Flood Impact Analysis and Stormwater Management
Farm Road Homes
65 Farm Road, Sherborn, MA

September 28, 2023
Updated October 4, 2023

Prepared for:

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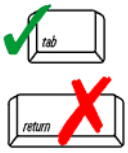
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

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.

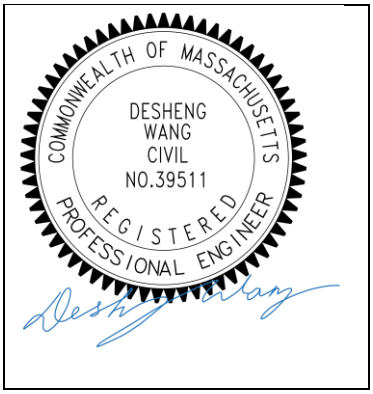
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



10/4/2023
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): Clustered development with open space

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. **N/A no discharge at all to downgradient off site from the project area.**

☒ 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] confirmed the infiltration rate

☒ 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.

N/A

☒ 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:

N/A

☐ 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.

N/A

[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) N/A

☐ 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.

Onsite drinking water wells is set more than 100 ft from infiltration basins.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable N/A Meet new project requirement to meet all performance standards

☐ 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.

Illicit Discharge Compliance Statement

Responsibility:

The owner is responsible for ultimate compliance with all provisions of the Massachusetts Stormwater Management Standards/ Policy, the USEPA NPDES Construction General Permit and responsible for identifying and eliminating illicit discharges (as defined by the USEPA[1])

Owner name/address/contact phone:

Fenix Partners Farm Road Development, LLC
177 Lake Street, Sherborn, MA 01770
C. 617-308-1961

To the best of my knowledge, the attached plans, computations and specifications meet the requirements of Standard 10 of the Massachusetts Stormwater Regulations (Handbook) regarding illicit discharges to the stormwater management system and that no known illicit discharges exist on the site.

Included with this statement are site plans, drawn to the scale, that identify the location of systems for conveying stormwater on the site and show that these systems do not allow the entry of any illicit discharges into the stormwater management system. The plans also show any systems for conveying wastewater and/ or groundwater on the site and show that there are no connections between the stormwater and wastewater systems.

Manager		10/4/2023
Robert W Murchinson	Title	Date

[1] Illicit Discharge Detection and Elimination – A Guidance Manual 2004

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1.0 Introduction

Existing Conditions

The project site is a 40B residential development located at 65 Farm Road in Sherborn, MA. The existing site contains 14 acres of land, consisting of 0.94 acres of wetland and 13.06 acres of upland. The upland area, where horse stables and open space are surrounded by woods, can be accessed via a gravel driveway (see Table 1 for details). The site is bordered by conservation land to the east, north, northwest, residential houses to the southwest, and Farm Road to the south.

Proposed Conditions

The proposed Farm Road Homes project will see the upland area repurposed for the development of a 32 unit neighborhood (16 single family homes and 8 duplexes). The units will be accessible from Farm Road via a paved road and individual drives. A network of paved sidewalks and walkways is also proposed (see Table 1 for details).

Table 1. Project Site Condition Summary

General Site Condition	Land Condition	**Land Break down**	Acres	Sq.Ft	Coverage, %
		Total Area	14.00	609702	-
	Unusable land	Wetland (Unusable)	0.94	40990	6.7%
	Usable land	Upland	13.06	568711	93.3%
Existing Conditions	**Disturbed**	Total	4.42	192531	31.6%
	Impervious	**Subtotal**	0.33	14400.00	2.4%
		Building (House & Porch)	0.04	1765	0.3%
		Gravel Road & Drive	0.29	12635	2.1%
		Sidewalk & Walkway	0.00	0	0.0%
	Pervious (usable OS)	Lawn/meadow	4.09	178131	29.2%
	Undisturbed	**Total**	9.58	417171	68.4%
	Usable OS	Upland Woods	8.64	376180	61.7%
	Unusable OS	Wetlands	0.94	40990	6.7%
	Total Usable OS	Lawn/landscape/woods	12.73	554311	90.9%
Proposed Conditions	**Disturbed**	**Total**	6.57	286284	47.0%
	Impervious	**Subtotal**	2.22	96856.09	15.9%
		Building (House & Porch)	1.12	48918	8.0%
		Paved (Road & Drive)	0.92	40180	6.6%
		Sidewalk & Walkway	0.18	7758	1.3%
	Pervious (usable OS)	Lawn/landscape	4.35	189428	31.1%
	Undisturbed	**Total**	7.42	323418	53.0%
	Usable OS	Upland Woods	6.48	282427	46.3%
	Unusable OS	Wetlands	0.94	40990	6.7%
	Total Usable OS	Lawn/landscape/woods	10.83	471855	77.4%

The site has very permeable sandy soils. In regards to surface hydrology, the site drains from north to south and southwest. See Figure 1 for USGS site locus map and Figure 2 for NRCS soil map. The proposed development will create 2.683 acres (about 17.43 percent) of impervious area of road, driveway and walk to houses. The design employs LID using uncurbed driveway with crushed stone

shoulder and grass swale and recharge basins. The development area will be surrounded by open space wooded area.

Table 1b. Land use in the watershed of study

	Land Uses (Acres)		Impervious area (ac)		
Subbasin	Existing	Proposed	Existing	Proposed	Increment
Roof	0.153	1.069	0.153	1.069	0.916
Pave	0.650	1.614	0.650	1.614	0.964
Pervious	14.589	12.709			
Total	15.392	15.392	0.803	2.683	1.880
Imperviousness (%)			5.22	17.43	

The property is shaped irregular. No stormwater management system existed on site for existing condition. The runoff mostly drains from north to south and southwest to BVW on the southwest and IVW on the southeast. Two small areas will drain north and northeast to conservation land. Five design control points are chosen to compare and to design the onsite stormwater management system:

- Control Point 1: to west BVW, stormwater management system include infiltration Basin A, grass swale, two oil/grit separators
- Control Pond 2: to 53 Farm Road Driveway culvert by swales and an infiltration basin B2
- Control Point 3: to southeast IVW by water quality swales, two infiltration basins (B1, C)
- Control Point 4: to middle east by maintaining existing land condition and crushed stone bedding for solar panel footing
- Control Pond 5: to north by maintaining existing land condition and crushed stone bedding for solar panel footing

The proposed drainage system will be designed to mimic the existing surface drainage pattern. The goal is to maintain or reduce the runoff peaks and volumes for up to 100-year storm events for proposed conditions to be equal or less than the existing conditions.

Upon request of project proponent, Fenix Partners Farm Road Development, LLC, Creative Land & Water Engineering, LLC (CLAWE) devised the flood control and stormwater management plan for the site to satisfy the requirements of the ten DEP stormwater management standards. This report presents the results.

2.0 Flood Condition Analyses and Flood Control

There are no flood control or stormwater management structures under the existing conditions at the project site. Based on the drainage pattern, the control points for flood control calculations as described in section 1.0. The following is a summary of the existing and proposed land uses within the study area. More detailed land used breakdown can be found in Appendix A.

Table 1c. Land use table in the watershed

Condition	Land Use	Area				
		Total	HSG A	HSG B	HGS C	HSG D
		acre	acre	acre	acre	acre
Existing	Roof	0.15	0.00	0.06	0.00	0.09
	Drive/Park	0.24	0.06	0.09	0.00	0.09
	Walk/Patio/etc.	0.41	0.00	0.17	0.05	0.18
	Lawn	4.40	0.04	0.98	1.51	1.86
	Woods	10.19	0.79	2.20	0.07	7.13
	Total	15.39	0.89	3.51	1.64	9.36
Proposed	Roof	1.07	0.00	0.42	0.18	0.48
	Drive/Park	1.18	0.06	0.44	0.25	0.43
	Walk/Patio/etc.	0.44	0.00	0.14	0.08	0.22
	Lawn	5.55	0.04	1.37	0.63	3.50
	Woods	7.16	0.79	1.14	0.51	4.73
	Total	15.39	0.89	3.51	1.64	9.36

The NRCS soil survey map (Figure 2) are used for runoff calculations. A total of forty-two (42) deep hole soil test pits were excavated on the site to collect groundwater and soil permeability data for the stormwater management and septic system design (see site plan for locations) Our field soil testing showed the soil is gravely medium loamy sand to medium sand, well drained soil. Soil groups ranging from Hydrologic Class A soils to ledge outcrop D soil in overall site with estimated high groundwater depth 3-20 ft with percolation rates under <2 mpi to 7 mpi. See soil logs for details. Detailed soil log can be found in Appendix D.

For the proposed conditions, the flood control will be achieved by four infiltration basins distributed relatively evenly through the project site with roadside exfiltration and water swales for better distribution of runoff. Pretreatments for paved areas to the infiltration trenches are proved by two sets of distribution manhole and oil/grit separators and roadway/driveway side grass swales. Figure 3d is a schematic diagram for the drainage system. The drainage divide and details of the infiltration trench, distribution manhole, oil/grit separator, and can be found in figures 3 to 8.

More details of the design features can be found on the engineering plan by Creative Land & Water Engineering, LLC dated September 28, 2023.

The flood conditions under both existing and proposed conditions are summarized in Table 2. Detailed data and calculations area presented in Appendices A and B.

Table 2 Summary of Peak Runoffs Leaving the Project Site

Condition	Sub-watershed	Peak Runoffs (cfs)					Runoff Volume (ac-ft)				
		2-year	10-year	25-year	50-yar	100-year	2-year	10-year	25-year	50-yar	100-year
Existing-	CP1 (AE)	9.95	22.82	31.62	38.28	45.65	0.93	2.05	2.82	3.41	4.07
	CP2 (BE)	1.39	3.76	5.46	6.79	8.31	0.14	0.32	0.45	0.55	0.67
	CP3 (CE)	3.86	9.14	12.77	15.53	18.61	0.34	0.76	1.05	1.27	1.53
	CP4 (DE)	0.24	0.56	0.77	0.93	1.11	0.02	0.04	0.06	0.07	0.09
	CP5 (EE)	0.29	0.63	0.86	1.03	1.21	0.03	0.06	0.08	0.09	0.11
Proposed-with flood control	CP1 (APb, AP-1, AP-2, AP-3, AP-4,AP-5,AP-6,AP-7)	4.80	12.73	19.16	26.65	35.03	0.59	1.61	2.33	2.90	3.54
	CP2 (BPb, B2P-1,B2P-2)	1.13	2.66	3.85	4.79	5.84	0.11	0.27	0.41	0.53	0.67
	CP3 (CPb, CP-1, CP-2, CP-3,B1P-1)	0.73	5.51	9.13	11.49	13.84	0.07	0.31	0.48	0.62	0.74
	CP4 (DE)	0.16	0.38	0.53	0.64	0.76	0.01	0.03	0.04	0.05	0.06
	CP5 (EE)	0.15	0.32	0.44	0.53	0.62	0.01	0.03	0.04	0.04	0.05

Table 2a Summary runoff peak and volume change

Control Point	Change in Peak Runoffs (%)					Change in Runoff Volume (%)				
	2-year	10-year	25-year	50-yar	100-year	2-year	10-year	25-year	50-yar	100-year
Cntrlp1	-51.8%	-44.2%	-39.4%	-30.4%	-23.3%	-36.6%	-21.5%	-17.4%	-15.0%	-13.0%
Cntrlp2	-18.7%	-29.3%	-29.5%	-29.5%	-29.7%	-21.4%	-15.6%	-8.9%	-3.6%	0.0%
Cntrlp3	-81.1%	-39.7%	-28.5%	-26.0%	-25.6%	-79.4%	-59.2%	-54.3%	-51.2%	-51.6%
Cntrlp4	-33.3%	-32.1%	-31.2%	-31.2%	-31.5%	-50.0%	-25.0%	-33.3%	-28.6%	-33.3%
Cntrlp5	-48.3%	-49.2%	-48.8%	-48.5%	-48.8%	-66.7%	-50.0%	-50.0%	-55.6%	-54.5%
Mini	-18.7%	-29.3%	-28.5%	-26.0%	-23.3%	-21.4%	-15.6%	-8.9%	-3.6%	0.0%
Max	-81.1%	-49.2%	-48.8%	-48.5%	-48.8%	-79.4%	-59.2%	-54.3%	-55.6%	-54.5%

As indicated in Tables 2, 2a, and 3, the results of flood control are satisfactory to our design goals.

Table 3. Summary of Peak Elevations

Basin	2-yr	10-yr	25-yr	50-yr	100-yr
BASIN A	210.210	211.260	211.560	211.750	211.950
BSIN B1	217.200	217.500	217.630	217.700	217.780
BSIN B2	210.250	210.910	211.250	211.400	211.550
BSIN C1	220.540	220.770	220.870	220.910	220.960

Table 4. Summary of Basin Recharge for 100-year storm event

Basin	rech A	Vol, ac-ft	Vol. cf
BASIN A	rech A	0.63	27442.8
BSIN B1	rech B1	0.36	15681.6
BSIN B2	rech B2	0.28	12196.8
BSIN C1	rech c1	0.18	7840.8

3.0 Stormwater Management

This section demonstrates that the drainage design satisfies all ten DEP stormwater management standards.

Standard #1: Untreated Stormwater

No untreated stormwater from the proposed project area will be discharged to downgradient areas for the proposed conditions. Runoff from paved area will be adequately treated before overflowing to downgradient area. The treatment train includes deep sump catchbasins equipped with oil traps, modified manhole, oil/grit separator, water quality swales, and infiltration basin. LID uses driveway side stoned apron and grass swale and infiltration combination to minimize flow and erosion. The infiltration basins are designed to infiltrate and manage runoff up to a 100-year storm event that scattered fairly uniformly through the site.

Standard #2: Post-Development Peak Discharge Rates

Stormwater controls have been designed for 2, 10, 25, 50, and 100-year storms according to both state and the Town Sherborn regulations. The post-development peak discharge rates and volumes with flood control do not exceed pre-development rates on the site at the downgradient discharge points. See Tables 2 for details.

