HANCOCK ASSOCIATES

Stormwater Report

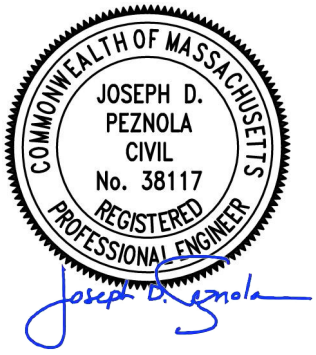
In Support of

Comprehensive Permit Filing

for

Neck Farm
13 Neck Road
(Map 24, Lot 32)

Lancaster, MA



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Prepared For:
Neck Farm, LLC

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Table of Contents

Tables

Appendices

Introduction

Neck Farm, LLC proposes to construct a Multi-Family Development at 13 Neck Road, Lancaster, MA. Associated improvements will include paved vehicular and pedestrian areas, recreational areas, landscaped areas, stormwater management systems, and utility services. The project area is currently comprised of a building, paved vehicular areas, paved walking paths, and vegetated areas. The project area is accessed by Neck Road on its northern border and Center Bridge Road on its western border and consists of 0.57± acres and is bounded Center Bridge Road to the west, Neck Road to the north, and residential properties to the south and east. Elevations on site range from elevation 270 at the northeast property line to elevation 267 at the Center Bridge Road.

The project area is not located within a FEMA flood zone as shown on FEMA map number 25027C0458E dated July 7, 2011. The proposed stormwater management system will include catch basins with deep sumps and hoods, porous pavement, and a network of pipes. The system will discharge to the existing stormwater system on Center Bridge Road.

Design guidance for the proposed porous pavement was used using the University of New Hampshire Center for Stormwater Technology Evaluation and Verification publications on porous pavement. Their guidance uses laboratory tests to determine the total time for concentration for runoff to infiltrate into the crushed stone reservoir course. The consensus of their laboratory testing concurred a time of concentration of 790 minutes shall be used for stormwater modeling for a 41" cross section of porous pavement. The proposed porous pavement cross section for this project is 24", so proportionally a time of concentration value of 460 minutes was used in our stormwater model. Stormwater modeling for this project reflects this data and was used for the design of the porous pavement onsite.

The proposed stormwater management system was designed to meet the Stormwater Management Standards described in the Massachusetts Stormwater Handbook and the Town of Lancaster's Stormwater Standards. The following report describes the system's compliance with these standards.

Standard 1: No New Untreated Discharges

The Massachusetts Stormwater Handbook states that no new stormwater conveyances may discharge untreated stormwater directly to or cause erosions in wetlands or waters of the Commonwealth. The project does not include new stormwater conveyances.

Standard 2: Peak Rate Attenuation

The Massachusetts Stormwater Handbook states that stormwater management systems shall be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. A summary of the existing and proposed discharge rates follows. The proposed condition discharge rates of runoff are at or below the existing rates to the same discharge points. Please see the attached "Existing Drainage Figure" and "Proposed Drainage Figure" figures (Appendix III) and HydroCAD output (Appendix IV) for more information.

For the purpose of these calculations the following assumptions were made:

- The project property lines and edge of pavement on the right-of-way were used to delineate watershed boundaries.
- The same total watershed area of the drainage areas is used to compare the existing and proposed conditions.

- The Natural Resources Conservation Service (NRCS) Web Soil Survey defines soils in the project area as 305B, Paxton fine sandy loam (Hydrologic Soil Group C). Test pits were dug onsite by this office in 2022 and discovered sandy soils as well as sandy loam parent material onsite.

One (1) drainage area have been modeled to represent the existing condition:

- Drainage Area EX1 consists of the conditions of the previous development, the now demolished single-family house that was on property. This consists of roof areas, paved vehicular areas, and grassed areas. Stormwater runoff from EX1 drains via overland flow to an existing network of pipes located at the intersection of Neck Road and Center Bridge Road, Discharge Point 10R.

In the proposed condition a stormwater management system will collect and treat stormwater runoff from the project site. This system will include porous pavement cells. Three (3) drainage areas have been modeled to represent the proposed condition:

- Drainage Area 1S will consist of paved vehicular and pedestrian areas. Stormwater discharge from 1S will drain overland to the proposed porous pavement cells. From there overflow is directed via a proposed pipe network into the existing network of pipes located at the intersection of Neck Road and Center Bridge Road, Discharge Point 1R
- Drainage Area 2S will consist of roof areas. Stormwater discharge from 2S will drain via roof drains directly into the reservoir course of the porous pavement cells. From there overflow is directed via a proposed pipe network into the existing network of pipes located at the intersection of Neck Road and Center Bridge Road, Discharge Point 1R
- Drainage Area 3S will consist of grassed/landscape areas and paved pedestrian areas. Stormwater discharge from 3S will flow overland and directed to the existing network of pipes located at the intersection of Neck Road and Center Bridge Road, Discharge Point 1R

The following table compares the peak rates of runoff under the existing and proposed conditions using the Northeast Regional Climate Center (NRCC) Atlas of Precipitation Extremes for the Northeastern United States and Southeastern Canada

Table 1: Peak Rates of Runoff

Discharge Point	**Peak Rate (cfs)**					
	2-Year Storm (3.22" Rainfall Depth)		**10-Year Storm** (4.86" Rainfall Depth)		**100-Year Storm** (8.64" Rainfall Depth)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed
10R/1R	1.02	0.41	1.97	0.79	4.32	1.76

cfs – Cubic Feet per Second

Standard 3: Recharge

The Massachusetts Stormwater Handbook states that loss of annual recharge to groundwater shall be eliminated or minimized. The annual recharge from the post-development site shall approximate the annual recharge from the pre-development conditions based on soil type. Recharge volumes are provided

for the majority of the proposed impervious areas. For the purpose of these calculations, all of the project areas are considered to be Hydrologic Soil Group C. The required recharge volume is 0.25" multiplied by the area of impervious surfaces. Please see the attached Hydrocad summaries for the recharge volumes provided within the reservoir course (Appendix VI). The volumes is as follows:

Required Recharge Volume, HSG C = Target Depth * Impervious Area = 0.25" * 19,060 SF = 397 CF

Capture Area Adjustment
There are areas within this development that do not drain to recharge facilities, subcatchment 3S are directed to the existing drainage features at the intersection of Neck Road and Center Bridge Road,.

((Site Area Draining to Recharge Facilities) / (Total Site Impervious Area) > 65%
(16,555 SF / 19,060 SF) x 100% = 87% (>65%)

Ratio of Total Site Impervious Area to Site Area Draining to Recharge Facilities
17,995 SF /16,335 SF= **1.15**

Adjusted Minimum Required Recharge Volume
397 CF x 1.15 = 457 CF

The recharge volume is provided below the weir (elevation 266.50) controlling the outflow for the porous pavement reservoir course. The volume provided is 1,779 cubic feet. Since the volume provided is greater than the required recharge volume, the standard is met.

The Massachusetts Stormwater Handbook states that the recharge volume must drain within 72 hours. Observations in soil testing performed on-site indicate that the soil that the pervious pavement will be installed upon is sandy loam as indicated on the site plan The following "drawdown" calculation assumes a Rawl's Rate of 1.02 inches per hour, corresponding to texture class "sandy loam".

Drawdown Time = Storage Volume / (Rawl's Rate * Bottom Area)
= 1,779 CF / (1.02 in/hr *8,840 SF) = 2.4 Hour

Since the drawdown time of 2.4 hours is less than 72 hours, the requirement is met.

Standard 4: Water Quality

The Massachusetts Stormwater Handbook states that systems shall be designed to remove 80% of the average annual post-development construction load of Total Suspended Solids (TSS). The treatment BMP's have been sized to provide at least 80% TSS removal and measures will be taken for long-term pollution prevention.

