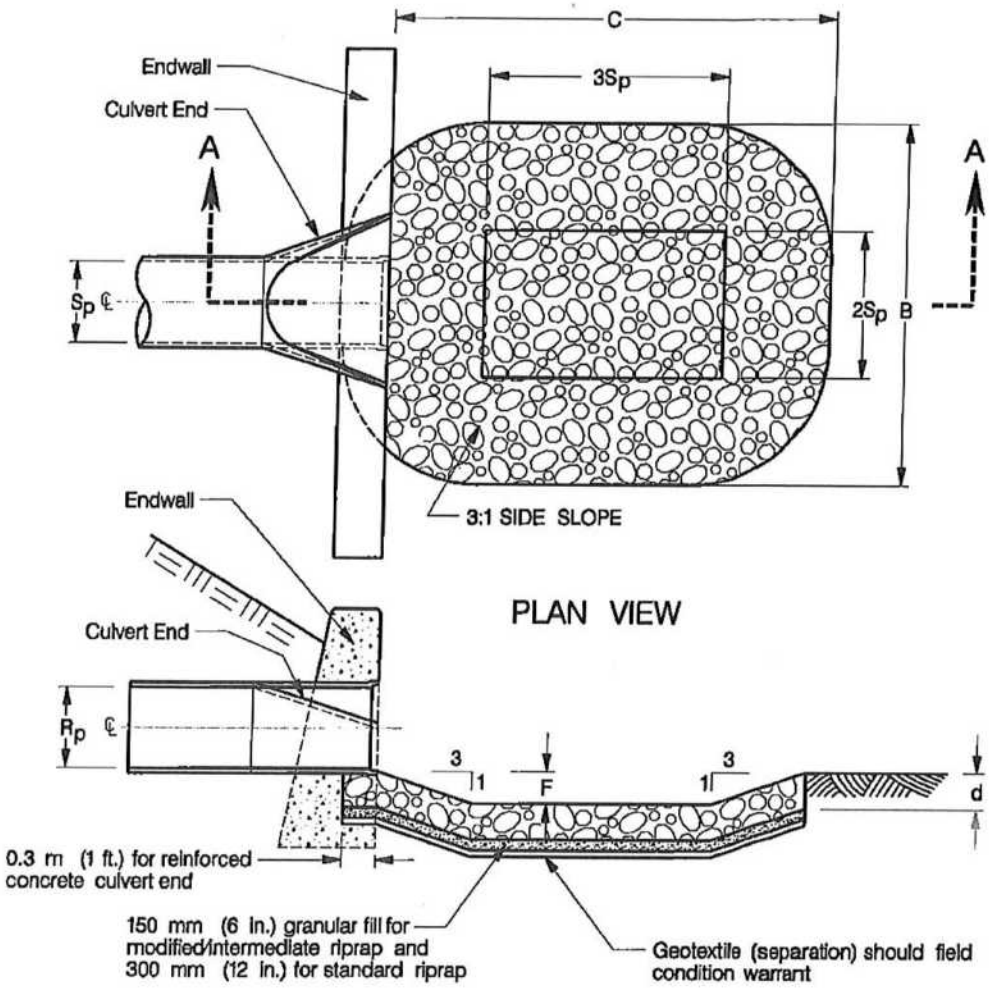


Figure 11-14 Type C Riprap Apron
(to be used where there is a well defined channel downstream of the outlet)



LEGEND

S_p = { Max. inside pipe span (non-circular sections); Inside pipe diameter (circular sections) }

R_p = { Max. inside pipe rise (non-circular sections); Inside pipe diameter (circular sections) }

d = { 300 mm (12 in.) Modified Riprap; 450 mm (18 in.) Intermediate Riprap; 900 mm (36 in.) Standard Riprap }

Type 1 $F = 0.5\ R_p$

Type 2 $F = R_p$

$C = 3S_p + 6F$

$B = 2S_p + 6F$

Figure 11-15 Preformed Scour Hole Type 1 and Type 2

AZIMUTH LAND DESIGN, LLC
Civil Engineers & Erosion Control Specialists
118 Turnpike Road, Suite 200, Southborough, Massachusetts 01772
Telephone (508) 485-0137 jamest@azimuthlanddesign.co

Stormwater Management Standard #2
Peak Rate Attenuation

As the Drainage Report dated 9-25-2023 shows, the postdevelopment site will not create an increase of flow to any of the abutting properties.

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Civil Engineers & Erosion Control Specialists
118 Turnpike Road, Suite 200, Southborough, Massachusetts 01772
Telephone (508) 485-0137 jamest@azimuthlanddesign.co

Stormwater Management Standard #3
44% removal of TSS before infiltration

All captured runoff on site will be directed to a CDS stormwater filtration unit before it is directed to the infiltration structure.

So, 25% of TSS will be removed by deep sump catch basins and then another 80% by a model 3035 CDS unit. The TSS reduction achieved will be 85% calculated as follows:

25% reduction for deep sump catch basins
80% reduction for the use of a CDS unit

(1- (.25) – (.80 x .75))= .15 or 85% removal before entering the infiltration structure.

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Stormwater Management Standard #3
65% of impervious surfaces being recharged

A total of 141,235 square feet of impervious cover will be created on site including building roof area, parking spaces, driving aisles and sidewalks.

The runoff from all of that impervious surface, 100% of it, will be captured and directed to the infiltration structure on site.

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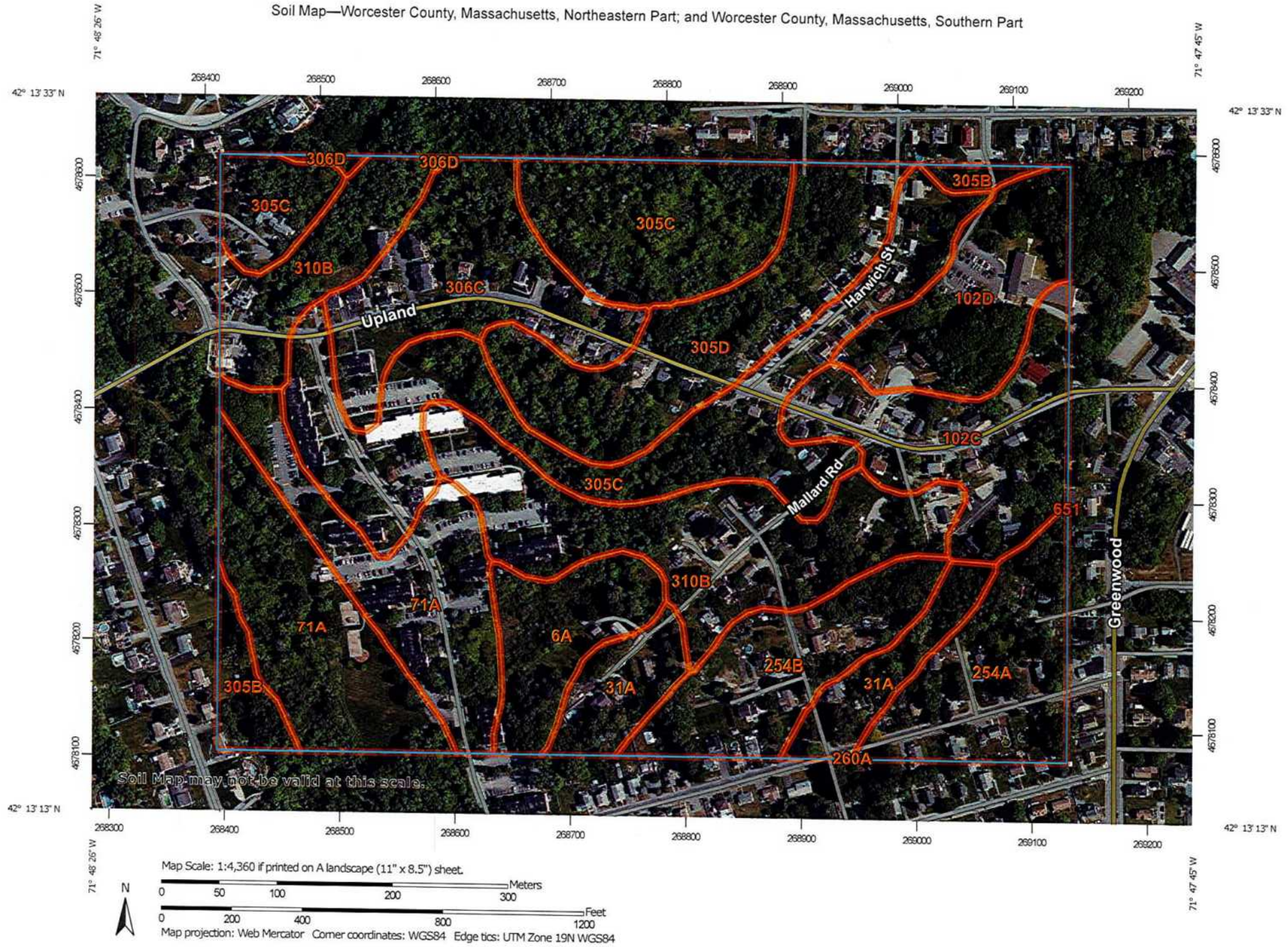
Stormwater Management Standard #3
Required Recharge Volume calculation