Standard #3: Recharge to Groundwater

The soils on the site are hydrologic class A to D soils based NRCS soil map and *in-situ* soil evaluations. The required infiltration will be 0.6 inches of runoff per storm from increased impervious areas in HSG A soil, and 0.35" in B soil, 0.25 inches in HSG C soil, and 0.1" in HSG D soils. Based on the soil conditions in the proposed impervious areas, the required recharge volume is calculated as 2256 ft^3. The recharge basins as designed has a total capacity a 100-yr storm of 8.26" rain, 63162 ft^3 . The basins have a static storage volume of 15705 ft^3 more than the required recharge volume and satisfies Standard 3. The system can recharge all runoff volume up to a 100-year storm. See Appendix C for details.

Hydrological soil group	A soil (0.6)	B Soil (0.35")	C Soil	D Soil	Total
DEP required GW recharge (in):	0.6	0.35	0.25	0.1	
Impervious area (acres):	0.058	0.997	0.500	1.128	2.68
DEP required GW recharge volume:	126.00	1266.83	453.78	409.40	**2256.01**

Standard # 4: Water Quality

(a) Water Quality Volume. 1.0" water quality rule applies to this site. The water quality treatment volume for runoff from paved roadway is pretreated by stone filter apron, grass swales, catch basin and/or distribution manhole for large flow bypass, and first flush to oil/grit separator, and the infiltration trench. The storage volume in the system is more than 44396 ft^3 under static storage level. much larger than the required 9738. 60 ft^3 based on 1-inch rule over total impervious area given the

onsite well water supply condition. The driveway runoff will be shed off to grassed channel/swale as LID that will credit for satisfactory water quality.

Site Conditions	Water quality rule	1	inches
	Impervious area	WQV req.	WQV provided
	acres	cu. ft	cu. ft
existing	0.803	none	none
Proposed	2.683	9738.6017	44396.28

(b) TSS Removal. The BMPs used for the proposed project to enhance water quality include: water quality swales, deep sump catch basins with oil trap, oil/grit separator with modified distribution manhole to treat the first flush and improve the TSS removal rate, and infiltration basins for the common driveway. Therefore, based on the full recharge of runoff and sediment settling dynamics analysis, the TSS removal rate for the paved area could reach 95%. However, the current DEP stormwater management handbook only allows 25% TSS removal for water quality unit regardless its design and capacity under current version. Using the DEP pre-determined TSS removal credit, the system will have 44% pretreatment TSS removal prior going to the infiltration basins and the overall TSS removal rate will be 80% as allowed for infiltration basins. See the attached calculation sheets in Appendix C for details.

Standard # 5: Higher Potential Pollutant Loads

The proposed land use will not have higher potential pollutant loads. Given the large volume for stormwater treatment, the site should have a lower pollutant load compared with the existing conditions. See Appendix C for details. Oil traps will be added to the on-site catch basin.

Standard #6: Protection of Critical Areas

The site does not contain or in the vicinity of any of the critical resource areas as listed below:

- Surface drinking water supplies, certified vernal pools, Areas of Critical Environmental Concern;
- Shellfish growing areas;
- Public swimming beaches;
- Cold water fisheries.

The proposed stormwater management facilities will promote groundwater recharge and mimic existing water treatment quality.

Standard #7: Redevelopment Projects

The proposed project is not a redevelopment. The proposed stormwater management will meet all ten DEP stormwater standards (2008). As proposed, the project will provide better water quality and mitigated flood impact to downgradient resource area.

Standard #8: Erosion/Sediment Control

Staked wattles and silt fences will be installed at the downgradient limit of work before any excavation starts. Six-inch thick of 3"-4" crushed trap rocks underlain with Mirafi 104N should be spread at the entrance of the proposed common driveway to the project site to prevent mud from escaping the site during construction. Any sediment tracked to Farm Road should be swept promptly. See details in the plans and Appendix E.

Standard #9: Long-term Operation/Maintenance Plan

See Appendix E for details.

Standard #10: Illicit Discharges

There are no existing illicit discharges into stormwater system and there will be no illicit discharges under 310 CMR 10.04 will be allowed for proposed conditions. This is emphasized in the Operation and Maintenance Plan and the Illicit Discharge Statement signed by the project proponent.

3.1 Groundwater Mounding Analysis

Due to the restriction of the land grading, five infiltration trenches only have 2-3 ft separation from the estimated seasonal high groundwater. As required by the DEP stormwater management handbook, Vol. 3 Ch. 1. P 28, groundwater mounding analysis using Hantush Method is conducted to show that the Basins will be dewatered within 72 hours. The recharge volume for a 100-year storm is used to conduct the mounding analysis. The analysis showed that the mounding height after three days will be less than 0.5 ft for all basins. The mounding analysis is summarized in Table 4. Detailed the mounding analysis is presented in Appendix G.

Table 4. Summary of Groundwater Mounding Analysis

Parameters	Stormwater - 100 Year					Note
Recharge area	Basin A	Basin B1	Basin B2	Basin C		All Basins will be dewatered in less than three days.
Dimension, Length, ft	296.72	89.83	70.30	163.07		
Dimension, Width, ft	32	35	42.6	15		
Area, sq. ft	9494.92	3143.95	2994.90	2446.01		
Recharge Vol. Cu ft (per day or event)	27442.8	15681.6	12196.8	7840.8		
Duration, day	1	1	1	1		
Recharge rate, cu ft/day/sq. ft	2.89	4.99	4.07	3.21		
Dewater time, day	3	3	3	3		
GW Separation, ft	4	2	4.5	4		
Distance to wetland, ft	146	50	291	60		
Maximum mounding height, ft	4.61	5.59	4.72	2.87		
Estimated effective Max MH, ft	**4.122**	**2.718**	**4.544**	**2.87**		
Impact mounding height by other systems, ft	**0**	**0**	**0**	**0**		
Combined Mound height, ft	**4.61**	**5.59**	**4.72**	**2.87**		
3-day residual height, ft	0.47	0.69	0.75	0.55		
5-day residual height, ft	**0.26**	**0.41**	**0.41**	**0.24**		
Estimated effective 3d MH, ft	**0.47**	**0.45**	**0.75**	**0.55**		
Estimated effective 5d MH, ft	**0.26**	**0.15**	**0.27**	**0.26**		
Bottom of Basin, ft	**208**	**216**	**204.5**	**219**		
Top of stones, ft						
EHGW, ft	204	214	200	215		
	average					
Bottom aquifer, ft	**184**	**196**	**180**	**199**		
3 day elevation, ft	**204.47**	**214.69**	**200.75**	**215.55**		
Flood routing elev, ft	211.950	217.780	211.550	220.960		
Top of grade, ft	212.5	218.5	212.5	221.5		
Aquafer depth, ft	20	18	20	16		
Hydraulic Conductivity, ft/day	16.42	25.92	25.92	16.42		

* mounded water tables for stormwater management area are at 3-day.

4.0 Summary

Flood control and stormwater management have been designed to meet the latest stormwater BMPs standards. The design satisfies all ten stormwater management standards as required in the MA DEP Stormwater Management Regulation and Sherborn by-law. Here are some of the highlights:

- Proposed peak flows and runoff volumes for 2-year to 100-year storm events will not exceed the existing conditions;
- The system mimic natural hydrological patterns by using LID development.
- Overall Total suspended solids (TSS) removal rate will be 92% per DEP SWMH pre-determined value for the BMP structures and will likely higher based on our design analysis, which can reach 98% ;
- The capacity for water quality treatment and groundwater recharge exceeds DEP requirements.
- Groundwater Mounding analysis has conducted to show that the infiltration trenches will be dewater within 72 hours.

Figures

Figure 1: Site Locus
Figure 2: NRCS Soil Map
Figure 3a: Drainage Divide- Existing Conditions
Figure 3b: Drainage Divide- Proposed Conditions
Figure 3c. Schematic layout of the existing drainage condition

Figure 3d. Schematic layout of the proposed drainage system

Figure 4a: Flow Distribution Design – DMH#1 and OGS #1 roadway

Figure 4b: Flow Distribution Design – DMH#3 and OGS #2 roadway

Figure 5: Storage Indication Table _ Basin A
Figure 6: Storage Indication Table - Basin B1
Figure 7. Storage Indication Table - Basin B2
Figure 8. Storage Indication Table - Basin C

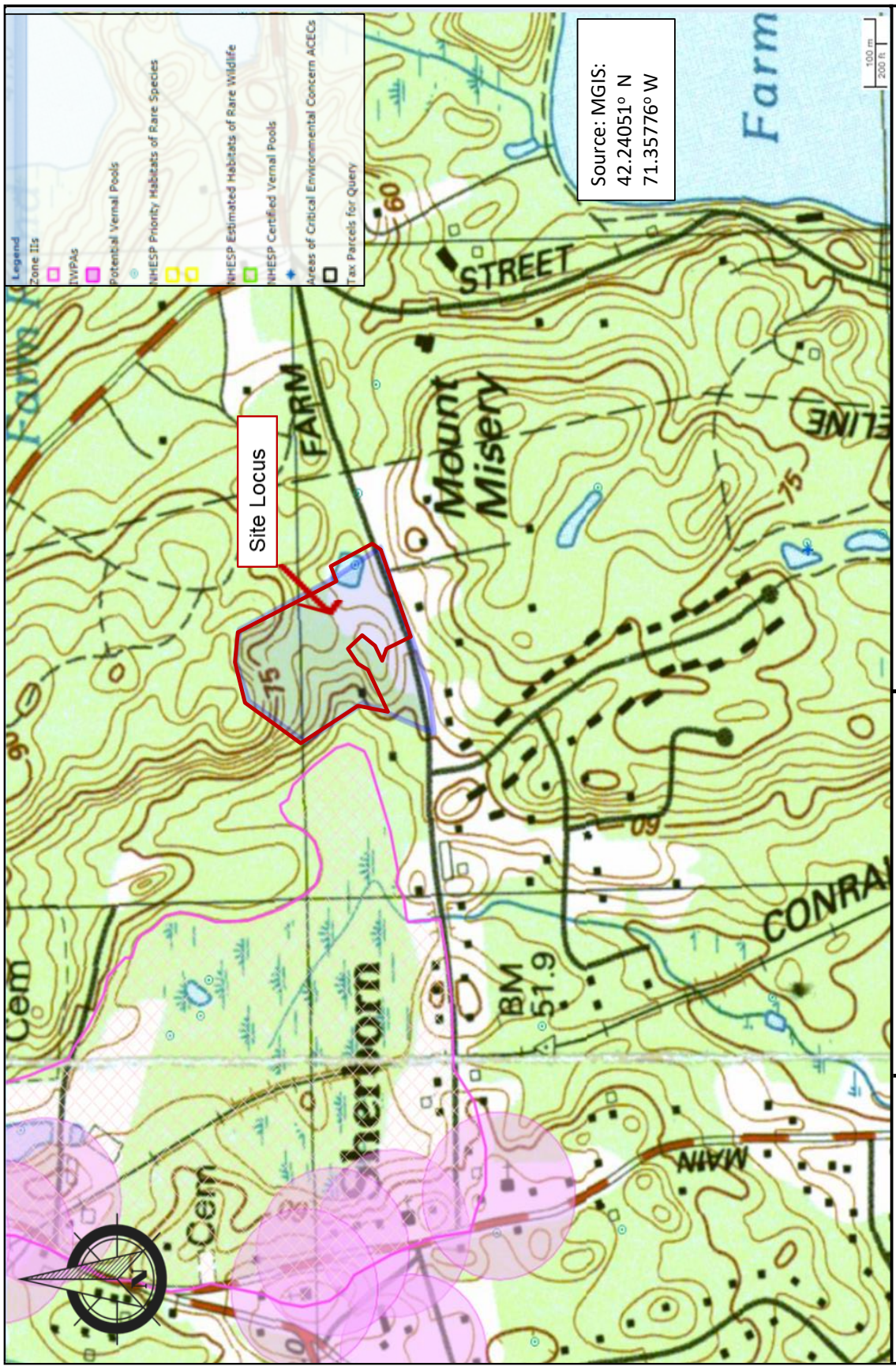
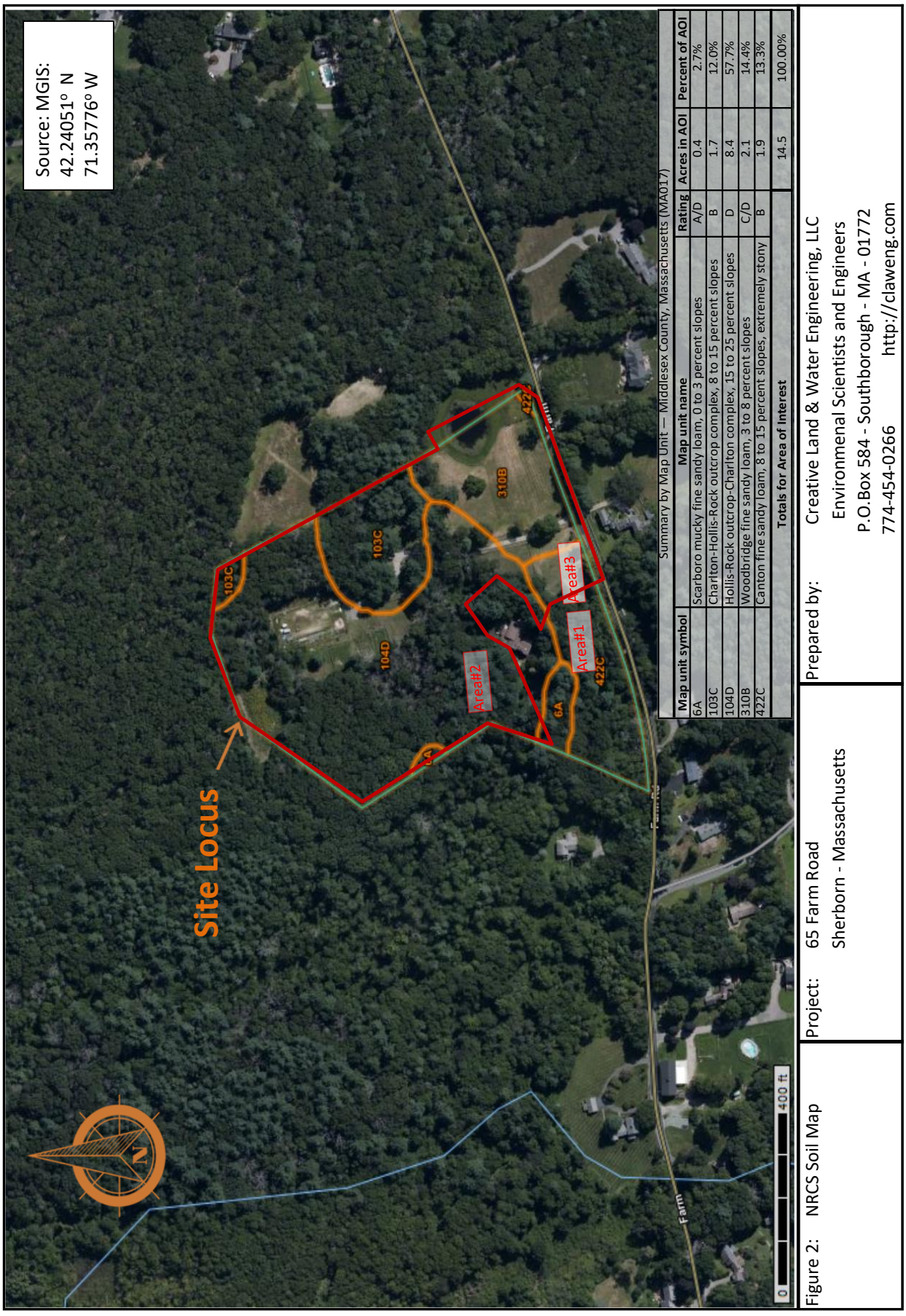