Stormwater runoff from vehicular paved areas will be treated for at least 80% TSS removal via porous pavement. The treatment train computation is as follows:

Table 2: Treatment Train Calculation

BMP	TSS Removal Rate	Starting TSS Load	Amount Removed	Remaining Load
Porous Pavement	0.80	1	0.80	0.20
Total TSS Removal				0.80

These BMP's are sized to capture and treat the 1.0" water quality flow rate from the contributing paved areas because the project area is located within a Critical Area, known as the Central Nashua River Valley.

Water Quality Volume Calculations
The Massachusetts Department of Environmental Protection Wetlands Program Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices, the Q rate associated with the 1.0-inch water quality volume is calculated using the following equations:

WQV = (A)*1.0in.

Where:
A = paved surface drainage area (in square feet)
WQV = water quality volume in watershed inches (1.0-inch in this case)

Porous Pavement
WQV = (19,060 SF) (1.0 inch.) (1.0 ft / 12inches)
WQV = 1,588 CF (1,779 CF Provided)

Standard 5: Land Uses with Higher Potential Pollutant Loads

The proposed project is not a Land Use with Higher Potential Pollutant Load (LUHPPL).

Standard 6: Critical Area

The proposed project is within a Critical Area known as the Central Nashua River Valley. The Central Nashua River Valley has been designated as an Area of Environmental Concern (ACEC). See standard 4 for Standard 4 for water quality volume calculations demonstrating compliance with the requirement to retain the 1" water quality volume.

Standard 7: Redevelopment

The proposed project is not a redevelopment.

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

Best management practices (BMP) for erosion and sedimentation control are staked straw bales, filter fences, wattles, hydro seeding, and phased development. Many stormwater BMP technologies (e.g., infiltration technologies) are not designed to handle the high concentrations of sediments typically found in construction runoff and must be protected from construction-related sediment loadings. Construction BMP's **must** be maintained. In developing the proposed project certain measures will be implemented to minimize impacts erosion and sedimentation could have on surrounding areas. This section addresses items that involve proper construction techniques, close surveillance of workmanship, and immediate response to emergency situations. The developer must be prepared to provide whatever reasonable measures are necessary to protect the environment during construction and to stabilize all disturbed areas as soon as construction ends. Construction period pollution prevention and erosion and sediment control shall meet the requirements for the 2022 EPA Construction General Permit for all projects requiring coverage under the CGP.

Pre-Construction

1. The contractor shall have a stockpile of materials required to control erosion on-site to be used to supplement or repair erosion control devices. These materials shall include, but are not limited to straw bales, silt fence, wattles and crushed stone.
2. The contractor is responsible for erosion control on site and shall utilize erosion control measures where needed, regardless of whether the measures are specified on the plan or in the order of conditions.

Preliminary Site Work

1. Excavated materials should be stockpiled, separating the topsoil for future use on the site. Erosion control shall be utilized along the down slope side of the piles and side slopes shall not exceed 2:1.
2. If intense rainfall is anticipated, the installation of supplemental straw bale dikes, silt fences, or armored dikes shall be considered.
3. Unsuitable excavated material shall be removed from the site.
4. Construction entrance shall be installed.
5. Existing catch basins shall be protected with silt sacks.

Ongoing Site Work

1. Erosion control measures shall be regularly inspected and replaced as needed.
2. Dewatering shall be done in a manner so as not to transmit silt, sand or particulate matter to the receiving water or existing drainage system.

Landscaping

1. Landscaping shall occur as soon as possible to provide permanent stabilization of disturbed surfaces.
2. If the season or adverse weather conditions do not allow the establishment of vegetation, temporary mulching with straw, wood chips weighted with snow fence or branches, or other methods shall be provided.
3. A minimum of 4 inches of topsoil shall be placed and its surface smoothed to the specified grades.
4. The use of herbicides is strongly discouraged.

5. Hydro seeding is encouraged for steep slopes. Application rates on slopes greater than 3:1 shall have a minimum seeding rate of 5-lbs/1000 SF. A latex or fiber tackifier shall be used on these slopes at a minimum rate of 50 lbs. of tackifier per 500 gallons of water used.

Standard 9: Operations and Maintenance Plan

The information provided herein is intended to provide the base information for operation and maintenance of the site in perpetuity subject to updates and revisions as required at a future date. As such all future property owners must be notified in writing of this plan and be provided with a copy of this plan, a complete set of the design drawings and/or a completed as-built plan showing all the drainage features as they were constructed, which are considered part of this document. Please see the attached Operations and Maintenance Log (Appendix VII).

Stormwater management system owner: Neck Farm, LLC
The party responsible for operation and maintenance: Neck Farm, LLC

Preliminary Stormwater Operation and Maintenance Budget
Quarterly Inspection and Maintenance x $2,500 per visit = $10,000 annually

Illicit Discharge - Practices to Minimize Storm Water Contamination

- All waste materials will be collected and stored in a securely lidded metal dumpster.
- All trash and debris from the site will be deposited in the dumpster. The dumpster will be emptied on a regular schedule prior to being over full.
- All personnel will be instructed regarding the correct procedure for waste disposal.
- Good housekeeping and spill control practices will be followed to minimize storm water contamination from petroleum products, paints, and cleaning products.
- All site vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage.
- Spill kits will be provided with any activity that could provide contamination.
- All paint containers and curing compounds will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewers, but will be properly disposed according to the manufacturer's instructions.
- All spills will be cleaned up immediately upon discovery. Spills large enough to reach the storm sewers will be reported to the Massachusetts Department of Environmental Protection Northeast Regional Office at 1-888-304-1133.

Porous Pavement
In most porous pavement designs, the pavement itself acts as pretreatment to the stone reservoir below. Consequently, frequent cleaning and maintenance of the pavement surface is critical to prevent clogging. To keep the surface clean, frequent vacuum sweeping along with jet washing of asphalt and concrete pavement is required. No winter sanding shall be conducted on the porous surface. Annual inspections shall occur with a representative from the Town of Lancaster Department of Community Development and Planning as witness to the inspection.

Deep Sump Hooded Catch Basins
Inspect deep sump catch basins four times per year including the end of the foliage and snow removal seasons. Sediments must also be removed four times per year or when the depth of deposits is greater than or equal to one half the depth of the sump. Vacuum trucks are to be used to remove trapped sediment and supernatant.

Although catch basin debris often contains concentrations of oil and hazardous materials such as petroleum hydrocarbons and metals, MassDEP classifies them as solid waste. Any contaminated materials must be evaluated in accordance with the Hazardous Waste Regulations, 310 CMR 30.00, and handled as hazardous waste. MassDEP regulations prohibit landfills from accepting materials that contain free draining liquids.

Street Sweeping

Parking lot and drive aisles shall be swept biannually: once in the spring following winter activities such as sanding and once in the fall following leaf loss. Street sweepings does not mean the material generated during the cleanup of a spill or material from other structures associated with a roadway such as catch basins.

Roof Drain Leaders

Routine roof inspections shall be performed two times per year. The roof shall be kept clean and free of debris, and the roof drainage systems shall be kept clear. Gutters and downspouts shall be cleaned at least twice per year, or more frequently as necessary.

Vegetated Areas Maintenance

Although not a structural component of the drainage system, the maintenance of vegetated areas may affect the functioning of stormwater management practices. This includes the health/density of vegetative cover and activities such as the application and disposal of lawn and garden care products, disposal of leaves and yard trimmings.

Initial Post-Construction Inspection

During the initial period of vegetation establishment pruning and weeding are required twice in first year by contractor or owner. Any dead vegetation/plantings found after the first year will be replaced. Proper mulching is mandatory and regular watering may be required initially to ensure proper establishment of new vegetation.