There will be a total of 141,235 square feet of impervious surface area will be created on site. All of it will lie over what are officially mapped as hydrologic soil group "C" soils as shown on the attached Web soil survey which indicates Paxton and Woodbridge series soils on site.

So, the required recharge volume is:
141,235 s.f. x (1/12 foot/inch) x (0.25 inches) = 2,942 cubic feet

Soil Map—Worcester County, Massachusetts, Northeastern Part; and Worcester County, Massachusetts, Southern Part



Map Scale: 1:4,360 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

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

USDA Natural Resources Conservation Service

Web Soil Survey
National Cooperative Soil Survey

2/28/2024

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 scales ranging from 1:20,000 to 1:25,000.

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

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 16, Sep 10, 2023

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

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

MAP LEGEND

MAP INFORMATION

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
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	3.8	4.0%
31A	Walpole sandy loam, 0 to 3 percent slopes	4.5	4.8%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	6.3	6.7%
102C	Chatfield-Hollis-Rock outcrop complex, 0 to 15 percent slopes	6.7	7.1%
102D	Chatfield-Hollis-Rock outcrop complex, 15 to 35 percent slopes	5.3	5.6%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	5.6	6.0%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	5.4	5.7%
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	0.0	0.0%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	0.4	0.4%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	19.7	21.0%
305D	Paxton fine sandy loam, 15 to 25 percent slopes	8.2	8.7%
306C	Paxton fine sandy loam, 8 to 15 percent slopes, very stony	7.0	7.5%
306D	Paxton fine sandy loam, 15 to 25 percent slopes, very stony	0.2	0.2%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	13.2	14.1%
651	Udorthents, smoothed	0.0	0.0%
Subtotals for Soil Survey Area		**86.2**	**91.7%**
Totals for Area of Interest		**94.0**	**100.0%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	6.5	6.9%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	1.4	1.5%
Subtotals for Soil Survey Area		**7.8**	**8.3%**

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Totals for Area of Interest		94.0	100.0%

AZIMUTH LAND DESIGN, LLC
Civil Engineers & Erosion Control Specialists
118 Turnpike Road, Suite 200, Southborough, Massachusetts 01772
Telephone (508) 485-0137 jamest@azimuthlanddesign.co

Stormwater Management Standard #3
Sizing the Recharge BMP

The required recharge volume at 49 Upland Street will be 2,942 cubic feet. We can see from the Static Method that the proposed infiltration structure can handle this volume.

From the Drainage Report, the total available storage in the infiltration structure is 56,474 cubic feet or more than 19 times the required recharge volume.

72 Hour Drawdown

To confirm that the infiltration structure has been designed with adequate bottom area we confirm that it will completely drain within 72 hours. To do this, we confirm that the required recharge volume will drain out of it in that time.

The formula to confirm this is:

Time = Rv/(K)(Bottom Area)
= (2,942 cubic feet)/((2.41 inches/hour)(10,800 square feet))
= (2,942 cubic feet)/((2.41 inches/hour)(1/12 feet per inch)(10,800 square feet))
= (2,942)/(2,169)
= 1.4 hours

This is much less than the maximum 72 hour drawdown time and therefore adequate.

Commonwealth of Massachusetts
City/Town of Worcester

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

A. Facility Information

Henchey, LLC
Owner Name

49 Upland Street
Street Address

29/040/0000254
Map/Lot #

Worcester
City

MA
State

01607
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes:

DH's 1&2

Web soil survey
Source

305C 10-6-22
Soil Map Unit

Paxton
Soil Name

severe
Soil Limitations

Till
Soil Parent material

uncertain
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes:

Year Published/Source

Map Unit

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:

Wetland Type

7. Current Water Resource Conditions (USGS): 10/6/22
Month/Day/ Year

Range: ☐ Above Normal ☐ Normal ☒ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Worcester

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

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

Deep Observation Hole Number: 1 (Hole #) 10-6-2022 (Date) 8:10 (Time) 60° SUNNY (Weather) ____ (Latitude) ____ (Longitude:)

1. Land Use: WOODLAND (e.g., woodland, agricultural field, vacant lot, etc.) DECIDUOUS TREES (Vegetation) VERY FEW (Surface Stones (e.g., cobbles, stones, boulders, etc.)) ≈12 (Slope (%))

Description of Location: SOUTHERLY END OF SITE

2. Soil Parent Material: TILL UNCERTAIN (Landform) UNCERTAIN (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body — feet; Property Line ≈60 feet; Drainage Way — feet; Drinking Water Well — feet; Wetlands >100 feet; Other ____ feet

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

5. Groundwater Observed: ☐ Yes ☑ No If yes: ____ Depth Weeping from Pit ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-16"	Ap	SANDY LOAM	10YR3/2								
16"-32"	B	SANDY LOAM	10YR7/6								
32"-48"	C1	SANDY LOAM	10YR6/4				15	2			
48"-84"	C2	SANDY LOAM	10YR6/4			>75% 10YR8/6	15	2			

Additional Notes:

Commonwealth of Massachusetts
City/Town of Worcester

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

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

Deep Observation Hole Number: 2 (Hole #) 10-6-22 (Date) 8:40 (Time) 60° SUNNY (Weather) _____ (Latitude) _____ (Longitude:)

1. Land Use: WOODLAND (e.g., woodland, agricultural field, vacant lot, etc.) DECIDUOUS TREES (Vegetation) VERY FEW (Surface Stones (e.g., cobbles, stones, boulders, etc.) ≈12 (Slope (%)

Description of Location: SOUTH END OF SITE

2. Soil Parent Material: TILL UNCERTAIN (Landform) UNCERTAIN (Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet; Drainage Way _____ feet; Wetlands ≈150 feet; Property Line ≈150 feet; Drinking Water Well _____ feet; Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☑ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-20"	Ap	SANDY LOAM	10YR3/2								
20"-32"	B	SANDY LOAM	10YR7/4								
32"-60"	C1	SANDY LOAM	10YR6/4				5				
60"-84"	C2	SANDY LOAM	10YR6/4			>5% 10YR8/1	5				