Figure 1: USGS Locus Map

Project: 65 Farm Road
Sherborn - Massachusetts

Prepared by: Creative Land & Water Engineering, LLC
Environmenal Scientists and Engineers
P.O.Box 584 - Southborough - MA - 01772
774-454-0266 http://claweng.com



Summary by Map Unit — Middlesex County, Massachusetts (MA017)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
6A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	A/D	0.4	2.7%
103C	Charlton-Hollis-Rock outcrop complex, 8 to 15 percent slopes	B	1.7	12.0%
104D	Hollis-Rock outcrop-Charlton complex, 15 to 25 percent slopes	D	8.4	57.7%
310B	Woodbridge fine sandy loam, 3 to 8 percent slopes	C/D	2.1	14.4%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	B	1.9	13.3%
Totals for Area of Interest			14.5	100.00%

Figure 2: NRCS Soil Map

Project: 65 Farm Road
Sherborn - Massachusetts

Prepared by: Creative Land & Water Engineering, LLC
Environmenal Scientists and Engineers
P.O.Box 584 - Southborough - MA - 01772
774-454-0266 http://claweng.com

Figure 3a: Watershed divide: Existing Condition (see plan)

Figure 3b: Watershed divide: Proposed Condition (see plan)

Existing:

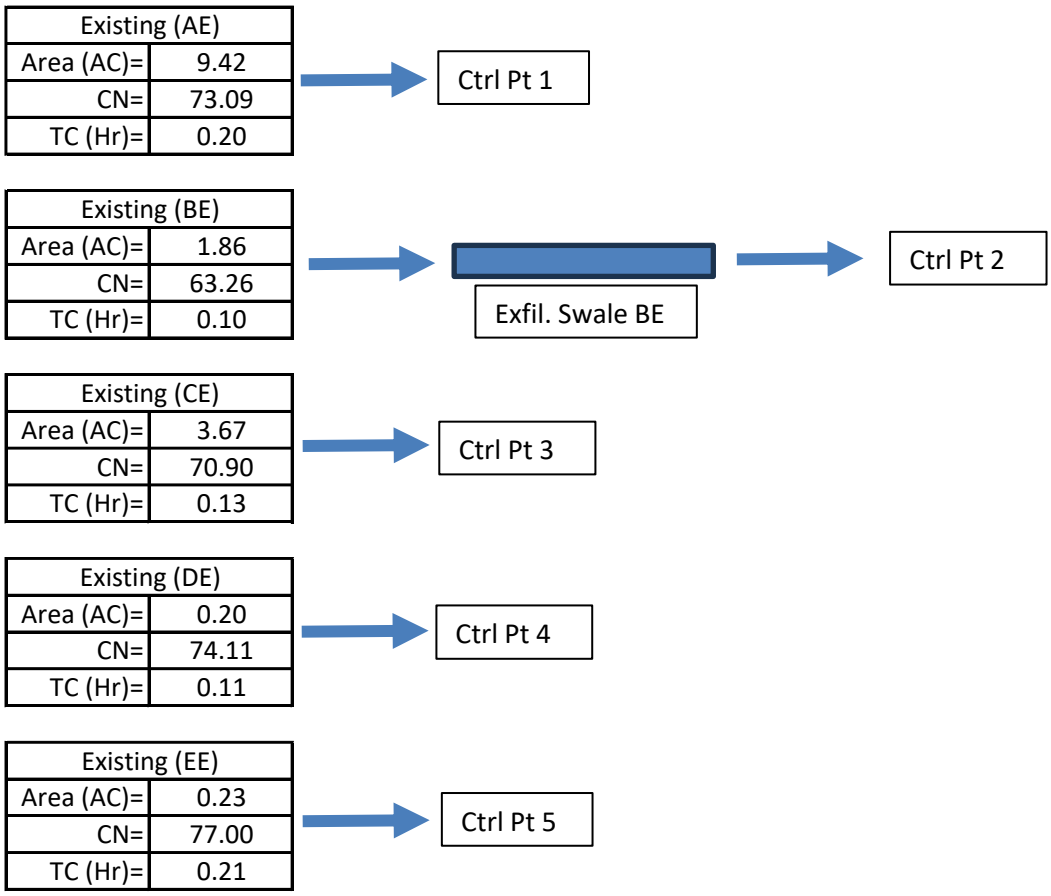


Figure 3c. Schematic layout of the existing drainage system

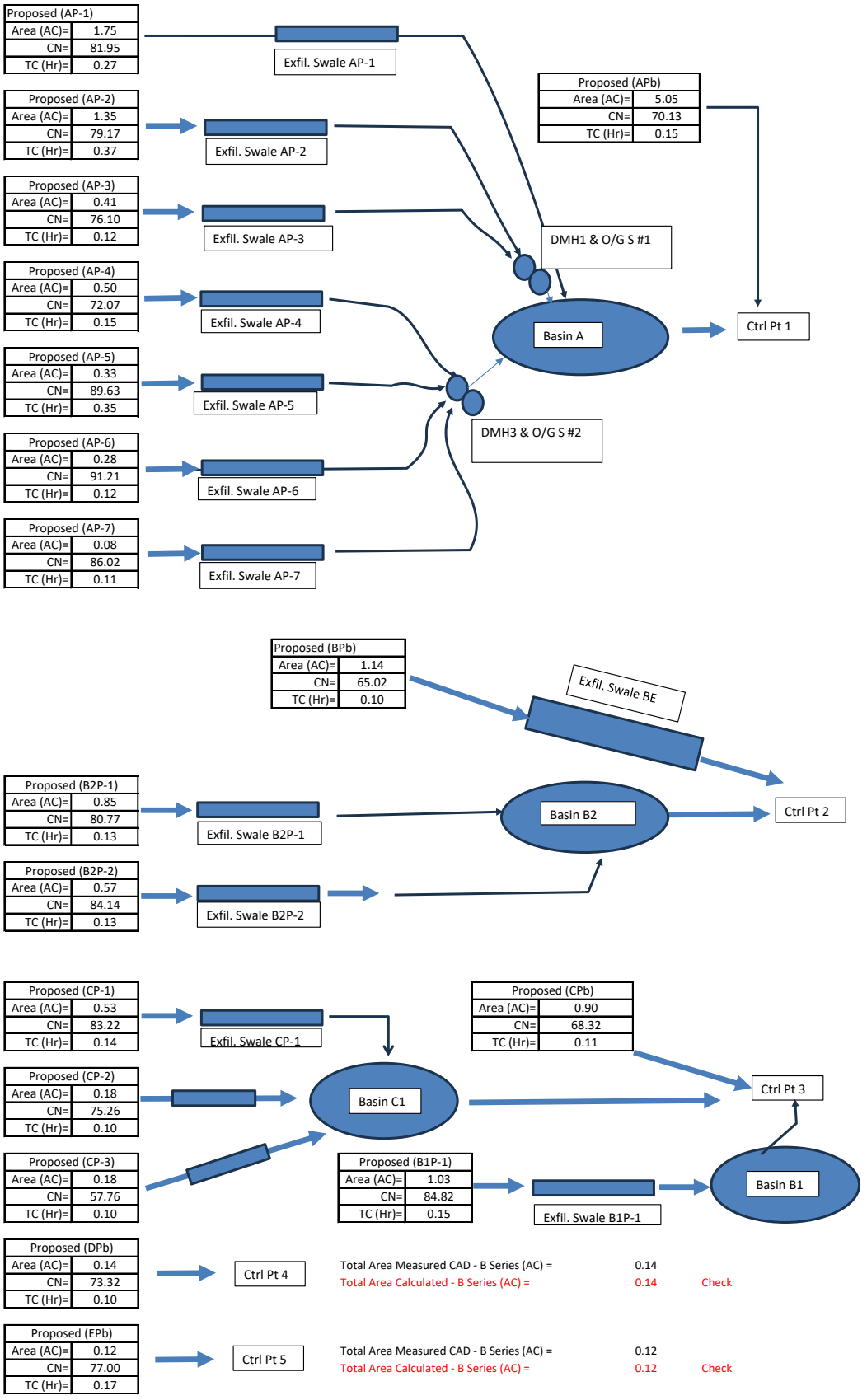


Figure 3d. Schematic layout of the proposed drainage system

Figure 4a: Flow Distribution Design – DMH#1 and OGS #1 roadway

Figure 4b: Flow Distribution Design – DMH#3 and OGS #2 roadway

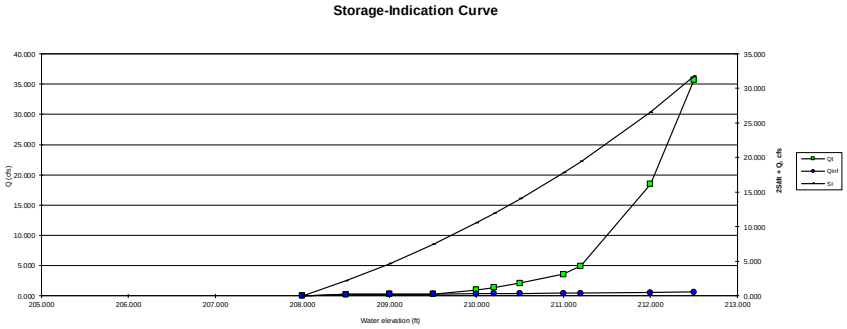
dsw

Outflow Analysis and Storage Indication

Basin A

Location:	65 Farm Rd Sherborn, MA			By:	dsw	Date:	7/26/2023
				Chkd:		Date:	
				Job No.:	J269-12	Sheet:	1 of 4
100-year elevation, ft	211.95			100-year flood storage, ac-ft:	0.5997	Area, sf	9494.92
dt (sec.)	60			Upper perimeter (ft):	447	Lower perimeter (ft	316
Broad-crested weir width (ft):	0.5	Rawls	yes	Upper Permeability (ft/s):	5.58E-05	Slope (H:V):	3.00
Broad-crested weir length (ft):	4	Emergency BCW length (ft):	5	Lower permeability(ft/s):	5.58E-05	Inf. safety factor:	1
Weir crest elevation (ft):	211	Weir crest elevation (ft):	212	Total infil. depth (ft):	2	Starting INV (ft):	179.25
Pipe 1 Dia. (ft)	1.5			Pipe 2 Dia. (ft)	1.5	Slot width (in.):	6
Pipe 1 INV (ft):	213			Pipe 2 INV (ft):	230	Slot INV (ft):	209.5
				EHGW (ft):	204		

Elevation ft	Total Q cfs	2S/dt + Q cfs	Qinf cfs	Inf head ft	Head 1 ft	Qpipe 1 cfs	Head 2 ft	Qpipe 2 cfs	Head, weir-e ft	Qweir-e cfs	Head, weir-p ft	Qweir-p cfs	Head-slot ft	Qslot cfs	Pond area sq. ft	Storage 1000 cu. ft	Dewater hrs.	storage ac-ft
208.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4059	0.000	0.000	0
208.500	0.259	72.788	0.259	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	4651	2.176	4.658	0.04995
209.000	0.293	155.236	0.293	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5244	4.648	7.146	0.10671
209.500	0.330	248.176	0.330	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	5911	7.435	9.635	0.17069
210.000	0.969	352.832	0.367	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.250	0.602	6577	10.556	10.970	0.24233
210.200	1.379	397.998	0.382	2.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.350	0.997	6850	11.899	11.287	0.27315
210.500	2.107	469.270	0.405	2.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	1.702	7260	14.015	11.625	0.32174
211.000	3.571	597.388	0.443	3.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.750	3.127	7943	17.815	11.996	0.40897
211.200	4.925	652.784	0.461	3.200	0.000	0.000	0.000	0.000	0.200	0.944	0.000	0.000	0.850	3.520	8270	19.436	12.102	0.44618
212.000	18.488	904.089	0.534	4.000	0.000	0.000	0.000	0.000	1.000	13.177	0.000	0.000	1.250	4.777	9577	26.568	12.272	0.60992
212.500	35.746	1095.105	0.630	4.500	0.000	0.000	0.000	0.000	1.500	24.396	0.500	5.303	1.750	5.417	11298	31.781	12.325	0.72959



elev ft	Stor ac-ft	Dis cfs	infil cfs
208.000	0.00000	0.000	0.000
208.500	0.04995	0.259	0.259
209.000	0.10671	0.293	0.293
209.500	0.17069	0.330	0.330
210.000	0.24233	0.969	0.367
210.200	0.27315	1.379	0.382
210.500	0.32174	2.107	0.405
211.000	0.40897	3.571	0.443
211.200	0.44618	4.925	0.461
212.000	0.60992	18.488	0.534
212.500	0.72959	35.746	0.630
0.000	0.000	0.000	0.000

Figure : Rating Curve and Storage-Indication Curve

Outflow Structure Analysis - Slotted Weir Version 1.2 (c) Designed and Maintained by Desheng Wang, Ph.D., P.E., Creative Land & Water Engineering, LLC.