Long-Term Maintenance

The planted areas shall be inspected on a semi-annual basis and any litter removed. Weeds and invasive plant species shall be removed by hand. Maintain planted areas adjacent to pavement to prevent soil washout. Immediately clean any soil deposits on pavement. Leaf litter and other detritus shall be removed twice per year. If needed to maintain aesthetic appearance, perennial plantings may be trimmed at the end of the growing season.

Trees and shrubs shall be inspected twice per year to evaluate health and attended to as necessary. Seeded ground cover or grass areas shall not receive mulching. Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. Plant alternative mixtures of grass species in the event of unsuccessful establishment. The grass vegetation should not be cut to a height less than four inches.

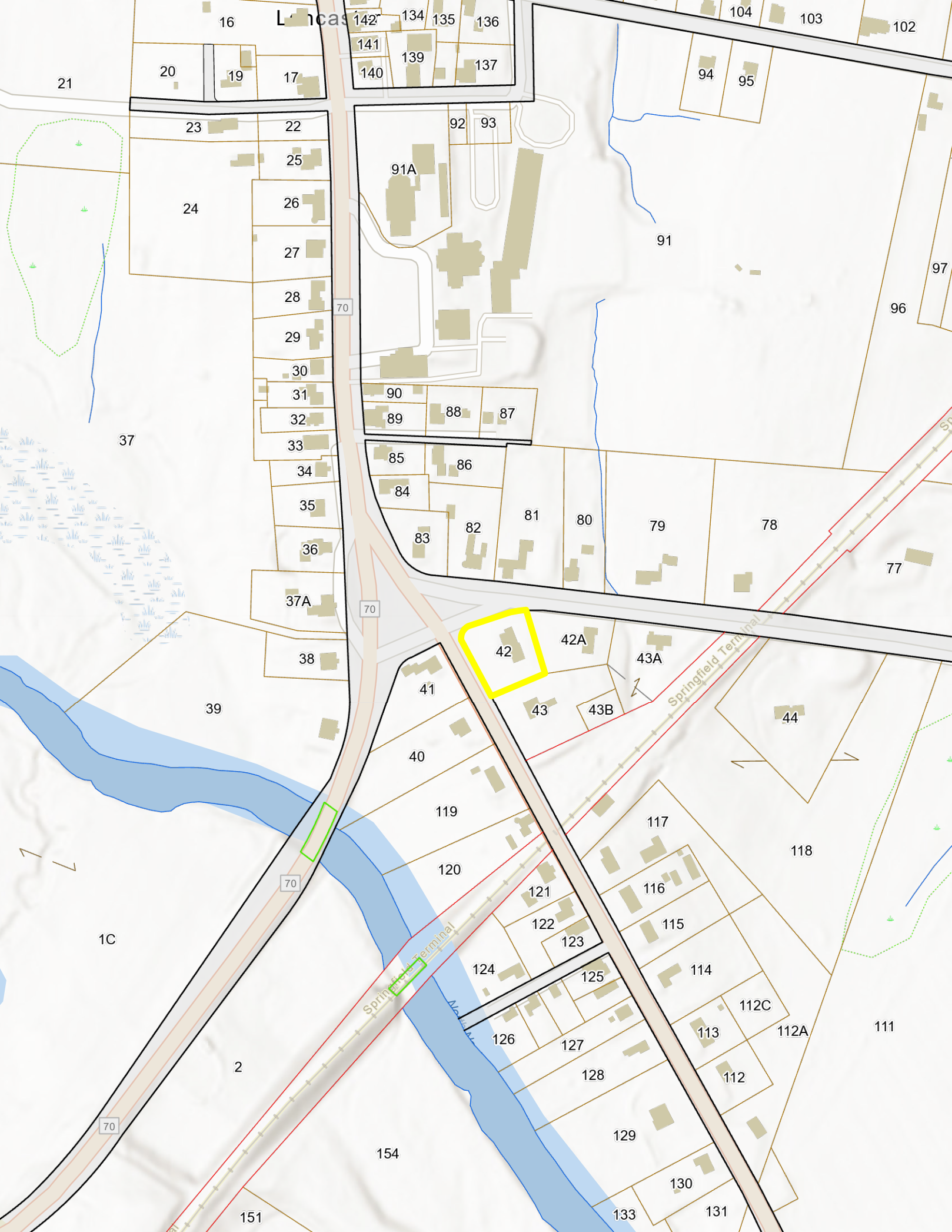
Pesticide/Herbicide Usage

No pesticides are to be used unless a single spot treatment is required for a specific control application.

Standard 10: Prohibition of Illicit Discharges

No illicit discharges currently exist and no future illicit discharges will be allowed including wastewater discharges and discharges of stormwater contaminated by contact with process wastes, raw materials, toxic pollutants, hazardous substances, soil, or grease.

Appendix I Locus Map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133
131

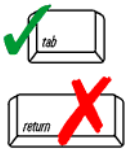
Appendix II Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☐ An Illicit Discharge Compliance Statement is attached;

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

Appendix III NRCS Soils Map

Soil Map—Worcester County, Massachusetts, Northeastern Part
(13 Neck Road, Lancaster, MA)

Map Scale: 1:6,570 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 300 600 1200 1800

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Worcester County, Massachusetts, Northeastern Part
Survey Area Data: Version 15, Jun 10, 2020

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

Date(s) aerial images were photographed: Aug 12, 2019—Sep 29, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	3.8	1.9%
8A	Limerick silt loam, 0 to 3 percent slopes	27.7	13.7%
53A	Freetown muck, ponded, 0 to 1 percent slopes	2.9	1.4%
70A	Ridgebury fine sandy loam, 0 to 3 percent slopes	13.6	6.7%
70B	Ridgebury fine sandy loam, 3 to 8 percent slopes	2.3	1.1%
97A	Suncook loamy fine sand, 0 to 3 percent slopes	16.1	7.9%
98A	Winooski very fine sandy loam, 0 to 3 percent slopes	34.0	16.8%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	4.3	2.1%
255D	Windsor loamy sand, 15 to 25 percent slopes	0.2	0.1%
305B	Paxton fine sandy loam, 3 to 8 percent slopes	29.2	14.4%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	14.0	6.9%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	41.5	20.5%
651	Udorthents, smoothed	12.5	6.2%
Totals for Area of Interest		**202.2**	**100.0%**

Worcester County, Massachusetts, Northeastern Part

305B—Paxton fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2t2qp
Elevation: 0 to 1,570 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Paxton and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 8 inches: fine sandy loam
Bw1 - 8 to 15 inches: fine sandy loam
Bw2 - 15 to 26 inches: fine sandy loam
Cd - 26 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 18 to 39 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s

Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge
Percent of map unit: 9 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Summit, backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury
Percent of map unit: 6 percent
Landform: Depressions, ground moraines, hills, drainageways
Landform position (two-dimensional): Toeslope, backslope, footslope
Landform position (three-dimensional): Base slope, head slope, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton
Percent of map unit: 5 percent
Landform: Hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Data Source Information