Additional Notes:

Commonwealth of Massachusetts
City/Town of Worcester

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

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # 1	Obs. Hole # 2
☑ Depth observed standing water in observation hole	NOT OBSERVED inches	NOT OBSERVED inches
☐ Depth weeping from side of observation hole	NOT OBSERVED inches	NOT OBSERVED inches
☑ Depth to soil redoximorphic features (mottles)	48" inches	60" inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☑ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 16", 20" inches Lower boundary: 84", 84" inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Worcester

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

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator

10-6-2024
Date

JAMES TETREAULT SE 2421
Typed or Printed Name of Soil Evaluator / License #

JULY 2025
Expiration Date of License

—
Name of Approving Authority Witness

—
Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:

SEE LOG FOR DH3

Commonwealth of Massachusetts
City/Town of Worcester

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

A. Facility Information

Henchey, LLC
Owner Name

49 Upland Street
Street Address

29/040/0000254
Map/Lot #

Worcester
City

MA
State

01607
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

2. Soil Survey Available? ☒ Yes ☐ No If yes:

DH3 10-6-22

Web soil survey
Source

305C
Soil Map Unit

Paxton
Soil Name

severe
Soil Limitations

Till
Soil Parent material

uncertain
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes:

Year Published/Source

Map Unit

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:

Wetland Type

7. Current Water Resource Conditions (USGS): 10/6/22
Month/Day/ Year
Range: ☐ Above Normal ☐ Normal ☒ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Worcester

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

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

Deep Observation Hole Number: 3 (Hole #) 10-6-2022 (Date) 9:00 (Time) 62° SUNNY (Weather) _____ (Latitude) _____ (Longitude:)

1. Land Use WOODLAND (e.g., woodland, agricultural field, vacant lot, etc.) DECIDUOUS TREES (Vegetation) VERY FEW (Surface Stones (e.g., cobbles, stones, boulders, etc.)) ≈12 (Slope (%))

Description of Location: IN SOUTHERN PORTION OF SITE

2. Soil Parent Material: TILL UNCERTAIN (Landform) _____ (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body _____ feet; Property Line ≈150 feet; Drainage Way _____ feet; Drinking Water Well _____ feet; Wetlands ≈140 feet; Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☑ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-21"	Ap	SANDY LOAM									
21"-33"	B	SANDY LOAM									
33"-54"	BC	SANDY LOAM									
54"-98"	C	LOAMY SAND				NONE	35	5			

Additional Notes:
- NO REFUSAL
- SIGNIFICANT PORTIONS OF "C" HAD SAND TEXTURE

Commonwealth of Massachusetts
City/Town of Worcester

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

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

Deep Observation Hole Number: _____ Hole # _____ Date _____ Time _____ Weather _____ Latitude _____ Longitude:

1. Land Use: _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

   Description of Location: _____

2. Soil Parent Material: _____ _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet Drainage Way _____ feet Wetlands _____ feet
   Property Line _____ feet Drinking Water Well _____ feet Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes: _____

Commonwealth of Massachusetts
City/Town of Worcester

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

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # 3	Obs. Hole # _____
☑ Depth observed standing water in observation hole	NOT OBSERVED inches	_____ inches
☑ Depth weeping from side of observation hole	NOT OBSERVED inches	_____ inches
☑ Depth to soil redoximorphic features (mottles)	≥ 98 inches	_____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	_____ inches	_____ inches

_____ Index Well Number _____ Reading Date

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# _____ S_c _____ S_r _____ OW_c _____ OW_{max} _____ OW_r _____ S_h _____

2. Estimated Depth to High Groundwater: _____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☑ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 21" inches Lower boundary: 98" inches

c. If no, at what depth was impervious material observed? Upper boundary: _____ inches Lower boundary: _____ inches

Commonwealth of Massachusetts
City/Town of Worcester

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

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

Signature of Soil Evaluator — Date: 10-6-2022

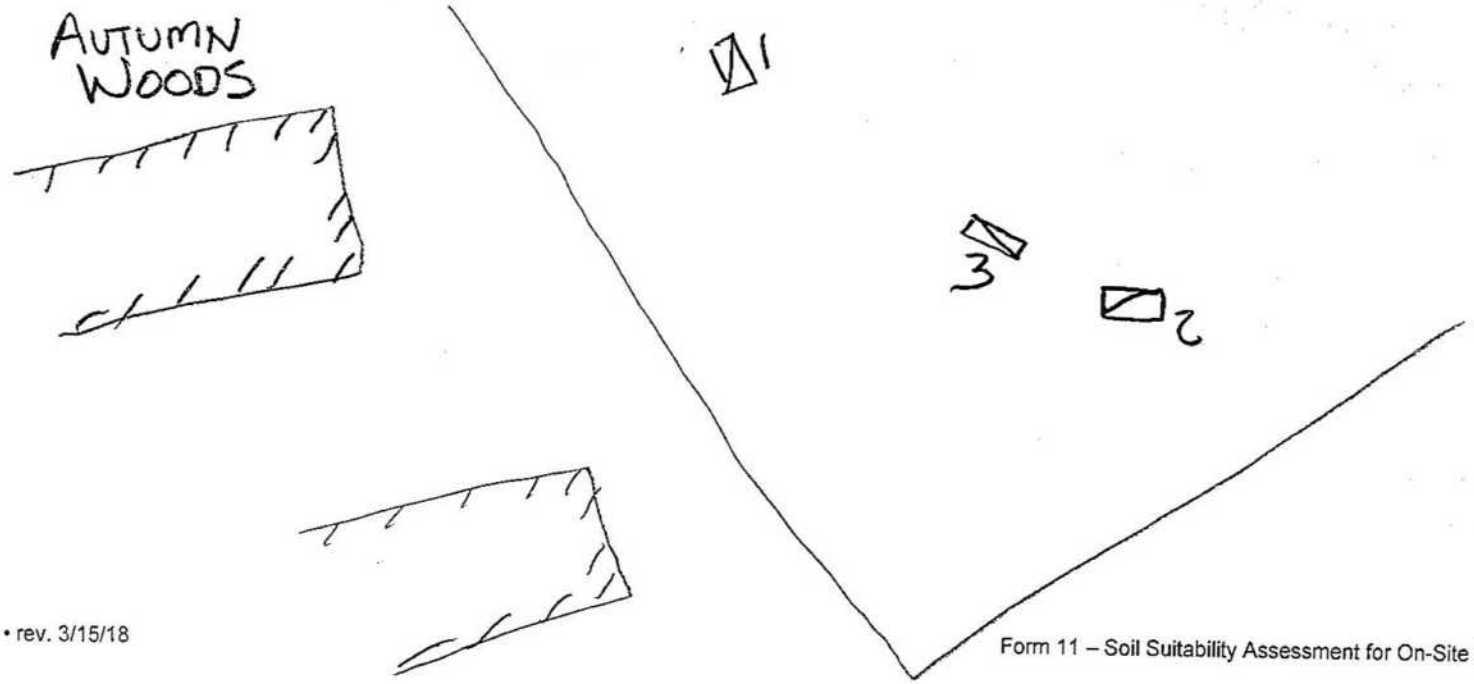
Typed or Printed Name of Soil Evaluator / License # — Expiration Date of License

JAMES LEBEAULT SE2421 — JULY 2025

Name of Approving Authority Witness — Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:



Commonwealth of Massachusetts
City/Town of Worcester

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

A. Facility Information

Henchey, LLC
Owner Name

49 Upland Street
Street Address

29/040/0000254
Map/Lot #

Worcester
City

MA
State

01607
Zip Code

B. Site Information

1. (Check one) ☒ New Construction ☐ Upgrade ☐ Repair

AUGUST 3, 202
DH 3A

2. Soil Survey Available? ☒ Yes ☐ No If yes:

Paxton
Soil Name

severe
Soil Limitations

Web soil survey
Source

305C
Soil Map Unit

Till
Soil Parent material

uncertain
Landform

3. Surficial Geological Report Available? ☐ Yes ☒ No If yes:

Year Published/Source

Map Unit

Description of Geologic Map Unit:

4. Flood Rate Insurance Map Within a regulatory floodway? ☐ Yes ☒ No

5. Within a velocity zone? ☐ Yes ☒ No

6. Within a Mapped Wetland Area? ☐ Yes ☒ No If yes, MassGIS Wetland Data Layer:

Wetland Type

7. Current Water Resource Conditions (USGS): 8/3/23
Month/Day/ Year

Range: ☐ Above Normal ☒ Normal ☐ Below Normal

8. Other references reviewed:

Commonwealth of Massachusetts
City/Town of Worcester

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

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

Deep Observation Hole Number: 3A (Hole #) 8/3/2023 (Date) 12:05 (Time) 76° SUNNY (Weather) ____ (Latitude) ____ (Longitude)

1. Land Use: WOODLAND (e.g., woodland, agricultural field, vacant lot, etc.) — MOSTLY DECIDUOUS TREES (Vegetation) — FEW (Surface Stones (e.g., cobbles, stones, boulders, etc.)) — ≈12 (Slope (%))

   Description of Location: SE OF DH 3

2. Soil Parent Material: TILL — UNCERTAIN (Landform) — UNCERTAIN (Position on Landscape (SU, SH, BS, FS, TS))

3. Distances from: Open Water Body ≈150 feet; Property Line ≈110 feet; Drainage Way ____ feet; Drinking Water Well ____ feet; Wetlands ≈120 feet; Other ____ feet

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

5. Groundwater Observed: ☐ Yes ☑ No — If yes: ____ Depth Weeping from Pit ____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			
0-18"	AP	SANDY LOAM	10YR3/2								
18"-32"	B	SANDY LOAM	10YR 5/6								
32-48"	BC	SANDY LOAM	10YR7/4								
48"-66"	C1	LOAMY SAND	10YR7/3				35	5			
66"-96"	C2	LOAMY SAND	10YR7/3			5% FAINT	35	5			

Additional Notes:
- NO REFUSAL
- MOTTLING NOT CLEAR ON ALL SIDES OF HOLE
- SOME SAND POCKETS
- EXTRA HOLE WHILE OUTBOARD FOR AIR LOCK

Commonwealth of Massachusetts
City/Town of Worcester

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

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

Deep Observation Hole Number: _____ Hole # _____ Date _____ Time _____ Weather _____ Latitude _____ Longitude:

1. Land Use: _____ (e.g., woodland, agricultural field, vacant lot, etc.) _____ Vegetation _____ Surface Stones (e.g., cobbles, stones, boulders, etc.) _____ Slope (%)

   Description of Location: _____

2. Soil Parent Material: _____ _____ Landform _____ Position on Landscape (SU, SH, BS, FS, TS)

3. Distances from: Open Water Body _____ feet; Drainage Way _____ feet; Wetlands _____ feet; Property Line _____ feet; Drinking Water Well _____ feet; Other _____ feet

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

5. Groundwater Observed: ☐ Yes ☐ No If yes: _____ Depth Weeping from Pit _____ Depth Standing Water in Hole

Soil Log

Depth (in)	Soil Horizon /Layer	Soil Texture (USDA)	Soil Matrix: Color-Moist (Munsell)	Redoximorphic Features			Coarse Fragments % by Volume		Soil Structure	Soil Consistence (Moist)	Other
				Depth	Color	Percent	Gravel	Cobbles & Stones			

Additional Notes: _____

Commonwealth of Massachusetts
City/Town of Worcester

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

D. Determination of High Groundwater Elevation

1. Method Used:

	Obs. Hole # 3A	Obs. Hole # ____
☑ Depth observed standing water in observation hole	NOT OBSERVED inches	____ inches
☑ Depth weeping from side of observation hole	NOT OBSERVED inches	____ inches
☑ Depth to soil redoximorphic features (mottles)	66" inches	____ inches
☐ Depth to adjusted seasonal high groundwater (S_h) (USGS methodology)	____ inches	____ inches

Index Well Number ____ Reading Date ____

$S_h = S_c - [S_r \times (OW_c - OW_{max})/OW_r]$

Obs. Hole/Well# ____ S_c ____ S_r ____ OW_c ____ OW_{max} ____ OW_r ____ S_h ____

2. Estimated Depth to High Groundwater: ____ inches

E. Depth of Pervious Material

1. Depth of Naturally Occurring Pervious Material

a. Does at least four feet of naturally occurring pervious material exist in all areas observed throughout the area proposed for the soil absorption system?

☑ Yes ☐ No

b. If yes, at what depth was it observed (exclude A and O Horizons)? Upper boundary: 18" inches Lower boundary: 96" inches

c. If no, at what depth was impervious material observed? Upper boundary: ____ inches Lower boundary: ____ inches

Commonwealth of Massachusetts
City/Town of Worcester

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

F. Certification

I certify that I am currently approved by the Department of Environmental Protection pursuant to 310 CMR 15.017 to conduct soil evaluations and that the above analysis has been performed by me consistent with the required training, expertise and experience described in 310 CMR 15.017. I further certify that the results of my soil evaluation, as indicated in the attached Soil Evaluation Form, are accurate and in accordance with 310 CMR 15.100 through 15.107.

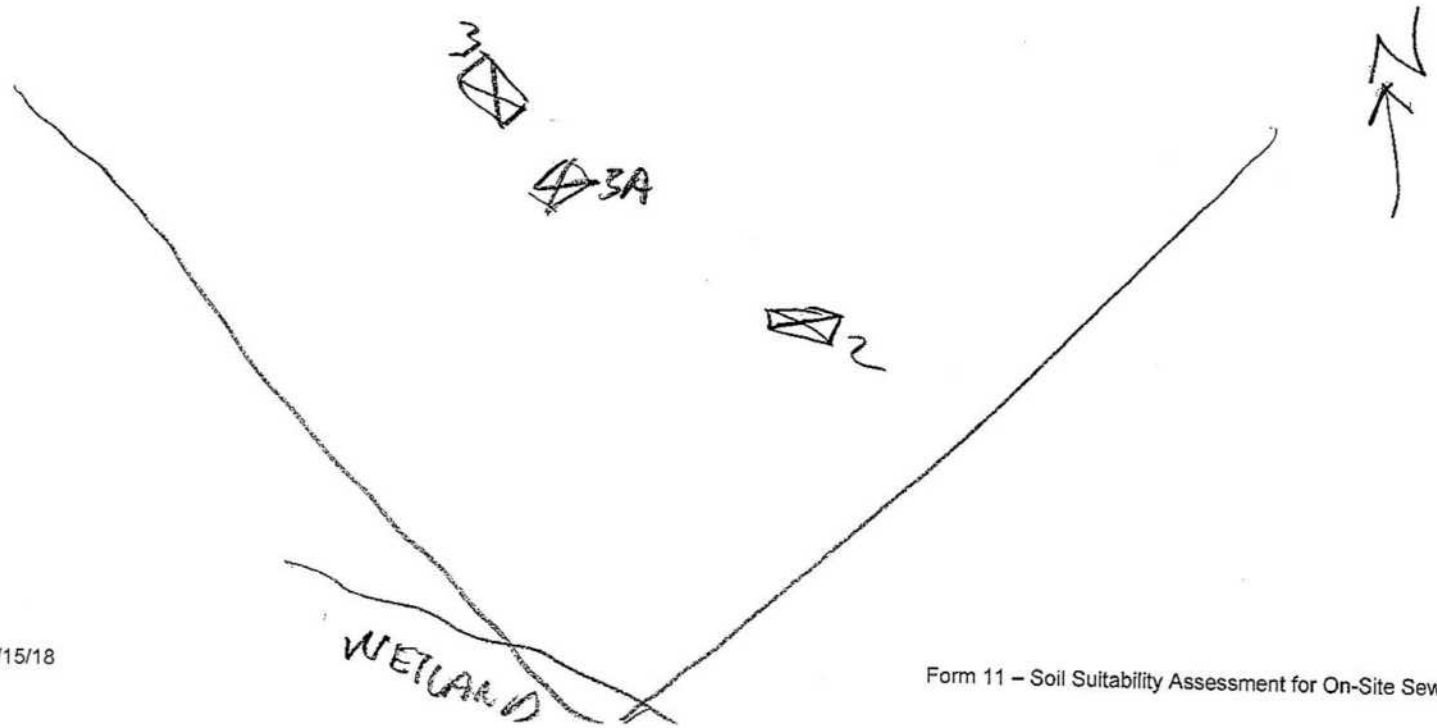
Signature of Soil Evaluator — Date: 8/3/2023