Figure 5: Storage Indication Table _ Basin A

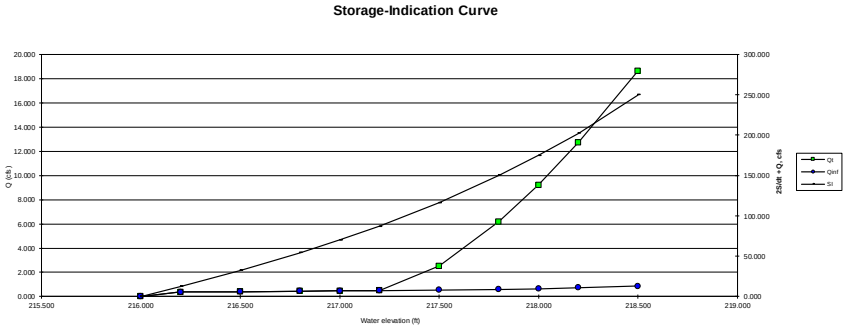
dsw

Outflow Analysis and Storage Indication

Basin B1

Location:	65 Farm Rd Sherborn, MA			By:	dsw	Date:	7/26/2023
				Chkd:		Date:	
				Job No.:	J269-12	Sheet:	2 of 4
100-year elevation, ft	217.78			100-year flood storage, ac-ft:	0.0978	Area, sf	3143.95
dt (sec.)	60			Upper perimeter (ft):	319	Lower perimeter (ft	203
Broad-crested weir width (ft):	0.5	Rawls	yes	Upper Permeability (ft/s):	0.000191	Slope (H:V):	3
Broad-crested weir length (ft):	2	Emergency BCW length (ft):	4	Lower permeability(ft/s):	0.000191	Inf. safety factor:	1
Weir crest elevation (ft):	230	Weir crest elevation (ft):	217.2	Total infil. depth (ft):	2	Starting INV (ft):	
Pipe 1 Dia. (ft)	1.5			Pipe 2 Dia. (ft)	0	Slot width (in.):	2
Pipe 1 INV (ft):	230			Pipe 2 INV (ft):	230	Slot INV (ft):	230
				EHGW (ft):	214		

Elevation ft	Total Q cfs	2S/dt + Q cfs	Qinf cfs	Inf head ft	Head 1 ft	Qpipe 1 cfs	Head 2 ft	Qpipe 2 cfs	Head, weir-e ft	Qweir-e cfs	Head, weir-p ft	Qweir-p cfs	Head-slot ft	Qslot cfs	Pond area sq. ft	Storage 1000 cu. ft	Dewater hrs.	storage ac-ft
216.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1762	0.000	0.000	0
216.200	0.362	12.542	0.362	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1893	0.365	0.560	0.00839
216.500	0.400	32.484	0.400	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2090	0.963	0.995	0.0221
216.800	0.438	54.396	0.438	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2287	1.619	1.430	0.03716
217.000	0.463	70.100	0.463	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2418	2.089	1.721	0.04796
217.200	0.498	86.871	0.498	1.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2604	2.591	2.011	0.05949
217.500	2.524	116.321	0.552	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.300	1.972	0.000	0.000	2883	3.414	2.162	0.07837
217.800	6.183	150.198	0.605	1.800	0.000	0.000	0.000	0.000	0.000	0.000	0.600	5.577	0.000	0.000	3163	4.320	2.220	0.09918
218.000	9.228	174.945	0.641	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.800	8.587	0.000	0.000	3349	4.972	2.243	0.11413
218.200	12.731	202.324	0.731	2.200	0.000	0.000	0.000	0.000	0.000	0.000	1.000	12.000	0.000	0.000	3819	5.688	2.261	0.13057
218.500	18.653	249.912	0.866	2.500	0.000	0.000	0.000	0.000	0.000	0.000	1.300	17.787	0.000	0.000	4524	6.938	2.284	0.15927



elev ft	Stor ac-ft	Dis cfs	infil cfs
216.000	0.00000	0.000	0.000
216.200	0.00839	0.362	0.362
216.500	0.02210	0.400	0.400
216.800	0.03716	0.438	0.438
217.000	0.04796	0.463	0.463
217.200	0.05949	0.498	0.498
217.500	0.07837	2.524	0.552
217.800	0.09918	6.183	0.605
218.000	0.11413	9.228	0.641
218.200	0.13057	12.731	0.731
218.500	0.15927	18.653	0.866
0.000	0.000	0.000	0.000

Figure : Rating Curve and Storage-Indication Curve

Outflow Structure Analysis - Slotted Weir Version 1.2 (c) Designed and Maintained by Desheng Wang, Ph.D., P.E., Creative Land & Water Engineering, LLC.

Figure 6: Storage Indication Table - Basin B1

dsw

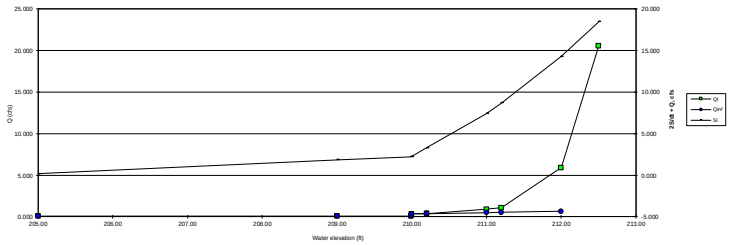
Outflow Analysis and Storage Indication

Basin B2

Location:	65 Farm Rd Sherborn, MA			By:	dsw	Date:	7/26/2023
				Chkd:		Date:	
				Job No.:	J269-12	Sheet:	1 of 4
100-year elevation, ft	211.55			100-year flood storage, ac-ft:	0.2556	Area, sf	2994.90
dt (sec.)	60			Upper perimeter (ft):	447	Lower perimeter (ft	316
Broad-crested weir width (ft):	0.5	Rawls	yes	Upper Permeability (ft/s):	0.000191	Slope (H:V):	3.00
Broad-crested weir length (ft):	4	Emergency BCW length (ft):	5	Lower permeability(ft/s):	0.000191	Inf. safety factor:	1
Weir crest elevation (ft):	211.5	Weir crest elevation (ft):	212	Total infil. depth (ft):	2	Starting INV (ft):	179.25
Pipe 1 Dia. (ft)	1.5			Pipe 2 Dia. (ft)	1.5	Slot width (in.):	2
Pipe 1 INV (ft):	213			Pipe 2 INV (ft):	213	Slot INV (ft):	210.2
				EHGW (ft):			

Elevation	Total Q	2S/dt + Q	Qinf	Inf head	Head 1	Qpipe 1	Head 2	Qpipe 2	Head, weir-e	Qweir-e	Head, weir-p	Qweir-p	Head-slot	Qslot	Pond area	Storage	Dewater	storage			Storage
ft	cfs	cfs	cfs	ft	ft	cfs	ft	cfs	ft	cfs	ft	cfs	ft	cfs	sq. ft	1000 cu. ft	hrs.	ac-ft	Elev. (ft)	Storage are	Vol., cf
204.50	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	154	0.000	0.000	-3E-16	204.50	153.6	0
204.99	0.074	5.943	0.074	0.490	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	154	0.176	1.324	0.00404	204.99	154.4	176.07325
205.00	0.074	6.072	0.0743	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	177	0.180	1.338	0.00413	205.00	177.2	179.94061
209.00	0.075	61.326	0.0747	4.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	178	1.838	7.521	0.04218	209.00	178	1837.54
209.99	0.075	74.212	0.0750	5.490	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	157	2.224	8.956	0.05106	209.99	156.8	2224.1231
210.00	0.357	75.228	0.3568	5.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1864	2.246	8.984	0.05156	210.00	1864	2246.1332
210.20	0.383	109.572	0.3833	5.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2002	3.276	9.757	0.0752	211.00	2556	7393.7155
211.00	0.895	247.353	0.4893	6.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.400	0.406	2556	7.394	11.546	0.16974	211.50	2955.00	10607.26
211.20	1.087	290.392	0.5199	6.700	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	0.567	2716	8.679	11.906	0.19925	212.00	3354	14286.458
212.00	5.897	482.112	0.6421	7.500	0.000	0.000	0.000	0.000	0.500	4.136	0.000	0.000	0.900	1.119	3354	14.286	12.352	0.32797	212.50	3778.21	18446.693
212.50	20.543	635.405	0.7233	8.000	0.000	0.000	0.000	0.000	1.000	13.177	0.500	5.303	1.400	1.340	3778	18.446	12.440	0.42346			

Storage-Indication Curve



elev	Stor	Dis	infil
ft	ac-ft	cfs	cfs
204.500	0.00000	0.0000	0.0000
204.990	0.00404	0.0739	0.0739
205.000	0.00413	0.0743	0.0743
209.000	0.04218	0.0747	0.0747
209.990	0.05106	0.0750	0.0750
210.000	0.05156	0.3568	0.3568
210.200	0.07520	0.3833	0.3833
211.000	0.16974	0.8953	0.4893
211.200	0.19925	1.0873	0.5199
212.000	0.32797	5.8969	0.6421
212.500	0.42346	20.5432	0.7233
0.000	0.000	0.000	0.000

Figure : Rating Curve and Storage-Indication Curve

Outflow Structure Analysis - Slotted Weir Version 1.2 (c) Designed and Maintained by Desheng Wang, Ph.D., P.E., Creative Land & Water Engineering, LLC.

Figure 7. Storage Indication Table - Basin B2

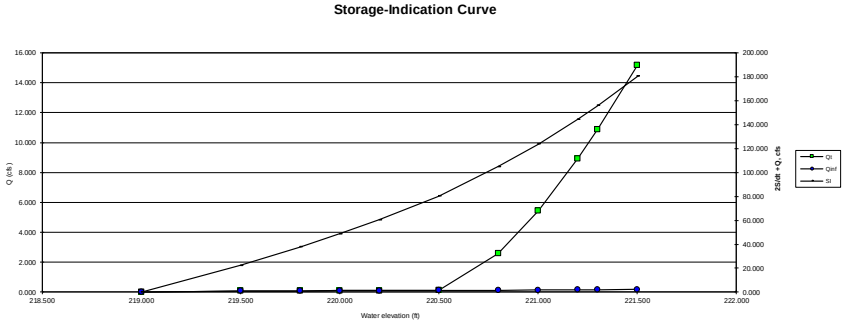
dsw

Outflow Analysis and Storage Indication

Basin C

Location:	65 Farm Rd Sherborn, MA			By:	dsw	Date:	7/26/2023
				Chkd:		Date:	
				Job No.:	J269-12	Sheet:	4 of 4
100-year elevation, ft	220.96			100-year flood storage, ac-ft:	0.0792	Area, sf	2446.01
dt (sec.)	60			Upper perimeter (ft):	278	Lower perimeter (ft)	174
Broad-crested weir width (ft):	0.5	Rawls	yes	Upper Permeability (ft/s):	5.58E-05	Slope (H:V):	3
Broad-crested weir length (ft):	3	Emergency BCW length (ft):	5	Lower permeability(ft/s):	5.58E-05	Inf. safety factor:	1
Weir crest elevation (ft):	222	Weir crest elevation (ft):	220.5	Total infil. depth (ft):	2	Starting INV (ft):	179.25
Pipe 1 Dia. (ft)	1.5			Pipe 2 Dia. (ft)	1.5	Slot width (in.):	4
Pipe 1 INV (ft):	222			Pipe 2 INV (ft):	222	Slot INV (ft):	222
				EHGW (ft):	215		

Elevation ft	Total Q cfs	2S/dt + Q cfs	Qinf cfs	Inf head ft	Head 1 ft	Qpipe 1 cfs	Head 2 ft	Qpipe 2 cfs	Head, weir-e ft	Qweir-e cfs	Head, weir-p ft	Qweir-p cfs	Head-slot ft	Qslot cfs	Pond area sq. ft	Storage 1000 cu. ft	Dewater hrs.	storage ac-ft
219.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1215	0.000	0.000	0
219.500	0.081	22.326	0.081	0.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1458	0.667	4.559	0.01532
219.800	0.089	37.633	0.089	0.800	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1603	1.126	6.052	0.025856
220.000	0.095	48.648	0.095	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1700	1.457	7.048	0.033439
220.200	0.104	60.505	0.104	1.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1856	1.812	8.043	0.041599
220.500	0.117	80.228	0.117	1.500	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	2089	2.403	9.536	0.055173
220.800	2.594	104.747	0.130	1.800	0.000	0.000	0.000	0.000	0.000	0.000	0.300	2.465	0.000	0.000	2322	3.065	9.672	0.070353
221.000	5.441	123.587	0.138	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500	5.303	0.000	0.000	2477	3.544	9.705	0.081368
221.200	8.939	144.512	0.154	2.200	0.000	0.000	0.000	0.000	0.000	0.000	0.700	8.785	0.000	0.000	2754	4.067	9.725	0.09337
221.300	10.894	155.875	0.161	2.300	0.000	0.000	0.000	0.000	0.000	0.000	0.800	10.733	0.000	0.000	2892	4.349	9.733	0.099849
221.500	15.177	180.350	0.177	2.500	0.000	0.000	0.000	0.000	0.000	0.000	1.000	15.000	0.000	0.000	3168	4.955	9.746	0.113756



elev ft	Stor ac-ft	Dis cfs	infil cfs
219.000	0.00000	0.000	0.000
219.500	0.01532	0.081	0.081
219.800	0.02586	0.089	0.089
220.000	0.03344	0.095	0.095
220.200	0.04160	0.104	0.104
220.500	0.05517	0.117	0.117
220.800	0.07035	2.594	0.130
221.000	0.08137	5.441	0.138
221.200	0.09337	8.939	0.154
221.300	0.09985	10.894	0.161
221.500	0.11376	15.177	0.177
0.000	0.000	0.000	0.000

Figure : Rating Curve and Storage-Indication Curve

Outflow Structure Analysis - Slotted Weir Version 1.2 (c) Designed and Maintained by Desheng Wang, Ph.D., P.E., Creative Land & Water Engineering, LLC.

Figure 8. Storage Indication Table - Basin C

Appendix A: HYDROLOGICAL ANALYSIS AND ROAD DRAINAGE CALCULATIONS

Computer Model HEC-HMS was used for the calculations of peak flow, unit hydrograph. The input data are summarized in Table A-1.