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

Appendix IIII Existing and Proposed Drainage Figures

SOIL TESTING DATA

DATE: 1/6/2022
EVALUATOR: RUSSELL TEDFORD- SE#14379

TP-2022-1
0-18" Ap SL TOP SOIL
18-33" Bw SL
33-64"+ C S MEDIUM SAND
REDOX 40", ESHGW 40", NO REFUSAL

TP-2022-2
0-19" FILL DRIVEWAY SUBBASE
19-29" Bw SL
29-60"+ C S MEDIUM SAND
REDOX 40", ESHGW 40", NO REFUSAL

TP-2022-3
0-24" FILL SL
24-36" Bw SL GRAVEL 0-5%
36-58"+ C S MEDIUM SAND
REDOX 38", ESHGW 38", NO REFUSAL

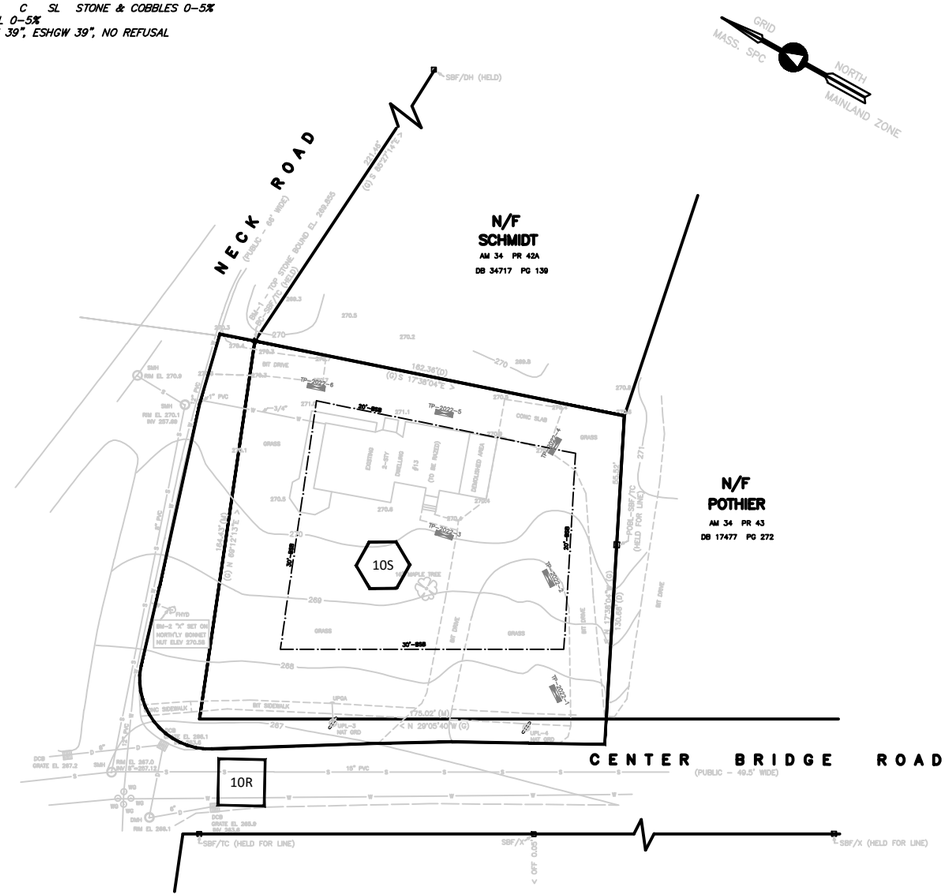
TP-2022-4
0-36" FILL CONSTRUCTION DEBRIS
36-60"+ C SL STONE & COBBLES 0-5%
GRAVEL 0-5%
NO REDOX, NO REFUSAL, BOULDERS 60"

TP-2022-5
0-12" FILL SL CONSTRUCTION DEBRIS
12-24" Ab SL
20-36" Bw SL
36-64"+ C SL STONE & COBBLES 0-5%
GRAVEL 0-5%
REDOX 36", ESHGW 36", NO REFUSAL

TP-2022-6
0-24" Ap SL
24-36" BW SL
36-66"+ C SL STONE & COBBLES 0-5%
GRAVEL 0-5%
REDOX 39", ESHGW 39", NO REFUSAL

LEGEND

SUBCATCHMENT 10S
REACH 10R
POND 1P



PRE-DEVELOPMENT WATERSHED PLAN

SOIL TESTING DATA

DATE: 1/6/2022
EVALUATOR: RUSSELL TEDFORD- SE#14379

TP-2022-1
0-18" Ap SL TOP SOIL
18-33" Bw SL
33-64"+ C S MEDIUM SAND
REDOX 40", ESHGW 40", NO REFUSAL

TP-2022-2
0-19" FILL DRIVEWAY SUBBASE
19-29" Bw SL
29-60"+ C S MEDIUM SAND
REDOX 40", ESHGW 40", NO REFUSAL

TP-2022-3
0-24" FILL SL
24-36" Bw SL GRAVEL 0-5%
36-58"+ C S MEDIUM SAND
REDOX 38", ESHGW 38", NO REFUSAL

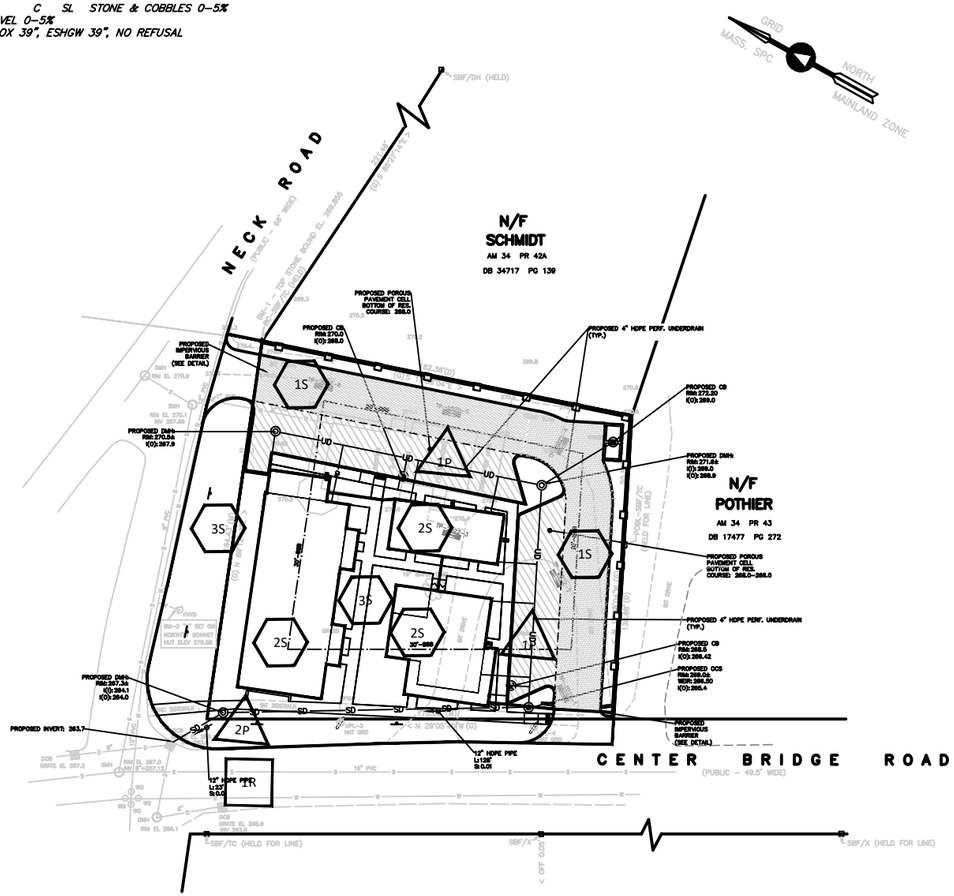
TP-2022-4
0-36" FILL CONSTRUCTION DEBRIS
36-60"+ C SL STONE & COBBLES 0-5%
GRAVEL 0-5%
NO REDOX, NO REFUSAL, BOULDERS 60"

TP-2022-5
0-12" FILL SL CONSTRUCTION DEBRIS
12-24" Ab SL
20-36" Bw SL
36-64"+ C SL STONE & COBBLES 0-5%
GRAVEL 0-5%
REDOX 36", ESHGW 36", NO REFUSAL