Typed or Printed Name of Soil Evaluator / License # — Expiration Date of License: JULY 2025

Name of Approving Authority Witness — Approving Authority

Note: In accordance with 310 CMR 15.018(2) this form must be submitted to the approving authority within 60 days of the date of field testing, and to the designer and the property owner with Percolation Test Form 12.

Field Diagrams: Use this area for field diagrams:



AZIMUTH LAND DESIGN, LLC
Civil Engineers & Erosion Control Specialists
118 Turnpike Road, Suite 200, Southborough, Massachusetts 01772
Telephone (508) 485-0137 jamest@azimuthlanddesign.co

Stormwater Management Standard #4
Water Quality

The water quality volume for this project will be 1 inch because, even though there are no discharges to critical areas proposed on this site, the infiltration is into loamy sand texture soils with an infiltration rate of 2.41 feet per second.

So, water quality volume = (1/12 feet per inch) * (141,235 s.f. impervious surface)
= 11,770 cubic feet.

The storage capacity of the proposed infiltration structure will be 56,474 cubic feet or almost 5 times the water quality volumen.

As to the removal of total suspended solids(TSS), for the runoff from the impervious surfaces captured by the site's drainage system the calculation is as follows:

First, 25% of TSS is removed by deep sump catch basins leaving 75% of TSS remaining.
Then 80% of that is removed by the CDS 3035 unit (.75 -(.80x.75) leaving 18.75%
Then 80% of that is removed by the infiltration basin (.1875-(.80x.1875) leaving 5.00%
which means that 95% removal of TSS is achieved in this portion of the runoff.

TSS removal calculation worksheets and the parameter brief verifying the TSS removal of the CDS structure are attached.

CONTECH ENGINEERED SOLUTIONS

9025 Centre Pointe Drive, Suite 400
West Chester, OH 45069
Phone: (513) 645-7000
Toll Free: (800) 338-1122
www.ContechES.com

Parameter Brief

Removal of Suspended Solids using the CDS® System – Laboratory Evaluations

The CDS® system is a hydrodynamic separator which uses patented continuous deflective separation (CDS) technology to separate and capture trash, debris, sediment and oil and grease from stormwater runoff. Indirect screening allows for 100% removal of floatables and neutrally buoyant material without blinding the screen. Flow and screening controls separate captured solids and minimize resuspension of previously captured pollutants.

The CDS system can effectively capture 100% of particulate material, including trash and debris, greater than screen aperture size (2400 or 4700 microns). In addition, the CDS can remove medium and coarse sediments. A full-scale laboratory evaluation of the CDS system using test materials with various particle size distributions is summarized here.

Laboratory Study – Full-Scale Evaluation at University of Florida

A full-scale CDS unit (Model CDS2020-5B) was tested at the facility of University of Florida, Gainesville, FL. This full-scale CDS unit was evaluated under controlled laboratory conditions of pumped influent and the controlled addition of sediment.

Two different gradations of silica sand material (UF Sediment & OK-110) were used in the CDS performance evaluation. The particle size distributions (PSD) of the test materials were analyzed using standard method "Gradation ASTM D-422 with Hydrometer" by a certified laboratory. UF Sediment is a mixture of three different U.S. Silica Sand products referred as: "Sil-Co-Sil 106", "#1 DRY" and "20/40 Oil Frac". Particle size distribution analysis shows that the UF Sediment has a very fine gradation (d_{50} = 20 to 30 µm) covering a wide size range (uniform coefficient C_u averaged at 10.6). In comparison with the hypothetical TSS gradation specified in the NJDEP (New Jersey Department of Environmental Protection) and NJCAT (New Jersey Corporation for Advanced Technology) protocol for lab testing, the UF Sediment covers a similar range of particle size but with a finer d_{50} (d_{50} for NJDEP is approximately 50 µm) (NJDEP, 2003). The OK-110 silica sand is a commercial product of U.S. Silica Sand. The particle size distribution analysis of this material, also included in Figure 1, shows that 99.9% of the OK-110 sand is finer than 250 microns, with a mean particle size (d_{50}) of 106 microns. The PSDs for the test material are shown in Figure 1.

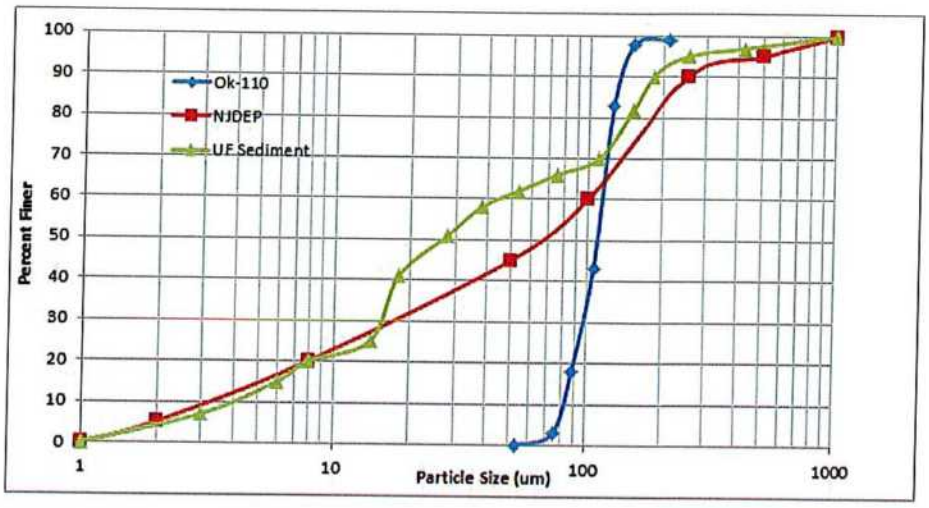


Figure 1. Particle size distributions for the test materials, as compared to the NJCAT/NJDEP theoretical distribution.

Tests were conducted to quantify the CDS unit (1.1 cfs design capacity) performance at various flow rates, ranging from 1% up to 125% of the design capacity of the unit, using the 2400 micron screen. All tests were conducted with controlled influent concentrations approximately 200 mg/L. Effluent samples were taken at equal time intervals across the entire duration of each test run. These samples were then processed with a Dekaport Cone sample splitter to obtain representative sub-samples for Suspended Sediment Concentration (SSC – ASTM Standard Method D3977-97) and particle size distribution analysis.