Table A-1 Summary of Input Parameter

Sub-watershed	Area (Acre)	Area(Mi^2)	CN	Imp.(%)	I	TC (Hr)	Lag (Min.)
Existing (AE)	9.42	0.01472	73.09	4.31	0.736	0.20	7.37
Existing (BE)	1.86	0.00290	63.26	9.87	1.162	0.10	3.60
Existing (CE)	3.67	0.00574	70.90	5.82	0.821	0.13	4.75
Existing (DE)	0.20	0.00032	74.11	0.00	0.699	0.11	4.04
Existing (EE)	0.23	0.00037	77.00	0.00	0.597	0.21	7.64
Total	15.392	0.02405	-				
Proposed (APb)	5.05	0.00789	70.13	3.98	0.852	0.15	5.36
Proposed (AP-1)	1.75	0.00273	81.95	12.41	0.441	0.27	9.61
Proposed (AP-2)	1.35	0.00211	79.17	12.45	0.526	0.37	13.46
Proposed (AP-3)	0.41	0.00064	76.10	3.73	0.628	0.12	4.28
Proposed (AP-4)	0.50	0.00078	72.07	10.74	0.775	0.15	5.29
Proposed (AP-5)	0.33	0.00052	89.63	64.88	0.231	0.35	12.68
Proposed (AP-6)	0.28	0.00044	91.21	65.73	0.193	0.12	4.37
Proposed (AP-7)	0.08	0.00012	86.02	67.63	0.325	0.11	4.06
Proposed (BPb)	1.14	0.00178	65.02	16.12	1.076	0.10	3.60
Proposed (B1P-1)	1.03	0.00160	84.82	37.17	0.358	0.15	5.45
Proposed (B2P-1)	0.85	0.00133	80.77	44.96	0.476	0.13	4.84
Proposed (B2P-2)	0.57	0.00089	84.14	49.20	0.377	0.13	4.53
Proposed (CPb)	0.90	0.00141	68.32	0.10	0.927	0.11	4.00
Proposed (CP-1)	0.53	0.00083	83.22	50.44	0.403	0.14	5.08
Proposed (CP-2)	0.18	0.00029	75.26	41.86	0.657	0.10	3.60
Proposed (CP-3)	0.18	0.00028	57.76	0.00	1.462	0.10	3.60
Proposed (DPb)	0.14	0.00022	73.32	0.00	0.728	0.10	3.60
Proposed (EPb)	0.12	0.00018	77.00	0.00	0.597	0.17	6.05
Total	15.39	0.02405	-				

Meteorological Model	Method: SCS Hypothetical Storm	
	Storm Selection: Type III	
	1" Storm Event (Inch): 1	
	2-Year 24-Hour Rainfall Depth (Inch):	3.36
	10-Year 24-Hour Rainfall Depth (Inch):	5.25
	25-Year 24-Hour Rainfall Depth (Inch):	6.43
	50-year 24-hour rainfall depth (inch):	7.3
	100-Year 24-Hour Rainfall Depth (Inch):	8.25

Table A-2. Summary of Land uses

Watershed	Land Use (Acre)					
	Roof	Driveway / Park	Walk / Patio / Etc.	Lawn	Woods	Total
Existing (AE)	0.07	0.14	0.20	1.50	7.52	9.42
Existing (BE)	0.05	0.11	0.02	0.67	1.00	1.86
Existing (CE)	0.03	0.00	0.18	2.23	1.23	3.67
Existing (DE)	0.00	0.00	0.00	0.00	0.20	0.20
Existing (EE)	0.00	0.00	0.00	0.00	0.23	0.23
Total	0.15	0.24	0.41	4.40	10.19	**15.39**
Proposed (APb)	0.05	0.14	0.01	1.10	3.74	5.050
Proposed (AP-1)	0.11	0.03	0.08	1.36	0.17	1.747
Proposed (AP-2)	0.06	0.11	0.01	0.21	0.98	1.353
Proposed (AP-3)	0.01	0.00	0.00	0.04	0.36	0.412
Proposed (AP-4)	0.05	0.00	0.00	0.15	0.30	0.501
Proposed (AP-5)	0.05	0.12	0.04	0.12	0.00	0.332
Proposed (AP-6)	0.08	0.10	0.01	0.10	0.00	0.285
Proposed (AP-7)	0.04	0.01	0.00	0.03	0.00	0.078
Proposed (BPb)	0.05	0.11	0.02	0.50	0.46	1.138
Proposed (B1P-1)	0.09	0.25	0.04	0.55	0.09	1.026
Proposed (B2P-1)	0.22	0.08	0.09	0.44	0.03	0.851
Proposed (B2P-2)	0.08	0.10	0.10	0.27	0.02	0.570
Proposed (CPb)	0.00	0.00	0.00	0.35	0.56	0.905
Proposed (CP-1)	0.13	0.09	0.04	0.26	0.00	0.529
Proposed (CP-2)	0.03	0.03	0.01	0.07	0.04	0.185
Proposed (CP-3)	0.00	0.00	0.00	0.01	0.17	0.177
Proposed (DPb)	0.00	0.00	0.00	0.00	0.14	0.139
Proposed (EPb)	0.00	0.00	0.00	0.00	0.12	0.115
Total	1.069	1.175	0.439	5.547	7.162	**15.39**

Detailed land use table, calculation sheets of CN and TC, and output report of HEC-HMS are on the following pages.

Creative Land & Water Engineering, LLC
Environmental Scientists and Engineers
P.O. Box 584 - Southborough - MA - 01772
774-454-0266 www.claweng.com

Subject:	SCS Modified Soil Cover Complex Method
Project:	Farm Road Homes
Location:	65 Farm Rd, Sherborn, MA
Job No.:	7/18/2023

Sub-Basin:	AE	Analysis By:	FA	Date:	7/21/2023
Condition:	Existing	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.069	6.76
2	Drive/Park	A,B,C,D	98	0.137	13.47
3	Walk/Patio/ Etc	A,B,C,D	98	0.199	19.55
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.019	0.73
2	Woods	A	30	0.721	21.63
3	Lawn	B	61	0.138	8.44
4	Woods	B	55	0.570	31.35
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	1.344	107.50
8	Woods	D	77	6.224	479.29
			Total :	9.422	688.72
			Average CN:		73.09
			Imperviousness (%):		**4.31**

Sub-Basin:	BE	Analysis By:	FA	Date:	7/21/2023
Condition:	Existing	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.055	5.38
2	Drive/Park	A,B,C,D	98	0.105	10.31
3	Walk/Patio/ Etc	A,B,C,D	98	0.023	2.28
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.023	0.88
2	Woods	A	30	0.066	1.98
3	Lawn	B	61	0.419	25.57
4	Woods	B	55	0.834	45.87
5	Lawn	C	74	0.175	12.95
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.053	4.27
8	Woods	D	77	0.105	8.05
			Total :	1.858	117.54
			Average CN:		63.26
			Imperviousness (%):		**9.87**

Sub-Basin:	CE	Analysis By:	FA	Date:	7/21/2023
Condition:	Existing	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.029	2.86
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.185	18.08
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.426	25.97
4	Woods	B	55	0.771	42.42
5	Lawn	C	74	1.338	98.99
6	Woods	C	70	0.069	4.86
7	Lawn	D	80	0.466	37.30
8	Woods	D	77	0.389	29.96
			Total :	3.673	260.45
			Average CN:		70.90
			Imperviousness (%):		**5.82**

Sub-Basin:	DE	Analysis By:	FA	Date:	7/21/2023
Condition:	Existing	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.000	0.00
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.000	0.00
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.027	1.47
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.177	13.63
			Total :	0.204	15.10
			Average CN:		74.11
			Imperviousness (%):		**0.00**

Sub-Basin:	EE	Analysis By:	FA	Date:	7/21/2023
Condition:	Existing	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.000	0.00
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.000	0.00
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.234	18.03
			Total :	0.234	18.03
			Average CN:		77.00
			Imperviousness (%):		**0.00**

Creative Land & Water Engineering, LLC
Environmental Scientists and Engineers
P.O. Box 584 - Southborough - MA - 01772
774-454-0266 www.claweng.com

Subject:	SCS Modified Soil Cover Complex Method
Project:	Farm Road Homes
Location:	65 Farm Rd, Sherborn, MA
Job No.:	7/18/2023

Sub-Basin:	APb	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.054	5.31
2	Drive/Park	A,B,C,D	98	0.137	13.47
3	Walk/Patio/ Etc	A,B,C,D	98	0.009	0.89
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.019	0.73
2	Woods	A	30	0.721	21.63
3	Lawn	B	61	0.018	1.11
4	Woods	B	55	0.327	18.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	1.068	85.41
8	Woods	D	77	2.696	207.63
			Total :	5.050	354.19
			Average CN:		70.13
			Imperviousness (%):		**3.98**

Sub-Basin:	AP-1	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.113	11.12
2	Drive/Park	A,B,C,D	98	0.026	2.52
3	Walk/Patio/ Etc	A,B,C,D	98	0.078	7.62
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	1.365	109.18
8	Woods	D	77	0.166	12.76
			Total :	1.747	143.20
			Average CN:		81.95
			Imperviousness (%):		**12.41**

Sub-Basin:	AP-2	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.056	5.50
2	Drive/Park	A,B,C,D	98	0.107	10.50
3	Walk/Patio/ Etc	A,B,C,D	98	0.005	0.50
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.055	3.04
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.208	16.64
8	Woods	D	77	0.921	70.93
			Total :	1.353	107.12
			Average CN:		79.17
			Imperviousness (%):		**12.45**

Sub-Basin:	AP-3	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.011	1.07
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.004	0.43
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.037	2.01
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.038	3.06
8	Woods	D	77	0.321	24.74
			Total :	0.412	31.32
			Average CN:		76.10
			Imperviousness (%):		**3.73**

Sub-Basin:	AP-4	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.052	5.11
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.002	0.16
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.079	4.84
4	Woods	B	55	0.115	6.33
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.067	5.36
8	Woods	D	77	0.186	14.30
			Total :	0.501	36.11
			Average CN:		72.07
			Imperviousness (%):		**10.74**

Sub-Basin:	AP-5	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.055	5.37
2	Drive/Park	A,B,C,D	98	0.124	12.15
3	Walk/Patio/ Etc	A,B,C,D	98	0.036	3.56
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.036	2.18
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.081	6.46
8	Woods	D	77	0.000	0.00
			Total :	0.332	29.72
			Average CN:		89.63
			Imperviousness (%):		**64.88**

Sub-Basin:	AP-6	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.079	7.77
2	Drive/Park	A,B,C,D	98	0.101	9.86
3	Walk/Patio/ Etc	A,B,C,D	98	0.007	0.71
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.009	0.57
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.088	7.05
8	Woods	D	77	0.000	0.00
			Total :	0.285	25.96
			Average CN:		91.21
			Imperviousness (%):		**65.73**

Sub-Basin:	AP-7	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.037	3.66
2	Drive/Park	A,B,C,D	98	0.014	1.40
3	Walk/Patio/ Etc	A,B,C,D	98	0.001	0.08
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.025	1.53
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.000	0.00
			Total :	0.078	6.67
			Average CN:		86.02
			Imperviousness (%):		**67.63**

Sub-Basin:	BPb	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.055	5.38
2	Drive/Park	A,B,C,D	98	0.105	10.31
3	Walk/Patio/ Etc	A,B,C,D	98	0.023	2.28
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.023	0.88
2	Woods	A	30	0.066	1.98
3	Lawn	B	61	0.419	25.57
4	Woods	B	55	0.317	17.42
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.053	4.27
8	Woods	D	77	0.077	5.90
			Total :	1.138	73.99
			Average CN:		65.02
			Imperviousness (%):		**16.12**

Sub-Basin:	B1P-1	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.093	9.14
2	Drive/Park	A,B,C,D	98	0.252	24.72
3	Walk/Patio/ Etc	A,B,C,D	98	0.036	3.50
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.012	0.74
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.234	17.31
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.304	24.34
8	Woods	D	77	0.094	7.25
			Total :	1.026	87.01
			Average CN:		84.82
			Imperviousness (%):		**37.17**

Sub-Basin:	B2P-1	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.215	21.09
2	Drive/Park	A,B,C,D	98	0.080	7.81
3	Walk/Patio/ Etc	A,B,C,D	98	0.088	8.60
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.266	16.20
4	Woods	B	55	0.008	0.44
5	Lawn	C	74	0.156	11.53
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.021	1.66
8	Woods	D	77	0.018	1.42
			Total :	0.851	68.74
			Average CN:		80.77
			Imperviousness (%):		**44.96**

Sub-Basin:	B2P-2	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.083	8.14
2	Drive/Park	A,B,C,D	98	0.101	9.86
3	Walk/Patio/ Etc	A,B,C,D	98	0.097	9.47
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.109	6.62
4	Woods	B	55	0.018	0.97
5	Lawn	C	74	0.031	2.27
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.133	10.61
8	Woods	D	77	0.000	0.00
			Total :	0.570	47.94
			Average CN:		84.14
			Imperviousness (%):		**49.20**

Sub-Basin:	CPb	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.000	0.00
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.001	0.09
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.170	10.37
4	Woods	B	55	0.049	2.72
5	Lawn	C	74	0.171	12.65
6	Woods	C	70	0.509	35.63
7	Lawn	D	80	0.004	0.34
8	Woods	D	77	0.000	0.00
			Total :	0.905	61.81
			Average CN:		68.32
			Imperviousness (%):		**0.10**

Sub-Basin:	CP-1	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.130	12.71
2	Drive/Park	A,B,C,D	98	0.094	9.23
3	Walk/Patio/ Etc	A,B,C,D	98	0.043	4.23
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.152	9.29
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.035	2.60
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.075	6.00
8	Woods	D	77	0.000	0.00
			Total :	0.529	44.06
			Average CN:		83.22
			Imperviousness (%):		**50.44**

Sub-Basin:	CP-2	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.035	3.40
2	Drive/Park	A,B,C,D	98	0.034	3.32
3	Walk/Patio/ Etc	A,B,C,D	98	0.009	0.85
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.070	4.24
4	Woods	B	55	0.038	2.08
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.000	0.00
			Total :	0.185	13.91
			Average CN:		75.26
			Imperviousness (%):		**41.86**

Sub-Basin:	CP-3	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.000	0.00
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.000	0.00
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.010	0.58
4	Woods	B	55	0.148	8.15
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.020	1.52
			Total :	0.177	10.25
			Average CN:		57.76
			Imperviousness (%):		**0.00**