TP-2022-6
0-24" Ap SL
24-36" BW SL
36-66"+ C SL STONE & COBBLES 0-5%
GRAVEL 0-5%
REDOX 39", ESHGW 39", NO REFUSAL

LEGEND

SUBCATCHMENT 10S
REACH 10R
POND 1P



POST-DEVELOPMENT WATERSHED PLAN

PROJECT NAME:

NECK FARM

PROJECT ADDRESS:

13 Neck Road
Lancaster, Massachusetts 01523

PREPARED FOR:

Neck Farm, LLC

66 West Street, Ste 1F
Leominster, Massachusetts 01453

HANCOCK ASSOCIATES

Civil Engineers

Land Surveyors

Environmental Consultants

34 CHELMSFORD STREET, CHELMSFORD, MA 01824
VOICE (978) 244-0110, FAX (978) 244-1133
WWW.HANCOCKASSOCIATES.COM

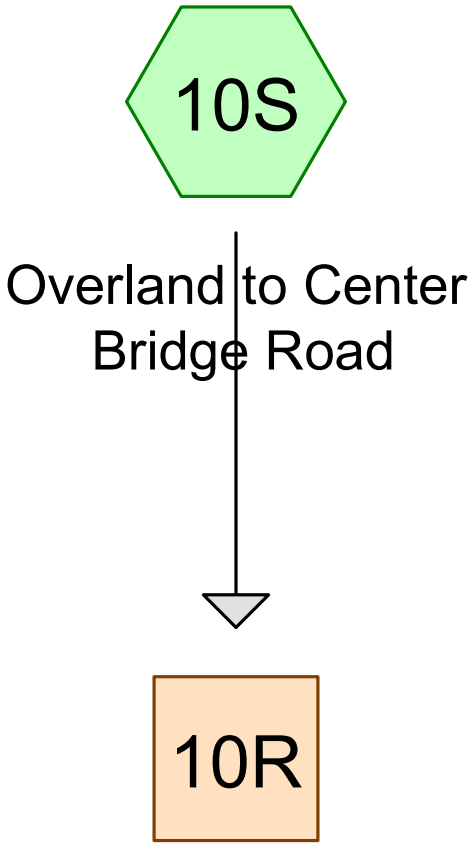
NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION
1	RT	JP	2/21/24	REVISED PERVIOUS PAVEMENT

DATE:	10/5/23	DESIGN BY:	RT
SCALE:	AS SHOWN	DRAWN BY:	RT
CHECK BY:	JP	CHECK BY:	BG

WATERSHED ANALYSIS PLAN

DWG: 24939-eng.dwg	WP
LAYOUT: PREPOST	
SHEET: 1 OF 1	
JOB NO.: 24939	

Appendix V Hydrocad Output



PRE DEVELOPMENT

Subcat Reach Pond Link

Routing Diagram for 24939-hcadR1
Prepared by Hancock Associates, Printed 4/11/2024
HydroCAD® 10.20-3g s/n 00711 © 2023 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
21,680	74	>75% Grass cover, Good, HSG C (10S)
6,340	98	Paved parking, HSG C (10S)
2,620	98	Roofs, HSG C (10S)
30,640	**81**	**TOTAL AREA**

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

Subcatchment 10S: Overland to Center Bridge Road Runoff Area=30,640 sf 29.24% Impervious Runoff Depth>1.37"
Flow Length=165' Tc=10.9 min CN=81 Runoff=1.02 cfs 3,503 cf

Reach 10R: Center Bridge Road Inflow=1.02 cfs 3,503 cf
Outflow=1.02 cfs 3,503 cf

Total Runoff Area = 30,640 sf Runoff Volume = 3,503 cf Average Runoff Depth = 1.37"
70.76% Pervious = 21,680 sf 29.24% Impervious = 8,960 sf

Summary for Subcatchment 10S: Overland to Center Bridge Road

Runoff = 1.02 cfs @ 12.16 hrs, Volume= 3,503 cf, Depth> 1.37"
Routed to Reach 10R : Center Bridge Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

Area (sf)	CN	Description
2,620	98	Roofs, HSG C
6,340	98	Paved parking, HSG C
21,680	74	>75% Grass cover, Good, HSG C
30,640	81	Weighted Average
21,680		70.76% Pervious Area
8,960		29.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0060	0.09		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.13"
1.7	115	0.0270	1.15		**Shallow Concentrated Flow, Shallow Flow** Short Grass Pasture Kv= 7.0 fps
10.9	165	Total			

Summary for Reach 10R: Center Bridge Road

Inflow Area = 30,640 sf, 29.24% Impervious, Inflow Depth > 1.37" for 2-Year event
Inflow = 1.02 cfs @ 12.16 hrs, Volume= 3,503 cf
Outflow = 1.02 cfs @ 12.16 hrs, Volume= 3,503 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

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

Subcatchment 10S: Overland to Center Bridge Road Runoff Area=30,640 sf 29.24% Impervious Runoff Depth>2.65"
Flow Length=165' Tc=10.9 min CN=81 Runoff=1.97 cfs 6,757 cf

Reach 10R: Center Bridge Road Inflow=1.97 cfs 6,757 cf
Outflow=1.97 cfs 6,757 cf

Total Runoff Area = 30,640 sf Runoff Volume = 6,757 cf Average Runoff Depth = 2.65"
70.76% Pervious = 21,680 sf 29.24% Impervious = 8,960 sf

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

Subcatchment 10S: Overland to Center Bridge Road Runoff Area=30,640 sf 29.24% Impervious Runoff Depth>5.98"
Flow Length=165' Tc=10.9 min CN=81 Runoff=4.32 cfs 15,270 cf

Reach 10R: Center Bridge Road Inflow=4.32 cfs 15,270 cf
Outflow=4.32 cfs 15,270 cf

Total Runoff Area = 30,640 sf Runoff Volume = 15,270 cf Average Runoff Depth = 5.98"
70.76% Pervious = 21,680 sf 29.24% Impervious = 8,960 sf

Summary for Subcatchment 10S: Overland to Center Bridge Road

Runoff = 4.32 cfs @ 12.15 hrs, Volume= 15,270 cf, Depth> 5.98"
Routed to Reach 10R : Center Bridge Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.64"