Results and Modeling

Based on the testing data from the University of Florida, a performance model was developed for the CDS system. A regression analysis was used to develop a fitting curve for the scattered data points at various design flow rates. This model, which demonstrated good agreement with the laboratory data, can then be used to predict CDS system performance with respect to SSC removal for any particle size gradation assuming sandy-silt type of inorganic components of SSC. Figure 2 shows CDS predictive performance for two typical particle size gradations (NJCAT gradation and OK-110 sand).

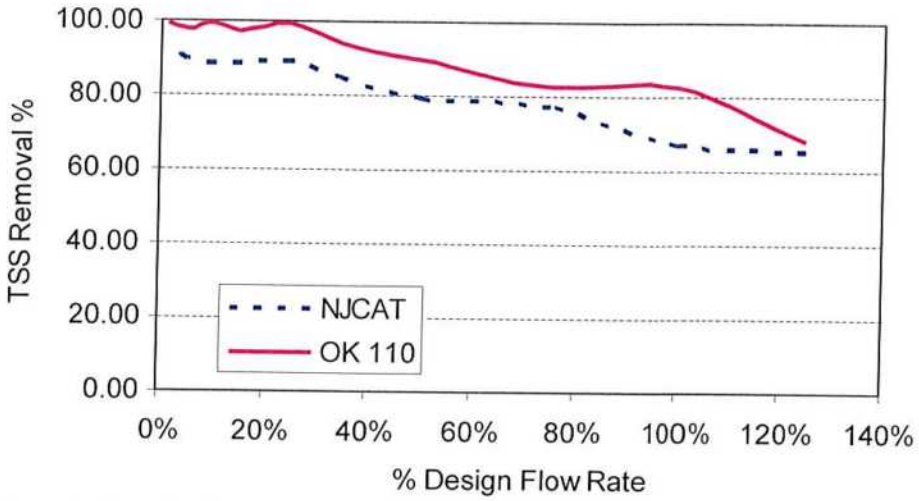


Figure 2. CDS stormwater treatment predictive performance for various particle gradations as a function of operating rate.

Many regulatory jurisdictions set a performance standard for hydrodynamic devices by stating that the devices shall be capable of achieving an 80% removal efficiency for particles having a mean particle size (d_{50}) of 125 microns (WADOE, 2008). The model can be used to calculate the expected performance of such a PSD (shown in Figure 3). Supported by the laboratory data, the model indicates (Figure 4) that the CDS system with 2400 micron screen achieves approximately 80% removal at 100% of design flow rate, for this particle size distribution (d_{50} = 125 µm).

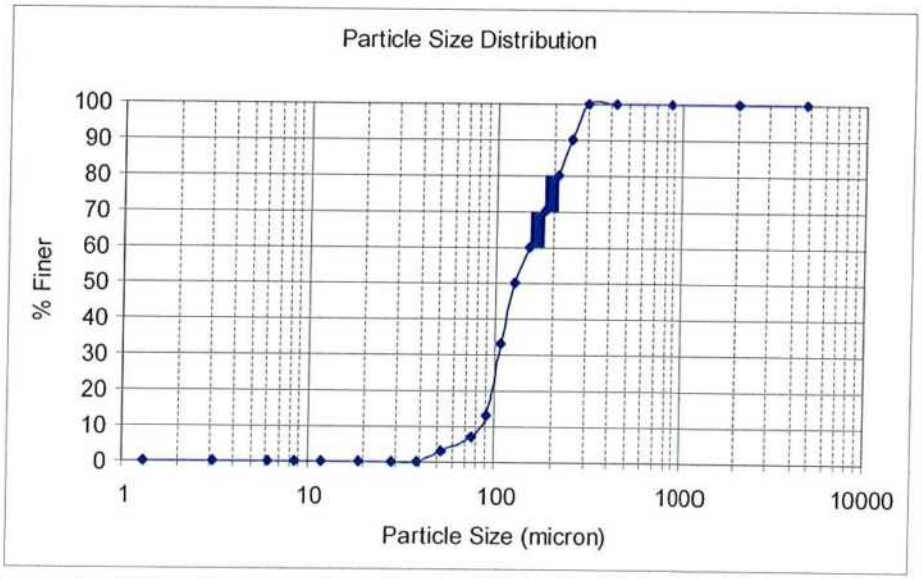


Figure 3. PSD with d_{50} = 125 microns, used to model performance for Ecology submittal.

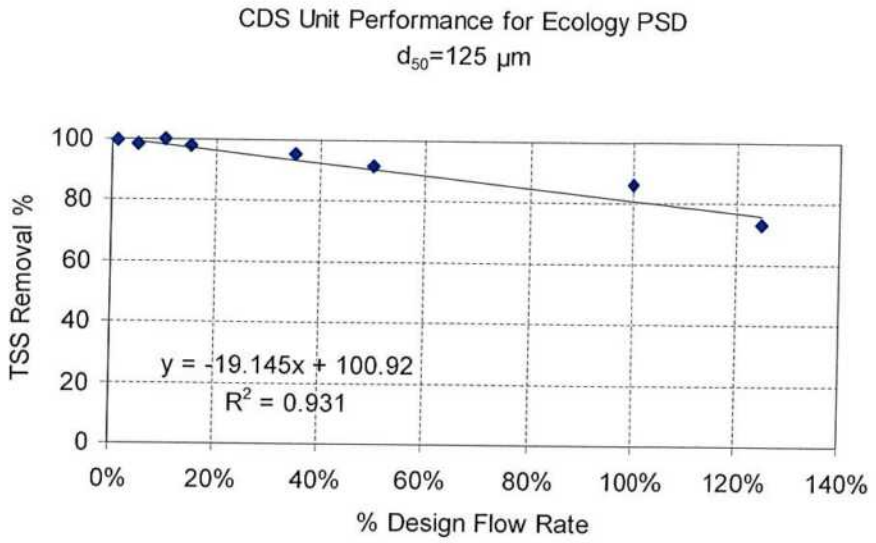


Figure 4. Modeled performance for CDS unit with 2400 microns screen, using Ecology PSD.

References:

New Jersey Department of Environmental Protection (NJDEP). (2003). Total Suspended Solids Laboratory Testing Procedures (December 23, 2003).

Washington State Department of Ecology (WADOE). (2008). Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol—Ecology (TAPE) (Publication Number 02-10-037). Olympia, Washington: Author. Available Online: www.ecy.wa.gov/biblio/0210037.html

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location: 49 UPLAND STREET, WORCESTER

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
DEEP SUMP CATCH BASINS	25%	1.00	0.25	0.75
CDS MODEL 3035 UNIT	80%	0.75	0.60	0.15
INFILTRATION BASIN	80%	0.15	0.12	0.03

Total TSS Removal = 97%

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 49 UPLAND ST
Prepared By: JAMES TETREAULT
Date: 2-26-2024

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

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

INSTRUCTIONS:

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Non-automated: Mar. 4, 2008

Location: 49 UPLAND ST., WORCESTER

PHOSPHORUS Removal Calculation Worksheet

A BMP[1]	P B ~~TSS~~ Removal Rate[1]	C Starting P Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
INFILTRATION BASIN	.95	1.00	.95	.05

Total Removal = 95 %

Separate Form Needs to be Completed for Each Outlet or BMP Train

Project: 49 UPLAND ST.
Prepared By: JAMES TETREAULT
Date: 2-26-24

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

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

AZIMUTH LAND DESIGN, LLC
Civil Engineers & Erosion Control Specialists
118 Turnpike Road, Suite 200, Southborough, Massachusetts 01772
Telephone (508) 485-0137 jamest@azimuthlanddesign.co

Stormwater Management Standard #5
Land Uses with Higher Potential Pollutant Loads

The proposed multifamily residential use of the site is not considered to constitute a land use with higher potential pollutant loading.