Sub-Basin:	DPb	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.000	0.00
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.000	0.00
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.023	1.28
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.116	8.90
			Total :	0.139	10.18
			Average CN:		73.32
			Imperviousness (%):		**0.00**

Sub-Basin:	EPb	Analysis By:	FA	Date:	7/21/2023
Condition:	Proposed	Checked By:		Date:	
Storm Frequency:		2-Year	10-Year	25-Year	100-Year
24-hour rainfall (in):		3.36	5.25	6.43	8.25
Impervious Area:	Land Use	Soil Group	CN	Area (acres)	Area x CN
1	Roof	A,B,C,D	98	0.000	0.00
2	Drive/Park	A,B,C,D	98	0.000	0.00
3	Walk/Patio/ Etc	A,B,C,D	98	0.000	0.00
4					
5					
6					
Pervious area:					
1	Lawn	A	39	0.000	0.00
2	Woods	A	30	0.000	0.00
3	Lawn	B	61	0.000	0.00
4	Woods	B	55	0.000	0.00
5	Lawn	C	74	0.000	0.00
6	Woods	C	70	0.000	0.00
7	Lawn	D	80	0.000	0.00
8	Woods	D	77	0.115	8.86
			Total :	0.115	8.86
			Average CN:		77.00
			Imperviousness (%):		**0.00**

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AE **Analysis By:** FA Date 7/18/2023
Condition: Existing **Checked By:** Date
Time (Hrs): 0.20 through subarea
0.20 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0278				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1758	0		=	0.176

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			644.86		
9. Watercourse slope, s	Ft./Ft.			0.1498		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	6.193		
11. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.029	=	0.029

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	0.000		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0	0		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff., n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.	0.000	0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)	Hour				=	0.20

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: BE **Analysis By:** FA Date 7/18/2023
Condition: Existing **Checked By:** Date
Time (Hrs): 0.09 through subarea
0.10 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0864				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0742	0		=	0.074

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			76.33		
9. Watercourse slope, s	Ft./Ft.			0.3233		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	9.098		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0023	=	0.002

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Lawn				
13. Flow length, L	Ft.	15.39				
14. Watercourse slope, s	Ft./Ft.	0.0650				
15. Average velocity, V (figure 3-1)	Ft./S	4.078501935	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.001	0.000	0.000	=	0.001

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	2.00				
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.5	0	0		
19. Channel slope, s	Ft./Ft.	0.0237				
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	13.13	0	0		
22. Flow length, L	Ft.	24.09				
23. Tt = L/3600V Computer Tt	Hr.	0.001	0.000	0.000	=	0.001

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft	2.000				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.500				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0393				
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.914	0.000	0.000		
32. Flow length, L	Ft.	234.11	0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.011	0.000	0.000	=	0.011
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)	Hour				=	0.09

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: CE **Analysis By:** FA Date 7/18/2023
Condition: Existing **Checked By:** Date
Time (Hrs): 0.13 through subarea
0.13 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0398				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1012	0		=	0.101

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			339.59		
9. Watercourse slope, s	Ft./Ft.			0.0368		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	3.067		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0308	=	0.031

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.		0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0	0		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.		0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)			Hour		=	0.13

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: DE **Analysis By:** FA Date 7/18/2023
Condition: Existing **Checked By:** Date
Time (Hrs): 0.11 through subarea
0.11 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0918				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1090	0		=	0.109

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			68.73		
9. Watercourse slope, s	Ft./Ft.			0.1302		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	5.774		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0033	=	0.003

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.		0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0	0		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.		0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)			Hour		=	0.11

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: EE **Analysis By:** FA Date 7/18/2023
Condition: Existing **Checked By:** Date
Time (Hrs): 0.21 through subarea
0.21 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0200				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.2006	0		=	0.201

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			60.15		
9. Watercourse slope, s	Ft./Ft.			0.0081		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	1.444		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0116	=	0.012

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.		0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0	0		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.		0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)			Hour		=	0.21

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: APb (Bypass) **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.15 through subarea
0.15 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0534				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1354	0		=	0.135

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			392.80		
9. Watercourse slope, s	Ft./Ft.			0.2527		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	8.043		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0136	=	0.014

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.		0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0	0		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.		0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)			Hour		=	0.15

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-1 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.27 through subarea
0.27 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0039				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.2564	0		=	0.256

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			202.75		
9. Watercourse slope, s	Ft./Ft.			0.1081		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	5.261		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0107	=	0.011

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.		0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0	0		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.		0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)			Hour		=	0.27

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-2 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.37 through subarea
0.37 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0050				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.3493	0		=	0.349

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)		Paved		Woods		
8. Flow length, L	Ft.	96.74		118.57		
9. Watercourse slope, s	Ft./Ft.	0.0109		0.3289		
10. Average velocity, V (figure 3-1)	Ft./S	2.117	0.000	9.176		
11. Tt = L/3600V Computer Tt	Hr.	0.0127	0.0000	0.0036	=	0.016

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Lawn	Riprap			
13. Flow length, L	Ft.	53.96	25.34			
14. Watercourse slope, s	Ft./Ft.	0.0593	0.1579			
15. Average velocity, V (figure 3-1)	Ft./S	3.896359328	6.356918932	0		
16. Tt = L/3600V Computer Tt	Hr.	0.004	0.001	0.000	=	0.005

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.25			
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.3125	0		
19. Channel slope, s	Ft./Ft.	0.0124	0.0272			
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.98	10.30	0		
22. Flow length, L	Ft.	20.18	18.35			
23. Tt = L/3600V Computer Tt	Hr.	0.001	0.000	0.000	=	0.001

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Riprap				
25. Bottom width, B	ft	2.000				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.500				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.2044				
30. Manning's roughness coeff. for channels, n		0.035	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	9.633	0.000	0.000		
32. Flow length, L	Ft.	63.61	0.00	0.00		
33. Tt = L/3600V Computer Tt	Hr.	0.002	0.000	0.000	=	0.002
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)	Hour				=	0.37

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-3 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.12 through subarea
0.12 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.1264				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0960	0		=	0.096

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			87.3500		
9. Watercourse slope, s	Ft./Ft.			0.3112		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	8.925		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0027	=	0.003

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Lawn	Riprap			
13. Flow length, L	Ft.	76.6900	25.3400			
14. Watercourse slope, s	Ft./Ft.	0.0489	0.1579			
15. Average velocity, V (figure 3-1)	Ft./S	3.538068587	6.356918932	0		
16. Tt = L/3600V Computer Tt	Hr.	0.006	0.001	0.000	=	0.007

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.25			
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.3125	0		
19. Channel slope, s	Ft./Ft.	0.0100	0.0272			
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.37	10.30	0		
22. Flow length, L	Ft.	210.1900	18.3500			
23. Tt = L/3600V Computer Tt	Hr.	0.011	0.000	0.000	=	0.011

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Riprap				
25. Bottom width, B	ft	2.000				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.500				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.2044				
30. Manning's roughness coeff. for channels, n		0.035	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	9.633	0.000	0.000		
32. Flow length, L	Ft.	63.61	0.00	0.00		
33. Tt = L/3600V Computer Tt	Hr.	0.002	0.000	0.000	=	0.002
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)	Hour				=	0.12

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-4 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.15 through subarea
0.15 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0784				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1162	0		=	0.116

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			105.40		
9. Watercourse slope, s	Ft./Ft.			0.307		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	8.871		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0033	=	0.003

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Lawn				
13. Flow length, L	Ft.	7.55				
14. Watercourse slope, s	Ft./Ft.	0.163				
15. Average velocity, V (figure 3-1)	Ft./S	6.458015195	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.00	1.25		
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.25	0.3125		
19. Channel slope, s	Ft./Ft.	0.0050	0.0128	0.0614		
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	3.80	6.09	15.45		
22. Flow length, L	Ft.	80.13	97.29	32.59		
23. Tt = L/3600V Computer Tt	Hr.	0.006	0.004	0.001	=	0.011

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn	Riprap			
25. Bottom width, B	ft	2.000	2			
26. Side slope (H:V)		2	2			
27. Design depth, D	ft	0.500	0.5			
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.354	0.000		
29. Channel slope, s	Ft./Ft.	0.0039	0.0554			
30. Manning's roughness coeff. for channels, n		0.025	0.035			
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	1.871	5.015	0.000		
32. Flow length, L	Ft.	68.64	108.32	0.00		
33. Tt = L/3600V Computer Tt	Hr.	0.010	0.006	0.000	=	0.016
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.15

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-5 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.35 through subarea
0.35 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0022				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.3223	0		=	0.322

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)		Paved		Lawn		
8. Flow length, L	Ft.	35.39		26.49		
9. Watercourse slope, s	Ft./Ft.	0.023		0.0094		
10. Average velocity, V (figure 3-1)	Ft./S	3.055	0.000	1.554		
11. Tt = L/3600V Computer Tt	Hr.	0.0032	0.0000	0.0047	=	0.008

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.00	1.25		
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.25	0.3125		
19. Channel slope, s	Ft./Ft.	0.0094	0.0128	0.0614		
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.21	6.09	15.45		
22. Flow length, L	Ft.	15.94	97.29	32.59		
23. Tt = L/3600V Computer Tt	Hr.	0.001	0.004	0.001	=	0.006

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn	Riprap			
25. Bottom width, B	ft	2	2			
26. Side slope (H:V)		2	2			
27. Design depth, D	ft	0.500	0.5			
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.354	0.000		
29. Channel slope, s	Ft./Ft.	0.0190	0.0554			
30. Manning's roughness coeff. for channels, n		0.025	0.035			
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	4.108	5.015	0.000		
32. Flow length, L	Ft.	147.10	108.32			
33. Tt = L/3600V Computer Tt	Hr.	0.010	0.006	0.000	=	0.016
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.35

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-6 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.12 through subarea
0.12 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0312				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1116	0		=	0.112

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)		Paved		Lawn		
8. Flow length, L	Ft.	28.68		30.55		
9. Watercourse slope, s	Ft./Ft.	0.0359		0.0363		
10. Average velocity, V (figure 3-1)	Ft./S	3.851	0.000	3.050		
11. Tt = L/3600V Computer Tt	Hr.	0.0021	0.0000	0.0028	=	0.005

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.25			
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.3125	0		
19. Channel slope, s	Ft./Ft.	0.0493	0.0614			
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	11.93	15.45	0.00		
22. Flow length, L	Ft.	2.03	32.59			
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.001	0.000	=	0.001

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Riprap				
25. Bottom width, B	ft	2				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.500				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0554				
30. Manning's roughness coeff. for channels, n		0.025				
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	7.021	0.000	0.000		
32. Flow length, L	Ft.	108.32				
33. Tt = L/3600V Computer Tt	Hr.	0.004	0.000	0.000	=	0.004
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.12

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: AP-7 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.11 through subarea
0.11 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0392				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1018	0		=	0.102

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			12.55		
9. Watercourse slope, s	Ft./Ft.			0.1227		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	5.605		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0006	=	0.001

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.00	1.25		
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.25	0.3125		
19. Channel slope, s	Ft./Ft.	0.0088	0.0128	0.0614		
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.04	6.09	15.45		
22. Flow length, L	Ft.	17.07	97.29	32.59		
23. Tt = L/3600V Computer Tt	Hr.	0.001	0.004	0.001	=	0.006

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn				
25. Bottom width, B	ft	2				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.5				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0554				
30. Manning's roughness coeff. for channels, n		0.025				
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	7.021	0.000	0.000		
32. Flow length, L	Ft.	108.32				
33. Tt = L/3600V Computer Tt	Hr.	0.004	0.000	0.000	=	0.004
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.11

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: BPb (Bypass) **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.09 through subarea
0.10 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0864				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0742	0		=	0.074

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			76.33		
9. Watercourse slope, s	Ft./Ft.			0.3233		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	9.098		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0023	=	0.002

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Lawn				
13. Flow length, L	Ft.	15.39				
14. Watercourse slope, s	Ft./Ft.	0.0650				
15. Average velocity, V (figure 3-1)	Ft./S	4.078501935	0	0		
16. Tt = L/3600V Computer Tt	Hr.	0.001	0.000	0.000	=	0.001

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	2.00				
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.5	0	0		
19. Channel slope, s	Ft./Ft.	0.0237				
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	13.13	0	0		
22. Flow length, L	Ft.	24.09				
23. Tt = L/3600V Computer Tt	Hr.	0.001	0.000	0.000	=	0.001

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24 Surface description (Table 3-1)						
25. Bottom width, B	ft	2.000				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.500				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0393				
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.914	0.000	0.000		
32. Flow length, L	Ft.	234.11	0.000	0.000		
33. Tt = L/3600V Computer Tt	Hr.	0.011	0.000	0.000	=	0.011
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)	Hour				=	0.09

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: B1P-1 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.15 through subarea
0.15 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0272				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1179	0		=	0.118

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)		Paved		Lawn		
8. Flow length, L	Ft.	141.31		55.58		
9. Watercourse slope, s	Ft./Ft.	0.0098		0.0090		
10. Average velocity, V (figure 3-1)	Ft./S	2.015	0.000	1.518		
11. Tt = L/3600V Computer Tt	Hr.	0.0195	0.0000	0.0102	=	0.030

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Lawn				
13. Flow length, L	Ft.	4.88				
14. Watercourse slope, s	Ft./Ft.	0.0799				
15. Average velocity, V (figure 3-1)	Ft./S	4.52	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0.00	0.00		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn				
25. Bottom width, B	ft	2				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.5				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0376				
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.785	0.000	0.000		
32. Flow length, L	Ft.	76.04				
33. Tt = L/3600V Computer Tt	Hr.	0.004	0.000	0.000	=	0.004
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.15

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: B2P-1 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.13 through subarea
0.13 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0276				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1172	0		=	0.117

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)						
8. Flow length, L	Ft.					
9. Watercourse slope, s	Ft./Ft.					
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	0.000		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0000	=	0.000

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.00	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0.00	0.00		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn				
25. Bottom width, B	ft	2				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.5				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0289				
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.073	0.000	0.000		
32. Flow length, L	Ft.	315.31				
33. Tt = L/3600V Computer Tt	Hr.	0.017	0.000	0.000	=	0.017
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.13

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: B2P-2 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.13 through subarea
0.13 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.2104				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0783	0		=	0.078