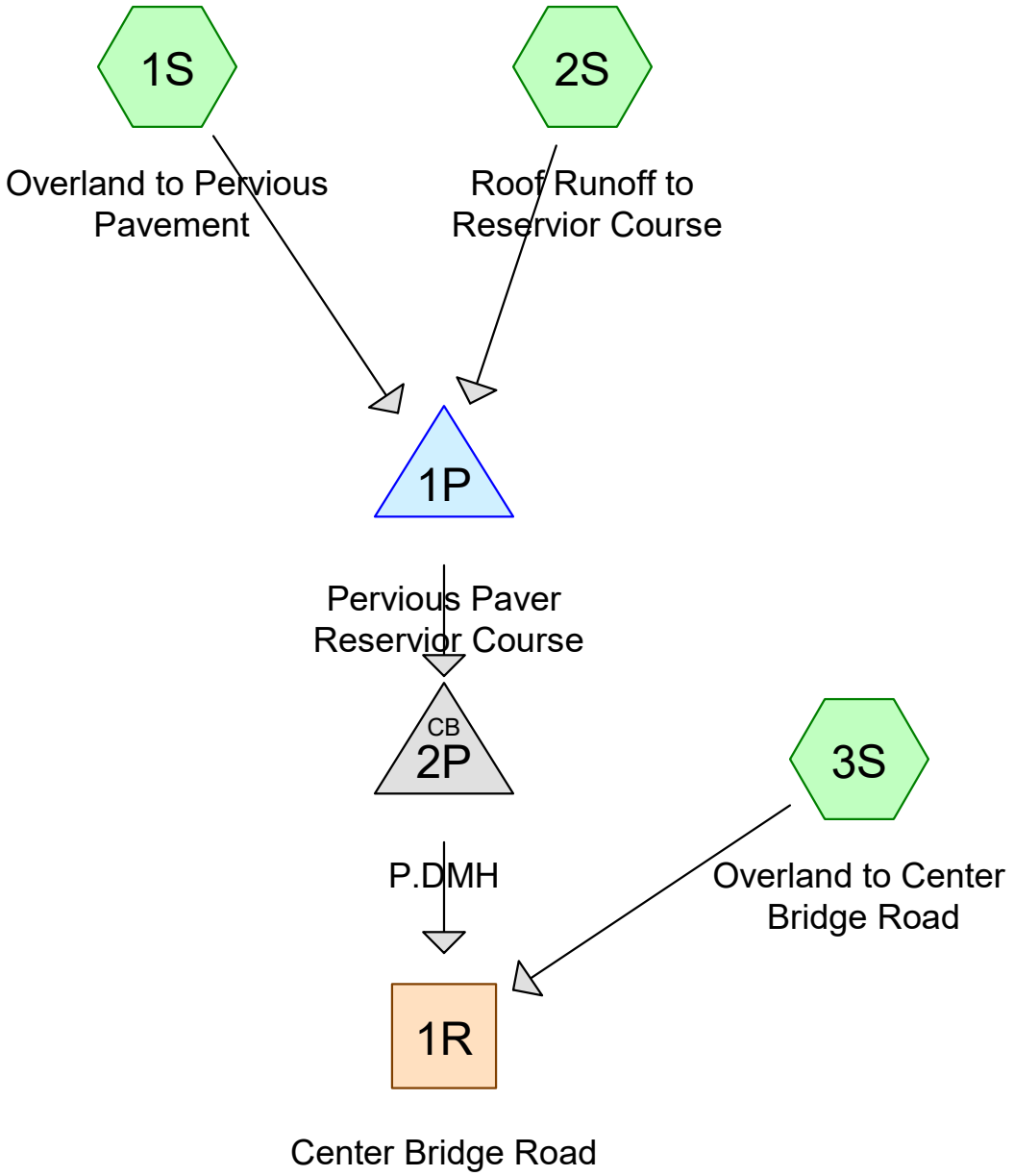
Area (sf)	CN	Description
2,620	98	Roofs, HSG C
6,340	98	Paved parking, HSG C
21,680	74	>75% Grass cover, Good, HSG C
30,640	81	Weighted Average
21,680		70.76% Pervious Area
8,960		29.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0060	0.09		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.13"
1.7	115	0.0270	1.15		**Shallow Concentrated Flow, Shallow Flow** Short Grass Pasture Kv= 7.0 fps
10.9	165	Total			

Summary for Reach 10R: Center Bridge Road

Inflow Area = 30,640 sf, 29.24% Impervious, Inflow Depth > 5.98" for 100-Year event
Inflow = 4.32 cfs @ 12.15 hrs, Volume= 15,270 cf
Outflow = 4.32 cfs @ 12.15 hrs, Volume= 15,270 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs



POST DEVELOPMENT

Subcat Reach Pond Link

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
11,580	74	>75% Grass cover, Good, HSG C (1S, 3S)
9,935	98	Paved parking, HSG C (1S, 3S)
6,445	98	Roofs, HSG C (2S)
1,070	98	Sidewalk, HSG C (1S)
1,610	98	Sidewalks, HSG C (3S)
30,640	**89**	**TOTAL AREA**

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

Subcatchment 1S: Overland to Pervious Pavement Runoff Area=13,265 sf 76.22% Impervious Runoff Depth>1.33"
Tc=460.0 min CN=92 Runoff=0.08 cfs 1,470 cf

Subcatchment 2S: Roof Runoff to Reservior Course Runoff Area=6,445 sf 100.00% Impervious Runoff Depth>2.79"
Tc=6.0 min CN=98 Runoff=0.45 cfs 1,500 cf

Subcatchment 3S: Overland to Center Bridge Road Runoff Area=10,930 sf 22.92% Impervious Runoff Depth>1.31"
Tc=6.0 min CN=80 Runoff=0.41 cfs 1,193 cf

Reach 1R: Center Bridge Road Inflow=0.41 cfs 1,193 cf
Outflow=0.41 cfs 1,193 cf

Pond 1P: Pervious Paver Reservior Course Peak Elev=266.05' Storage=170 cf Inflow=0.46 cfs 2,970 cf
Discarded=0.21 cfs 2,957 cf Primary=0.00 cfs 0 cf Outflow=0.21 cfs 2,957 cf

Pond 2P: P.DMH Peak Elev=264.00' Inflow=0.00 cfs 0 cf
12.0" Round Culvert n=0.012 L=23.0' S=0.0130 '/' Outflow=0.00 cfs 0 cf

Total Runoff Area = 30,640 sf Runoff Volume = 4,162 cf Average Runoff Depth = 1.63"
37.79% Pervious = 11,580 sf 62.21% Impervious = 19,060 sf

Summary for Subcatchment 1S: Overland to Pervious Pavement

Runoff = 0.08 cfs @ 17.90 hrs, Volume= 1,470 cf, Depth> 1.33"
Routed to Pond 1P : Pervious Paver Reservior Course

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

	Area (sf)	CN	Description
	9,040	98	Paved parking, HSG C
*	1,070	98	Sidewalk, HSG C
	3,155	74	>75% Grass cover, Good, HSG C
	13,265	92	Weighted Average
	3,155		23.78% Pervious Area
	10,110		76.22% Impervious Area

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

Summary for Subcatchment 2S: Roof Runoff to Reservior Course

Runoff = 0.45 cfs @ 12.09 hrs, Volume= 1,500 cf, Depth> 2.79"
Routed to Pond 1P : Pervious Paver Reservior Course

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

	Area (sf)	CN	Description
	6,445	98	Roofs, HSG C
	6,445		100.00% Impervious Area

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

Summary for Subcatchment 3S: Overland to Center Bridge Road

Runoff = 0.41 cfs @ 12.10 hrs, Volume= 1,193 cf, Depth> 1.31"
Routed to Reach 1R : Center Bridge Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.22"

	Area (sf)	CN	Description
*	1,610	98	Sidewalks, HSG C
	8,425	74	>75% Grass cover, Good, HSG C
	895	98	Paved parking, HSG C
	10,930	80	Weighted Average
	8,425		77.08% Pervious Area
	2,505		22.92% Impervious Area

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

Summary for Reach 1R: Center Bridge Road

Inflow Area = 30,640 sf, 62.21% Impervious, Inflow Depth > 0.47" for 2-Year event
Inflow = 0.41 cfs @ 12.10 hrs, Volume= 1,193 cf
Outflow = 0.41 cfs @ 12.10 hrs, Volume= 1,193 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Pervious Paver Reservior Course

Inflow Area = 19,710 sf, 83.99% Impervious, Inflow Depth > 1.81" for 2-Year event
Inflow = 0.46 cfs @ 12.09 hrs, Volume= 2,970 cf
Outflow = 0.21 cfs @ 12.00 hrs, Volume= 2,957 cf, Atten= 54%, Lag= 0.0 min
Discarded = 0.21 cfs @ 12.00 hrs, Volume= 2,957 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Routed to Pond 2P : P.DMH

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 266.05' @ 12.27 hrs Surf.Area= 8,840 sf Storage= 170 cf

Plug-Flow detention time= 4.1 min calculated for 2,957 cf (100% of inflow)
Center-of-Mass det. time= 2.7 min (883.6 - 880.9)