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Stormwater Management Standard #6
Critical Areas

This project will not include any discharges to critical areas. Such areas include Zone II interim wellhead protection areas, shellfish growing areas, bathing beaches, Outstanding Resource Waters, Special Resource Waters and Cold-Water Fisheries.

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Stormwater Management Standard #7
Redevelopment

The proposed development will not constitute a redevelopment project.

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Stormwater Management Standard #8
Construction Period Controls

Erosion and sediment control measures are shown on sheets ESC1 and ESC2 of the Definitive Site Plans and a construction sequence is outlined on detail sheet D4 as well as descriptions of the proposed application of various bmp's. A construction period and long term operation and maintenance plan is also included in this filing.

CONSTRUCTION PERIOD (SHORT TERM)
STORMWATER OPERATION & MAINTENANCE PROGRAM

February 6, 2024

49 Upland Street
Worcester, Massachusetts

Currently Owned by:
Henchey, LLC

During Construction the contractor is responsible for the following inspection and maintenance. Inspections and resulting maintenance tasks shall be recorded in an Inspection Log that is kept on site and available for inspection by Town, State, and Federal officials.

Contractor Information:

Contractor/Operator: _____

Address: _____

Contact Name and Phone Number: _____

1. Water tightness of catch basin sumps shall be tested and assured after installation.

2. Catch basins shall be protected from sedimentation through haybale filter dikes, filter fabric sacks, or other approved methods. At all times, sedimentation of the infiltration system shall be prohibited and prevented.

3. Catch basin grates shall be inspected monthly. Debris, sand, and accumulated trash shall be removed from inlets.

4. Catch basins shall be inspected bi-weekly and shall be cleaned out as necessary, when the siltsacks or sumps have accumulated one half (1/2) the original depth. If excessive oil, gasoline, or sediment is present, remove all liquid and solids from the sumps. If catch basins are regularly observed to have a sheen of petroleum product, install oil adsorbent materials that float on the surface Dispose of waste properly. Catch basin sumps shall be cleaned out quarterly. Catch basin traps shall be inspected after each cleaning, and any damage shall be repaired.

5. Drain manholes, the CDS unit and the in ground detention/infiltration systems shall be inspected monthly and shall be cleaned out as necessary. Cleanout shall be

recorded in the maintenance log. Dispose of waste properly. Engineer shall be notified of any evidence of sediment in the drain manholes.

6. The subsurface infiltration area must be kept free of sediment and shall not be used as a temporary settling area or for discharge of excavation dewatering.

7. The subsurface infiltration systems shall be observed through the inspection ports monthly for any sign of sediment laden water, backup, or contamination. The Engineer shall be notified if any of these conditions are observed.

8. The owner's designee shall inspect the systems, and the contractor shall clean all components as necessary (e.g. by removing the siltsacks, sediment, and sand) in order to turn over to the owner a clean and functioning system.

9. The pavement along the project frontage shall be inspected daily. In the period before a base course of pavement is laid down in the driving aisles, Upland Street shall be swept daily.

10. A watering truck shall be kept on site and utilized as necessary to prevent excessive dust from being produced at the site.

---------- Owner, Henchey, LLC

POST CONSTRUCTION (LONG TERM)
STORMWATER OPERATION & MAINTENANCE PROGRAM
February 6, 2024

Site at 49 Upland Street
Worcester, Massachusetts

Owner and Applicant:

Henchey, LLC
5 Edgemere, Boulevard, Shrewsbury, MA 01545
Contact: Chris Henchey Phone: 508-304-4056

Upon completion of the project, the drainage system will be maintained by the owner. Once the construction site has been fully stabilized, the owner should establish a schedule and keep a log of inspection and maintenance activities for the measures described below:

Landscape Maintenance:

Vegetated areas in the landscape will reduce erosion, encourage infiltration of rainwater, and keep stormwater clean. It is important to maintain the vegetated areas of the site.

1. Proper mowing is one of the most important ways to maintain a healthy lawn. Mow only when the grass is dry to get a clean cut and minimize the spread of disease. Mow grass to a height of 3". Mow frequently, cutting no more than 1/3 of the height of the grass at a time. Sharpen your mower blades after every 10 hours of mowing.

2. Grass clippings contain high amounts of nitrogen, a key ingredient in fertilizer. Make all attempts to use your grass clippings by leaving them on your lawn. If the grass clippings are not used, do not dispose of them near any wetlands and or water bodies and designate a place to compost them in an upland area.

3. If your lawn areas and plant material demand fertilizer then use only low phosphorous fertilizers. Fertilize in the fall, but in coordination with weather patterns.

4. The best defense against pests within the grass is to use an Integrated Pest Management system which consists of beneficial insects (lady bugs, spiders, certain nemetodes and bacteria.)

5. Minimize watering the lawn areas. If needed water in the early morning and water deeply and infrequently.

6. If needed, the trees and shrubs shall be pruned but at a minimum of once a year.

Impervious Surface Maintenance:

Particles that collect on paved surfaces can contain materials that can inhibit water quality. Sweeping sand and debris from the parking lot is a good housekeeping measure that will remove gross pollutants, and should be undertaken a minimum of twice per year. DEP recommends frequent sweeping of parking lots in high traffic areas as an integral part of stormwater management.

1. The parking lots shall be swept at least twice a year.

2. Accumulated leaves and grass clippings shall also be removed from the impervious surfaces at a minimum of twice a year

3. In the winter months, CaCl application shall be limited to the amount necessary to prevent sand from freezing. Sand shall be used sparingly but in sufficient quantity to maintain the parking and loading surface in a safe condition.

Catch Basins:

Catch basins with oil traps and deep sumps are the first line of defense to prevent pollutants from reaching water resources. Regular maintenance and cleaning of the catch basins is key to protecting water quality and can reduce the more expensive maintenance of other devices in the treatment train.

1. If excessive oil, gasoline, or sediment is present, remove all liquid and solids from the sumps. Absorbent products are available to attach to the interior of catch basins in order to absorb floatable petroleum products from sumps. If floatables are noted on a regular basis, these measures should be added to the catch basin sumps. Dispose of waste properly.

2. Catch basin grates shall be inspected on a monthly basis. Debris, sand, vegetation, and accumulated trash shall be removed and disposed of properly.

3. Catch Basin sumps shall be inspected on a monthly basis for the first year and quarterly thereafter, and will be cleaned upon the observance of spill of observable petroleum products, such as oil, coolant, or fuel. Dispose of waste properly.

4. If a spill of any harmful substance occurs on the surface of the parking area, the catch basin shall be protected against contamination by the use of a dike or absorbent material. Adequate quantities of absorbent material shall be stored in an accessible location. An emergency spill kit containing absorbent material should be kept in an area accessible to the parking lot.

5. In any case Catch Basin sumps shall be cleaned of sand and liquid at least twice per. Dispose of waste properly.

6. Catch basin traps shall be inspected after each cleaning, and any damaged shall be repaired.

Hydrodynamic Separator (CDS Unit):

The model 3035 CDS unit removes floatable trash, petroleum products, and sediments form the stormwater in order to prevent them from reaching the water supply. They must be inspected and cleaned periodically to be sure they are operating properly.

1. The separator shall be inspected at a minimum of two times a year (i.e. spring and fall).

2. The visual inspection should ascertain that the system components are in working order and that there are no blockages or obstructions to the inlet and or separation screen.