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)		Paved		Lawn		
8. Flow length, L	Ft.	43.29		113.63		
9. Watercourse slope, s	Ft./Ft.	0.0208		0.0635		
10. Average velocity, V (figure 3-1)	Ft./S	2.930	0.000	4.033		
11. Tt = L/3600V Computer Tt	Hr.	0.0041	0.0000	0.0078	=	0.012

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.00	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00				
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0	0		
19. Channel slope, s	Ft./Ft.	0.0118				
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	5.85	0.00	0.00		
22. Flow length, L	Ft.	147.97				
23. Tt = L/3600V Computer Tt	Hr.	0.007	0.000	0.000	=	0.007

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn	Lawn			
25. Bottom width, B	ft	2	2			
26. Side slope (H:V)		2	2			
27. Design depth, D	ft	0.5	0.5			
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.354	0.000		
29. Channel slope, s	Ft./Ft.	0.0236	0.0303			
30. Manning's roughness coeff. for channels, n		0.025	0.025			
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	4.586	5.193	0.000		
32. Flow length, L	Ft.	237.35	263.97			
33. Tt = L/3600V Computer Tt	Hr.	0.014	0.014	0.000	=	0.028
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.13

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: CPb (Bypass) **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.11 through subarea
0.11 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0352				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1063	0		=	0.106

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			53.31		
9. Watercourse slope, s	Ft./Ft.			0.0356		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	3.021		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0049	=	0.005

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.00	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0.00	0.00		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.					
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.11

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: CP-1 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.14 through subarea
0.14 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0206				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1317	0		=	0.132

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			33.93		
9. Watercourse slope, s	Ft./Ft.			0.0139		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	1.883		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0050	=	0.005

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.00	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0.00	0.00		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)		Lawn				
25. Bottom width, B	ft	2				
26. Side slope (H:V)		2				
27. Design depth, D	ft	0.5				
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.354	0.000	0.000		
29. Channel slope, s	Ft./Ft.	0.0237				
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	4.591	0.000	0.000		
32. Flow length, L	Ft.	73.88				
33. Tt = L/3600V Computer Tt	Hr.	0.004	0.000	0.000	=	0.004
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.14

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: CP-2 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.07 through subarea
0.10 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.2616				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0477	0		=	0.048

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			119.11		
9. Watercourse slope, s	Ft./Ft.			0.0296		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	2.754		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0120	=	0.012

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Riprap				
13. Flow length, L	Ft.	8.17				
14. Watercourse slope, s	Ft./Ft.	0.1530				
15. Average velocity, V (figure 3-1)	Ft./S	6.26	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.0004

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.25			
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.3125	0		
19. Channel slope, s	Ft./Ft.	0.0131	0.0104			
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	6.16	6.35	0.00		
22. Flow length, L	Ft.	26.68	86.94			
23. Tt = L/3600V Computer Tt	Hr.	0.001	0.004	0.000	=	0.005

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.					
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.07

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: CP-3 **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.09 through subarea
0.10 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Lawn - Dense Grasses				
2. Manning's Roughness Coef., n (Table 3-1)		0.24				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.1088				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0677	0		=	0.068

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Lawn		
8. Flow length, L	Ft.			42.21		
9. Watercourse slope, s	Ft./Ft.			0.0867		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	4.711		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0025	=	0.002

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)		Woods	Lawn	Riprap		
13. Flow length, L	Ft.	54.84	123.66	8.17		
14. Watercourse slope, s	Ft./Ft.	0.1823	0.1577	0.153		
15. Average velocity, V (figure 3-1)	Ft./S	6.83	6.35	6.26		
16. Tt = L/3600V Computer Tt	Hr.	0.002	0.005	0.000	=	0.0080

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.	1.00	1.25			
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0.25	0.3125	0		
19. Channel slope, s	Ft./Ft.	0.0300	0.0104			
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	9.31	6.35	0.00		
22. Flow length, L	Ft.	136.78	86.94			
23. Tt = L/3600V Computer Tt	Hr.	0.004	0.004	0.000	=	0.008

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.					
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.09

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: DPb (Bypass) **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.10 through subarea
0.10 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.1206				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.0978	0		=	0.098

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			2.98		
9. Watercourse slope, s	Ft./Ft.			0.2987		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	8.744		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0001	=	0.0001

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.00	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0.00	0.00		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.					
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.10

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Subject:	**Time of Concentration (Tc) or Travel Timel (Tt)**				
Project:	Farm Road Homes	**Job No.:**		J269-12	
Location:	65 Farm Road, Sherborn, MA				

Sub-Basin: EPb (Bypass) **Analysis By:** FA Date 7/18/2023
Condition: Proposed **Checked By:** Date
Time (Hrs): 0.17 through subarea
0.17 to be used
Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet Flow (Applicable to TC Only)						
1. Surface description (Table 3-1)		Woods - Light Underbrush				
2. Manning's Roughness Coef., n (Table 3-1)		0.4				
3. Flow length, L (total L <= 300 ft)	Ft.	50.00				
4. Two-yr 24-hr rainfall, P2	In.	3.36				
5. Land slope, s	Ft./Ft.	0.0416				
6. Tt = 0.007 (nL)^0.8/P2^0.5 s^0.4 Compute Tt	Hr.	0.1497	0		=	0.150

Shallow Concentrated Flow		Reach 1 - Paved	Reach 2 - Paved	Reach 3 - Unpaved		
7. Surface description (Lawn, Woods, ETC)				Woods		
8. Flow length, L	Ft.			99.13		
9. Watercourse slope, s	Ft./Ft.			0.0089		
10. Average velocity, V (figure 3-1)	Ft./S	0.000	0.000	1.508		
11. Tt = L/3600V Computer Tt	Hr.	0.0000	0.0000	0.0183	=	0.0183

Shallow Concentrated Flow		Reach 4 - Unpaved	Reach 5 - Unpaved	Reach 6 - Unpaved		
12. Surface description (Lawn, Woods, ETC)						
13. Flow length, L	Ft.					
14. Watercourse slope, s	Ft./Ft.					
15. Average velocity, V (figure 3-1)	Ft./S	0.00	0.00	0.00		
16. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Pipe		Reach 1	Reach 2	Reach 3		
17. Diameter, D	Ft.					
18. Hydraulic radius, r=a/Pw Computer r	Ft.	0	0	0		
19. Channel slope, s	Ft./Ft.					
20. Manning's roughness coeff., n		0.011	0.011	0.011		
21. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.00	0.00	0.00		
22. Flow length, L	Ft.					
23. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000

Channel flow - Open Trapezoid		Reach 1	Reach 2	Reach 3		
24. Surface description (Lawn, Woods, ETC)						
25. Bottom width, B	ft					
26. Side slope (H:V)						
27. Design depth, D	ft					
28. Hydraulic radius, r=a/Pw Computer r	Ft.	0.000	0.000	0.000		
29. Channel slope, s	Ft./Ft.					
30. Manning's roughness coeff. for channels, n		0.025	0.025	0.025		
31. V = 1.49 r^(2/3) s^(1/2) / n Compute V	Ft/S	0.000	0.000	0.000		
32. Flow length, L	Ft.					
33. Tt = L/3600V Computer Tt	Hr.	0.000	0.000	0.000	=	0.000
34. Watershed or subarea Tc or Tt (add Tr in steps 6, 11, 16, 23, and 33)				Hour	=	0.17

Appendix B: FLOOD ROUTING CALCULATIONS FOR STORAGE AREAS

On the following pages, are the results of flood routing calculations by Storage-Indication method. We prefer this classical technique to the short cut methods because the assumptions for the short cut methods are often violated in real drainage areas.

The computation is carried out by HEC-HMS.

Table B.1. Land used table

Condition	Land Use	Area				
		Total	HSG A	HSG B	HGS C	HSG D
		acre	acre	acre	acre	acre
Existing	Roof	0.15	0.00	0.06	0.00	0.09
	Drive/Park	0.24	0.06	0.09	0.00	0.09
	Walk/Patio/etc.	0.41	0.00	0.17	0.05	0.18
	Lawn	4.40	0.04	0.98	1.51	1.86
	Woods	10.19	0.79	2.20	0.07	7.13
	Total	15.39	0.89	3.51	1.64	9.36
Proposed	Roof	1.07	0.00	0.42	0.18	0.48
	Drive/Park	1.18	0.06	0.44	0.25	0.43
	Walk/Patio/etc.	0.44	0.00	0.14	0.08	0.22
	Lawn	5.55	0.04	1.37	0.63	3.50
	Woods	7.16	0.79	1.14	0.51	4.73
	Total	15.39	0.89	3.51	1.64	9.36

Table B.2. Summary of Peak Runoffs Leaving the Project Site

Sub-watershed		*Peak Runoffs (cfs)*					*Runoff Volume (ac-ft)*				
		2-year	*10-year*	*25-year*	*50-yar*	*100-year*	*2-year*	*10-year*	*25-year*	*50-yar*	*100-year*
Existing-	*CP1 (AE)*	9.95	22.82	31.62	38.28	45.65	0.93	2.05	2.82	3.41	4.07
	CP2 (BE)	1.39	3.76	5.46	6.79	8.31	0.14	0.32	0.45	0.55	0.67
	CP3 (CE)	3.86	9.14	12.77	15.53	18.61	0.34	0.76	1.05	1.27	1.53
	CP4 (DE)	0.24	0.56	0.77	0.93	1.11	0.02	0.04	0.06	0.07	0.09
	CP5 (EE)	0.29	0.63	0.86	1.03	1.21	0.03	0.06	0.08	0.09	0.11
Proposed- with flood control	*CP1 (APb, AP-1, AP-2, AP-3, AP-4,AP-5,AP-6,AP-7)*	4.800	12.73	19.16	26.65	35.030	0.59	1.61	2.33	2.9	3.540
	CP2 (BPb, B2P-1,B2P-2)	1.130	2.66	3.85	4.79	5.840	0.11	0.27	0.41	0.53	0.670
	CP3 (CPb, CP-1, CP-2, CP-3,B1P-1)	0.730	5.51	9.13	11.49	13.840	0.07	0.31	0.48	0.62	0.740
	CP4 (DE)	0.160	0.38	0.53	0.64	0.760	0.01	0.03	0.04	0.05	0.060
	CP5 (EE)	0.150	0.32	0.44	0.53	0.620	0.01	0.03	0.04	0.04	0.050

Table B.2a. Summary runoff peak and volume change

Control Point	*Change in Peak Runoffs (%)*					*Change in Runoff Volume (%)*				
	2-year	*10-year*	*25-year*	*50-yar*	*100-year*	*2-year*	*10-year*	*25-year*	*50-yar*	*100-year*
Cntrlp1	-51.8%	-44.2%	-39.4%	-30.4%	-23.3%	-36.6%	-21.5%	-17.4%	-15.0%	-13.0%
Cntrlp2	-18.7%	-29.3%	-29.5%	-29.5%	-29.7%	-21.4%	-15.6%	-8.9%	-3.6%	0.0%
Cntrlp3	-81.1%	-39.7%	-28.5%	-26.0%	-25.6%	-79.4%	-59.2%	-54.3%	-51.2%	-51.6%
Cntrlp4	-33.3%	-32.1%	-31.2%	-31.2%	-31.5%	-50.0%	-25.0%	-33.3%	-28.6%	-33.3%
Cntrlp5	-48.3%	-49.2%	-48.8%	-48.5%	-48.8%	-66.7%	-50.0%	-50.0%	-55.6%	-54.5%
Mini	-18.7%	-29.3%	-28.5%	-26.0%	-23.3%	-21.4%	-15.6%	-8.9%	-3.6%	0.0%
Max	-81.1%	-49.2%	-48.8%	-48.5%	-48.8%	-79.4%	-59.2%	-54.3%	-55.6%	-54.5%

Table B.3. Summary of Peak Elevations

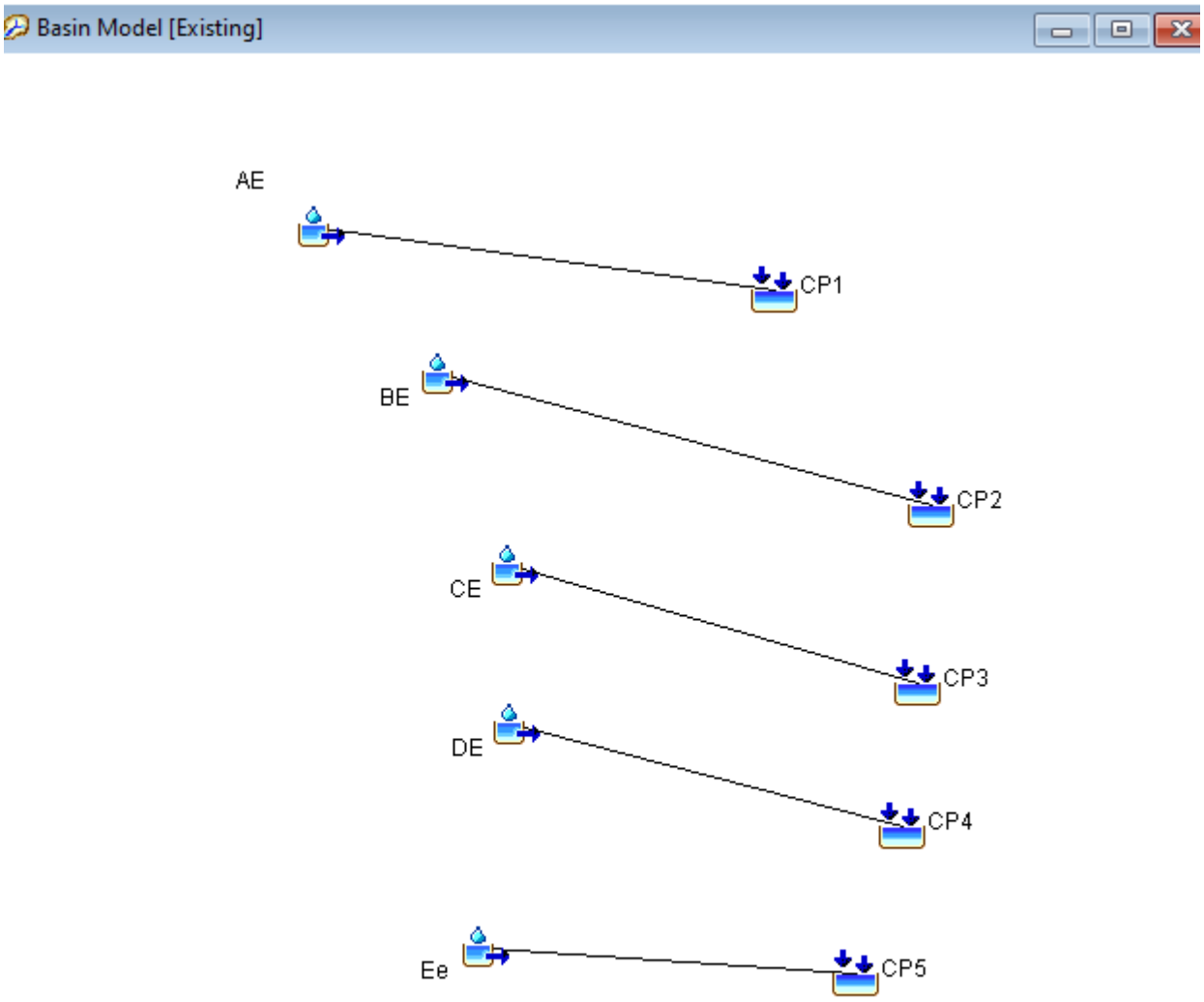
Basin	*2-yr*	*10-yr*	*25-yr*	*50-yr*	*100-yr*
BASIN A	210.210	211.260	211.560	211.750	211.950
BSIN B1	217.200	217.500	217.630	217.700	217.780
BSIN B2	210.250	210.910	211.250	211.400	211.550
BSIN C1	220.540	220.770	220.870	220.910	220.960