Volume	Invert	Avail.Storage	Storage Description
#1	266.00'	1,761 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 4,420 cf Overall - 18 cf Embedded = 4,402 cf x 40.0% Voids
#2	266.00'	18 cf	**4.0" Round Pipe Storage** Inside #1 L= 210.0'
		1,779 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
266.00	8,840	0	0
266.50	8,840	4,420	4,420

Device	Routing	Invert	Outlet Devices
#1	Discarded	266.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	265.40'	**12.0" Round Culvert** L= 128.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 265.40' / 264.10' S= 0.0102 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Device 2	266.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.21 cfs @ 12.00 hrs HW=266.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=266.00' TW=264.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 0.00 cfs of 1.02 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: P.DMH

Inflow Area = 19,710 sf, 83.99% Impervious, Inflow Depth = 0.00" for 2-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Routed to Reach 1R : Center Bridge Road

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 264.00' @ 5.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	264.00'	**12.0" Round Culvert** L= 23.0' CPP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 264.00' / 263.70' S= 0.0130 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=264.00' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Controls 0.00 cfs)

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

Subcatchment 1S: Overland to Pervious Pavement Runoff Area=13,265 sf 76.22% Impervious Runoff Depth>2.27"
Tc=460.0 min CN=92 Runoff=0.13 cfs 2,507 cf

Subcatchment 2S: Roof Runoff to Reservior Course Runoff Area=6,445 sf 100.00% Impervious Runoff Depth>4.26"
Tc=6.0 min CN=98 Runoff=0.68 cfs 2,290 cf

Subcatchment 3S: Overland to Center Bridge Road Runoff Area=10,930 sf 22.92% Impervious Runoff Depth>2.56"
Tc=6.0 min CN=80 Runoff=0.79 cfs 2,334 cf

Reach 1R: Center Bridge Road Inflow=0.79 cfs 2,334 cf
Outflow=0.79 cfs 2,334 cf

Pond 1P: Pervious Paver Reservior Course Peak Elev=266.12' Storage=429 cf Inflow=0.69 cfs 4,797 cf
Discarded=0.21 cfs 4,777 cf Primary=0.00 cfs 0 cf Outflow=0.21 cfs 4,777 cf

Pond 2P: P.DMH Peak Elev=264.00' Inflow=0.00 cfs 0 cf
12.0" Round Culvert n=0.012 L=23.0' S=0.0130 '/' Outflow=0.00 cfs 0 cf

Total Runoff Area = 30,640 sf Runoff Volume = 7,131 cf Average Runoff Depth = 2.79"
37.79% Pervious = 11,580 sf 62.21% Impervious = 19,060 sf

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

Subcatchment 1S: Overland to Pervious Pavement Runoff Area=13,265 sf 76.22% Impervious Runoff Depth>4.58"
Tc=460.0 min CN=92 Runoff=0.25 cfs 5,060 cf

Subcatchment 2S: Roof Runoff to Reservior Course Runoff Area=6,445 sf 100.00% Impervious Runoff Depth>7.72"
Tc=6.0 min CN=98 Runoff=1.23 cfs 4,149 cf

Subcatchment 3S: Overland to Center Bridge Road Runoff Area=10,930 sf 22.92% Impervious Runoff Depth>5.87"
Tc=6.0 min CN=80 Runoff=1.76 cfs 5,347 cf

Reach 1R: Center Bridge Road Inflow=1.76 cfs 5,347 cf
Outflow=1.76 cfs 5,347 cf

Pond 1P: Pervious Paver Reservior Course Peak Elev=266.46' Storage=1,630 cf Inflow=1.25 cfs 9,209 cf
Discarded=0.21 cfs 7,578 cf Primary=0.00 cfs 0 cf Outflow=0.21 cfs 7,578 cf

Pond 2P: P.DMH Peak Elev=264.00' Inflow=0.00 cfs 0 cf
12.0" Round Culvert n=0.012 L=23.0' S=0.0130 '/' Outflow=0.00 cfs 0 cf

Total Runoff Area = 30,640 sf Runoff Volume = 14,556 cf Average Runoff Depth = 5.70"
37.79% Pervious = 11,580 sf 62.21% Impervious = 19,060 sf

Summary for Subcatchment 1S: Overland to Pervious Pavement

Runoff = 0.25 cfs @ 17.88 hrs, Volume= 5,060 cf, Depth> 4.58"
Routed to Pond 1P : Pervious Paver Reservior Course

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.64"

	Area (sf)	CN	Description
	9,040	98	Paved parking, HSG C
*	1,070	98	Sidewalk, HSG C
	3,155	74	>75% Grass cover, Good, HSG C
	13,265	92	Weighted Average
	3,155		23.78% Pervious Area
	10,110		76.22% Impervious Area

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

Summary for Subcatchment 2S: Roof Runoff to Reservior Course

Runoff = 1.23 cfs @ 12.09 hrs, Volume= 4,149 cf, Depth> 7.72"
Routed to Pond 1P : Pervious Paver Reservior Course

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.64"

	Area (sf)	CN	Description
	6,445	98	Roofs, HSG C
	6,445		100.00% Impervious Area

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

Summary for Subcatchment 3S: Overland to Center Bridge Road

Runoff = 1.76 cfs @ 12.09 hrs, Volume= 5,347 cf, Depth> 5.87"
Routed to Reach 1R : Center Bridge Road

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=8.64"

	Area (sf)	CN	Description
*	1,610	98	Sidewalks, HSG C
	8,425	74	>75% Grass cover, Good, HSG C
	895	98	Paved parking, HSG C
	10,930	80	Weighted Average
	8,425		77.08% Pervious Area
	2,505		22.92% Impervious Area

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

Summary for Reach 1R: Center Bridge Road

Inflow Area = 30,640 sf, 62.21% Impervious, Inflow Depth > 2.09" for 100-Year event
Inflow = 1.76 cfs @ 12.09 hrs, Volume= 5,347 cf
Outflow = 1.76 cfs @ 12.09 hrs, Volume= 5,347 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Summary for Pond 1P: Pervious Paver Reservior Course

Inflow Area = 19,710 sf, 83.99% Impervious, Inflow Depth > 5.61" for 100-Year event
Inflow = 1.25 cfs @ 12.09 hrs, Volume= 9,209 cf
Outflow = 0.21 cfs @ 11.65 hrs, Volume= 7,578 cf, Atten= 83%, Lag= 0.0 min
Discarded = 0.21 cfs @ 11.65 hrs, Volume= 7,578 cf
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Routed to Pond 2P : P.DMH

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 266.46' @ 20.00 hrs Surf.Area= 8,840 sf Storage= 1,630 cf

Plug-Flow detention time= 61.3 min calculated for 7,552 cf (82% of inflow)
Center-of-Mass det. time= 4.6 min (886.3 - 881.7)

Volume	Invert	Avail.Storage	Storage Description
#1	266.00'	1,761 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 4,420 cf Overall - 18 cf Embedded = 4,402 cf x 40.0% Voids
#2	266.00'	18 cf	**4.0" Round Pipe Storage** Inside #1 L= 210.0'
		1,779 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
266.00	8,840	0	0
266.50	8,840	4,420	4,420

Device	Routing	Invert	Outlet Devices
#1	Discarded	266.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.01'
#2	Primary	265.40'	**12.0" Round Culvert** L= 128.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 265.40' / 264.10' S= 0.0102 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf
#3	Device 2	266.50'	**4.0' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Discarded OutFlow Max=0.21 cfs @ 11.65 hrs HW=266.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.21 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=266.00' TW=264.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 0.00 cfs of 1.03 cfs potential flow)
└**3=Sharp-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 2P: P.DMH

Inflow Area = 19,710 sf, 83.99% Impervious, Inflow Depth = 0.00" for 100-Year event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0 cf
Routed to Reach 1R : Center Bridge Road

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 264.00' @ 5.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	264.00'	**12.0" Round Culvert** L= 23.0' CPP, projecting, no headwall, Ke= 0.900