3. If during the inspection, it is noticed that any of the internal components are damaged or missing, contact CONTECH 1-800-338-2211.

4. The inspection should also identify evidence of vector infestation (mosquito larvae, for example) and accumulation of hydrocarbons, trash, and sediment in the system and the screen.

5. The screen shall be power washed and the unit's internal components cleaned when the level of sediment reached 75% of capacity in the isolated sump and/or when an appreciable level of hydrocarbons and trash has accumulated.

6. A vactor truck is recommended for cleanout of the CDS unit. Disposal of the material from the CDS unit should be in accordance with the local municipality's requirements.

7. Clean the treatment unit during dry weather conditions when no flow is entering the system. Remove debris, sand, and accumulated trash from the unit's interior and remove fines from the screen.

8. The CDS Unit is a confined space and only properly trained personnel possessing the proper training and possess the necessary safety equipment should enter the unit. Confined spaces can contain odorless, colorless poison gas.

In Ground Detention/Infiltration System

The in ground detention system keeps the peak rate of flow of runoff from this project from exceeding the peak rate of flow of runoff to abutting properties in the predevelopment condition. It must be inspected to make sure that debris is not

entering the piping system which might clog the pipes discharging into the system and to confirm the integrity of the system joints.

1. The in ground detention system shall be inspected twice per year at the inspection ports. Look for debris, either sediment or trash that may indicate the CDS unit is not functioning correctly and that may clog the outlets.
2. The inspection should also include looking for any signs of damage to or deformation of the precast concrete modules. If water, trash, sediment or other material has been visibly deposited in the system, report this to the owner or property manager so that maintenance can be scheduled.
3. If maintenance is required of inlet or outlet pipes, use a high powered pressure nozzle with rear facing jets to wash away sediments and debris within the pipes and remove the sediment.
4. If, during the inspection, it is noticed that any components of the in ground detention system are damaged or missing, contact the owner, property manager and the manufacturer.
5. The subsurface Infiltration structure will be provided with inspection ports. These ports shall be opened and the structure inspected at least once per year through the inspection ports. The underground module and stone area shall be inspected via observations through the inspection and observation ports. If water, trash, sediment, or any other material is visible at any inspection port, report this to the property manager so that maintenance can be scheduled.
6. The in ground detention system is a confined space and only properly trained personnel possessing the proper training and possess the necessary safety equipment should enter the system. Confined spaces can contain odorless, colorless poison gas.

There will be no on site storage of waste products. Waste generated on site will be normal residential waste and will be disposed of in dumpsters.

The apartment management will decide if there is any prohibition against vehicle washing on site.

The management company will not use sodium based de-icing agents.

---------- Owner, Henchey, LLC

Construction Phase Stormwater Inspection Report

General Information			
Project Name	49 Upland Street -- Worcester, MA		
Date of Inspection		**Start/End Time**	
Inspector's Name(s)			
Inspector's Title(s)			
Inspector's Contact Information			
Inspector's Qualifications			
Describe present status of construction			
Describe crews and work occurring on the site today			

Type of Inspection:
❑ Regular ❑ Pre-storm event ❑ During storm event ☐ Post-storm event

Weather Information
Has there been a storm event since the last inspection? ❑Yes ☐No **If yes, provide:** Storm Start Date & Time: Storm Duration (hrs): Approximate Amount of Precipitation (in):
Weather at time of this inspection? ☐ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snowing ❑ High Winds ❑ Other: Temperature:
Have any discharges occurred since the last inspection? ❑Yes ☐No **If yes, describe:**
Are there any discharges at the time of inspection? ☐☐Yes ❑No **If yes, describe:** **Normal detention basin outflow**

Site-specific BMPs

- *Number the structural and non-structural BMPs identified in your SWPPP on your site map and list them below (add as many BMPs as necessary). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required BMPs at your site.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
1	Sedimentation control barrier at perimeter of work area	☐Yes ❑No	❑Yes ☐No	
2	Temporary Sediment Basins	☐Yes ❑No	☐Yes ❑No	

	BMP	BMP Installed?	BMP Maintenance Required?	Corrective Action Needed and Notes
3	Site Entrance Mat(s)	❑Yes ☐No	❑Yes ❑No	
4	Diversion swales	☐Yes ❑No	❑Yes ☐No	
5	Diversion dikes	❑Yes ☐No	❑Yes ❑No	
6	Interior sedimentation control barriers at TSBs	❑Yes ☐No	❑Yes ❑No	
7	Temporary stabilization ground cover	❑Yes ☐No	❑Yes ❑No	
8	Stockpiles (covers and perimeter controls)	❑Yes ☐No	❑Yes ❑No	
9	Temporary settling basin outlet controls	☐Yes ❑No	❑Yes ☐No	
10	Flocculants and jute mesh	☐Yes ❑No	❑Yes ☐No	
11	Infiltration structure	☐Yes ❑No	❑Yes ☐No	
12	Permanent slope stabilization	☐Yes ❑No	☐Yes ❑No	
13		☐Yes ❑No	❑Yes ☐No	
14		☐Yes ❑No	☐Yes ❑No	
15		❑Yes ❑No	❑Yes ❑No	
16		❑Yes ❑No	❑Yes ❑No	
17		❑Yes ❑No	❑Yes ❑No	
18		❑Yes ❑No	❑Yes ❑No	
19		❑Yes ❑No	❑Yes ❑No	
20		❑Yes ❑No	❑Yes ❑No	

Overall Site Issues

Below are some general site issues that should be assessed during inspections. Customize this list as needed for conditions at your site.

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
1	Are all slopes and disturbed areas not actively being worked properly stabilized?	☐Yes ❑No	☐Yes ❑No	
2	Are natural resource areas (e.g., streams, wetlands, mature trees, etc.) protected with barriers or similar BMPs?	☐Yes ❑No	❑Yes ☐No	
3	Are perimeter controls and sediment barriers adequately installed (keyed into substrate) and maintained?	☐Yes ❑No	❑Yes ☐No	

	BMP/activity	Implemented?	Maintenance Required?	Corrective Action Needed and Notes
4	Are the infiltration structures properly protected from receiving silt laden runoff?	☐Yes ☐No	☐Yes ☐No	
5	Is the infiltration trench properly protected from receiving silt laden runoff?	☐Yes ☐No	☐Yes ☐No	
6	Is the construction exit preventing sediment from being tracked into the street?	☐Yes ☐No	☐Yes ☐No	
7	Is trash/litter from work areas collected and placed in covered dumpsters?	☐Yes ☐No	☐Yes ☐No	
8	Are washout facilities (e.g., paint, stucco, concrete) available, clearly marked, and maintained?	☐Yes ☐No	☐Yes ☐No	
9	Are vehicle and equipment fueling, cleaning, and maintenance areas free of spills, leaks, or any other deleterious material?	☐Yes ☐No	☐Yes ☐No	
10	Are materials that are potential stormwater contaminants stored inside or under cover?	☐Yes ☐No	☐Yes ☐No	
11		☐Yes ☐No	☐Yes ☐No	
12	(Other)	☐Yes ☐No	☐Yes ☐No	

Non-Compliance

Describe any incidents of non-compliance not described above or areas needing attention:

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: _____

Signature: _____ **Date:** _____

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Stormwater Management Standard #9
Construction Period Controls

A construction period and post construction Operation and Maintenance Plan is included in this filing.

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Stormwater Management Standard #10
Prevention of illicit discharges

The housing units on this site will be apartment units leased to residents. The leases will contain prohibitions against illicit discharges into the site's drainage system.