Inlet / Outlet Invert= 264.00' / 263.70' S= 0.0130 '/' Cc= 0.900
n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=264.00' TW=0.00' (Dynamic Tailwater)
↑**1=Culvert** (Controls 0.00 cfs)

Appendix VI Hydrocad Output for Recharge Volume

Stage-Area-Storage for Pond 1P: Pervious Paver Reservior Course

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
266.00	**8,840**	0
266.01	8,840	35
266.02	8,840	71
266.03	8,840	107
266.04	8,840	142
266.05	8,840	178
266.06	8,840	214
266.07	8,840	249
266.08	8,840	285
266.09	8,840	321
266.10	8,840	356
266.11	8,840	392
266.12	8,840	428
266.13	8,840	464
266.14	8,840	499
266.15	8,840	535
266.16	8,840	571
266.17	8,840	607
266.18	8,840	643
266.19	8,840	678
266.20	8,840	714
266.21	8,840	750
266.22	8,840	786
266.23	8,840	821
266.24	8,840	857
266.25	8,840	893
266.26	8,840	929
266.27	8,840	964
266.28	8,840	1,000
266.29	8,840	1,036
266.30	8,840	1,071
266.31	8,840	1,107
266.32	8,840	1,142
266.33	8,840	1,178
266.34	8,840	1,213
266.35	8,840	1,249
266.36	8,840	1,284
266.37	8,840	1,319
266.38	8,840	1,355
266.39	8,840	1,390
266.40	8,840	1,425
266.41	8,840	1,461
266.42	8,840	1,496
266.43	8,840	1,531
266.44	8,840	1,567
266.45	8,840	1,602
266.46	8,840	1,638
266.47	8,840	1,673
266.48	8,840	1,708
266.49	8,840	1,744
266.50	8,840	**1,779**

Appendix IV Operations and Maintenance Log

Neck Farm

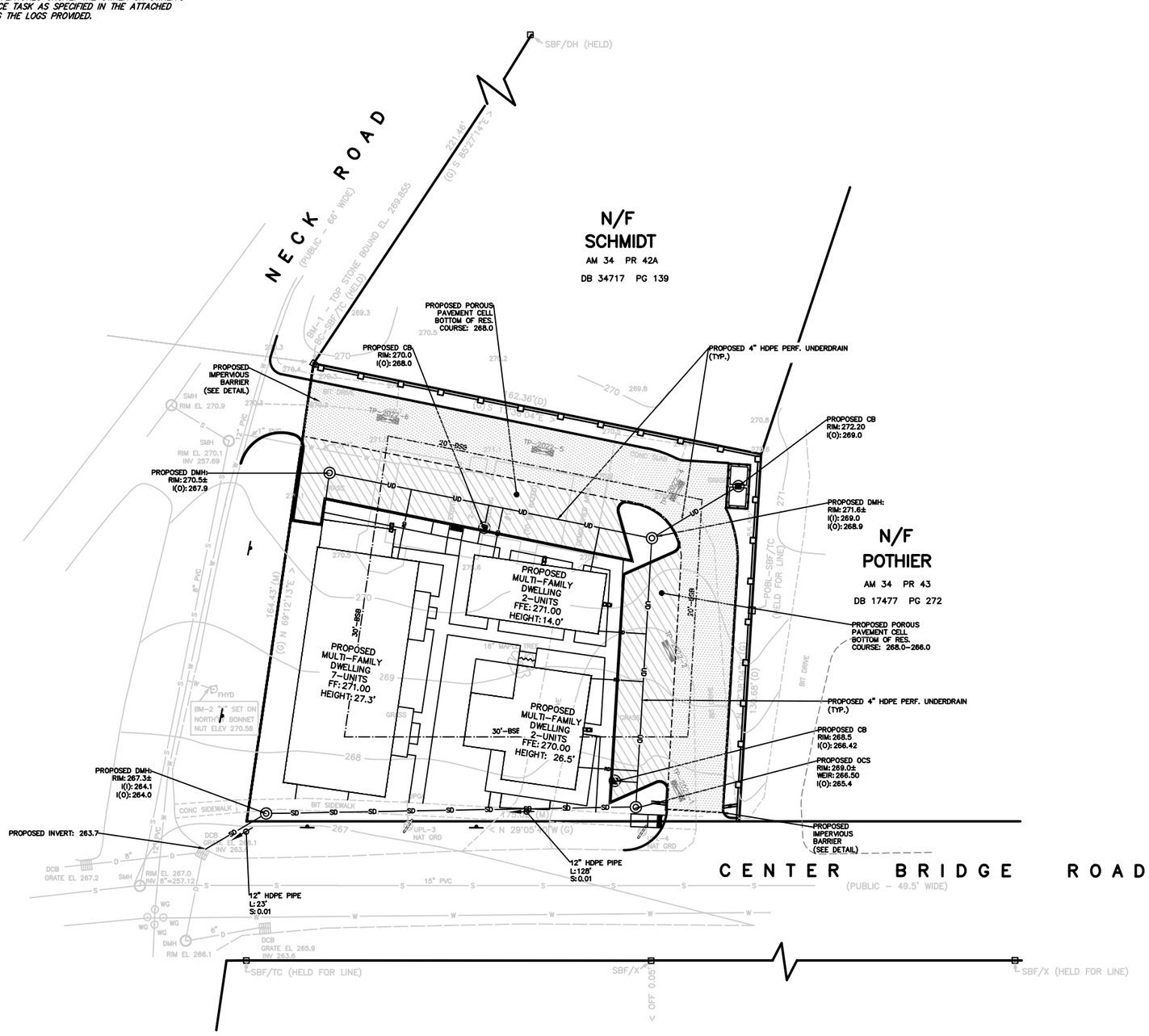
Operations and Maintenance Log

Inspections for Year:_____

Structural Best Management Practice	Action	Date Completed	Completed By	Comments
Deep Sump Hooded Catch Basin– Inspect/clean four times per year. Clean when sump is 50% full.	Inspect/ Clean			
	Inspect/ Clean			
	Inspect/ Clean			
	Inspect/ Clean			
	Inspect/ Clean			
Porous Pavement – Inspect twice per year. Clean as required.	Inspect			
	Inspect			
Street Sweeping Clean twice per year.	Clean			
	Clean			
Roof Drain Leaders – Inspect/clean twice per year.	Inspect/Clean			
	Inspect/Clean			
Vegetated Areas Maintenance – Inspect twice per year. Maintain as required.	Inspect			
	Inspect			

NOTES

1. THIS PLAN IS TO ACCOMPANY THE STORMWATER REPORT FOR THE NECK FARM PROJECT AND IS INTENDED TO SERVE AS A VISUAL AID TO SHOW STORMWATER MANAGEMENT FEATURES ONSITE. THE OWNER OR OWNER'S PROPERTY MANAGEMENT COMPANY SHALL PERFORM MAINTENANCE TASK AS SPECIFIED IN THE ATTACHED STORMWATER REPORT AND DOCUMENT SAID MAINTENANCE USING THE LOGS PROVIDED.



PROJECT NAME:

NECK FARM

PROJECT ADDRESS:

13 Neck Road
Lancaster, Massachusetts 01523

PREPARED FOR:

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NO.	BY	APP	DATE	ISSUE/REVISION DESCRIPTION

DATE:	10/5/23	DESIGN BY:	RT
SCALE:	AS SHOWN	DRAWN BY:	RT
CHECK BY:	JP	CHECK BY:	BG

STORMWATER MANAGEMENT OPERATIONS AND MAINTENANCE PLAN

DWG: 24939-eng.dwg	OM
LAYOUT: OM	
SHEET: 1 OF 1	
JOB NO.: 24939	