Table B.4. Summary of Basin Recharge for 100-year storm event

Basin	reach A	Vol, ac-ft	Vol. cf
BASIN A	reach A	0.63	27442.8
BSIN B1	reach B1	0.36	15681.6
BSIN B2	reach B2	0.28	12196.8
BSIN C1	reach c1	0.18	7840.8

HECHMS Glogbal Summary Table

Existing		2-yr		10-yr		25-yr		50-yr		100yr	
Watershed	Area, sq mi	Peak, cfs	Vol., ac-ft	Peak, cfs	Vol., ac-ft	Peak, cfs	Vol., ac-ft	Peak, cfs	Vol., ac-ft	Peak, cfs	Vol., ac-ft
AE	0.01472	9.95	0.93	22.82	2.05	31.62	2.82	38.28	3.41	45.65	4.07
BE	0.0029	1.39	0.14	3.76	0.32	5.46	0.45	6.79	0.55	8.31	0.67
CE	0.00574	3.86	0.34	9.14	0.76	12.77	1.05	15.53	1.27	18.61	1.53
CP1	0.01472	9.95	0.93	22.82	2.05	31.62	2.82	38.28	3.41	45.65	4.07
CP2	0.0029	1.39	0.14	3.76	0.32	5.46	0.45	6.79	0.55	8.31	0.67
CP3	0.00574	3.86	0.34	9.14	0.76	12.77	1.05	15.53	1.27	18.61	1.53
CP4	0.00032	0.24	0.02	0.56	0.04	0.77	0.06	0.93	0.07	1.11	0.09
CP5	0.00037	0.29	0.03	0.63	0.06	0.86	0.08	1.03	0.09	1.21	0.11
DE	0.00032	0.24	0.02	0.56	0.04	0.77	0.06	0.93	0.07	1.11	0.09
Ee	0.00037	0.29	0.03	0.63	0.06	0.86	0.08	1.03	0.09	1.21	0.11
Proposed		2yr			10-yr	25-yr		50-yr		100-yr	
APb	0.00789	4.8	0.43	11.75	0.99	16.63	1.39	20.35	1.69	24.5	2.04
AP-1	0.00273	2.76	0.27	5.26	0.52	6.86	0.67	8.04	0.79	9.33	0.93
AP-2	0.00211	1.7	0.19	3.37	0.37	4.46	0.49	5.27	0.58	6.16	0.68
AP-3	0.00064	0.56	0.05	1.21	0.1	1.64	0.13	1.97	0.16	2.32	0.19
AP-4	0.00078	0.59	0.05	1.32	0.11	1.81	0.15	2.19	0.18	2.6	0.22
AP-5	0.00052	0.7	0.08	1.13	0.13	1.4	0.17	1.6	0.19	1.82	0.22
AP-6	0.00044	0.78	0.07	1.25	0.12	1.55	0.14	1.76	0.16	2	0.19
AP-7	0.00012	0.21	0.02	0.34	0.03	0.42	0.04	0.48	0.04	0.54	0.05
BASN A	0.00734	1.41	0.56	6.02	1.13	10.95	1.51	14.27	1.81	17.66	2.14
BPb	0.00178	1.13	0.11	2.66	0.23	3.75	0.31	4.6	0.38	5.54	0.45
BSN B1	0.0016	0.51	0.16	2.58	0.31	4.08	0.41	5	0.48	5.9	0.56
BSN B2	0.00222	0.41	0.11	0.84	0.24	1.4	0.33	2.28	0.41	3.19	0.49
BSN C1	0.0014	0.49	0.12	2.37	0.23	3.54	0.3	4.23	0.36	4.94	0.42
B1P-1	0.0016	2.3	0.21	3.99	0.36	5.05	0.46	5.83	0.53	6.67	0.61
B2P-1	0.00133	1.87	0.17	3.26	0.29	4.15	0.37	4.81	0.43	5.53	0.5
B2P-2	0.00089	1.37	0.12	2.33	0.21	2.93	0.26	3.37	0.3	3.85	0.35
CPb	0.00141	0.73	0.06	1.97	0.16	2.85	0.22	3.53	0.28	4.29	0.34
CP-1	0.00083	1.24	0.11	2.11	0.19	2.67	0.24	3.07	0.28	3.52	0.32
CP-2	0.00029	0.37	0.03	0.67	0.06	0.87	0.07	1.02	0.09	1.18	0.1
CP-3	0.00028	0.04	0.01	0.23	0.02	0.37	0.03	0.49	0.04	0.62	0.05
CtrlP 1	0.01523	4.8	0.59	12.73	1.61	19.16	2.33	26.65	2.9	35.03	3.54
CtrlP 2	0.004	1.13	0.11	2.66	0.27	3.85	0.41	4.79	0.53	5.84	0.67
CtrlP 3	0.00441	0.73	0.07	5.51	0.31	9.13	0.48	11.49	0.62	13.84	0.78
CtrlP 4	0.00022	0.16	0.01	0.38	0.03	0.53	0.04	0.64	0.05	0.76	0.06
CtrlP 5	0.00018	0.15	0.01	0.32	0.03	0.44	0.04	0.53	0.04	0.62	0.05
div A	0.00734	1.02	0.16	5.55	0.61	10.46	0.95	13.76	1.21	17.13	1.51
div B1	0.0016	0.01	0	2.03	0.07	3.5	0.11	4.41	0.15	5.3	0.19
div B2	0.00222	0.03	0	0.36	0.05	0.87	0.1	1.73	0.15	2.62	0.21
div c1	0.0014	0.37	0.01	2.24	0.09	3.4	0.15	4.1	0.19	4.8	0.25
DPb	0.00022	0.16	0.01	0.38	0.03	0.53	0.04	0.64	0.05	0.76	0.06
EPb	0.00018	0.15	0.01	0.32	0.03	0.44	0.04	0.53	0.04	0.62	0.05
Reach-AP2	0.00211	1.67	0.16	3.34	0.34	4.42	0.45	5.23	0.54	6.11	0.64
Reach-AP3	0.00064	0.54	0.03	1.18	0.07	1.61	0.1	1.93	0.13	2.29	0.16
Reach-AP4	0.00078	0.52	0.02	1.24	0.06	1.73	0.09	2.1	0.12	2.51	0.15
Reach-AP5	0.00052	0.6	0.03	1.02	0.06	1.29	0.08	1.49	0.1	1.7	0.11
Reach-AP6	0.00044	0.74	0.04	1.2	0.07	1.5	0.09	1.71	0.11	1.95	0.13
Reach-AP7	0.00012	0.16	0.01	0.29	0.01	0.38	0.02	0.44	0.02	0.5	0.02
Reach-B1P	0.0016	2.27	0.16	3.95	0.31	5	0.41	5.78	0.48	6.62	0.56
Reach-B2P	0.00133	1.72	0.07	3.09	0.16	3.97	0.22	4.62	0.27	5.34	0.32
Reach-B2P	0.00089	1.14	0.04	2.08	0.08	2.66	0.11	3.09	0.13	3.57	0.16
Reach-CP-	0.00083	1.21	0.08	2.08	0.15	2.63	0.2	3.04	0.23	3.48	0.27
rech A	0	0.53	0.63	0.47	0.51	0.49	0.56	0.51	0.6	0.53	0.63
rech B1	0	0.73	0.38	0.55	0.24	0.57	0.29	0.59	0.33	0.6	0.36
rech B2	0	0.57	0.28	0.48	0.19	0.53	0.24	0.55	0.26	0.57	0.28
rech c1	0	0.16	0.2	0.13	0.14	0.13	0.15	0.13	0.17	0.14	0.18



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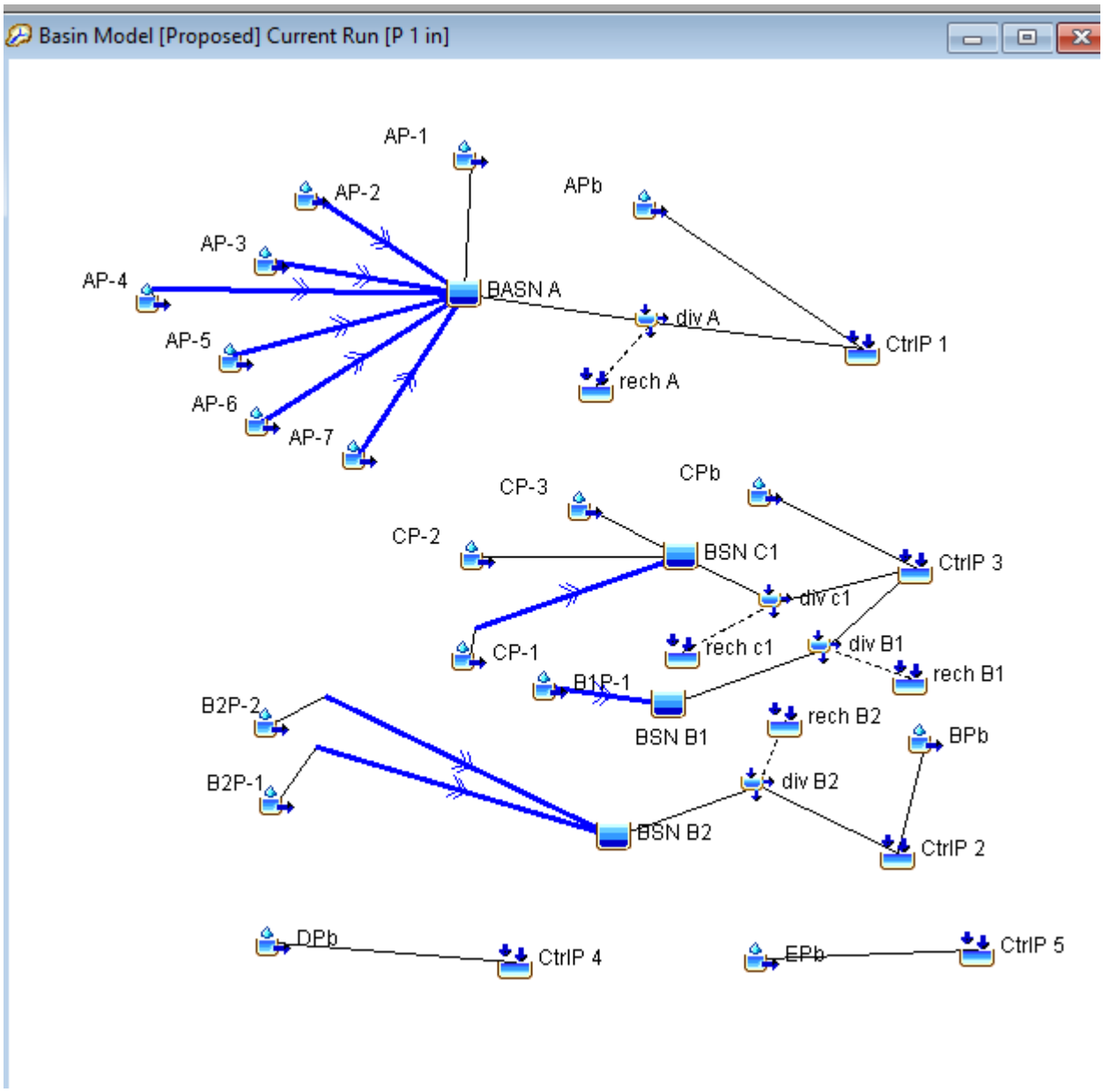
Above Output reports can be made available upon request to save space. See previous a global summary table.



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Above Output reports can be made available upon request to save space. See previous a global summary table.

Appendix C: CALCULATIONS OF STORMWATER QUALITY CONTROL[1]

1. Infiltration Pond

In current Best Management Practices, extended infiltration ponds are one of the most widely used methods. We have used the most recent studies (Schueler 1987, 1992, Urbonas and Stahre 1993) on stormwater quality control by extended infiltration ponds (EDP) to calculate nutrient load. The results are used as a basis for the designs of sediment forebays and water treatment pools. Information on pollutant concentration from runoff (EPA 1983) is used. Pollutant loads from predevelopment and postdevelopment are calculated and compared. Removal efficiency is calculated based on long-term average results from typical basins, U.S. EPA (1986), and adapted to reflect modifications of Walker (1986) and short term dynamic effect. A generalized formula is provided in the following (Wang and Carr 1996):

$$Pr = Prmax(1 - \frac{1}{1+Vi^{np}}) .\text{fr} \qquad (1)$$

in which, Pr = pollutant removal rate (%);

Prmax = maximum pollutant removal rate (%);
Vi = ratio of designed water treatment volume to the runoff volume from mean storm (about 0.5 inches rainfall);
np = power coefficient, 1.4 is used in this study.
fr = residence time coefficient to reflect the dynamic effect.

$$fr = 1 - [1 + \frac{V_s t}{nh}]^{-n} \qquad (2)$$

where, n = turbulence or short circuiting constant (Fair and Geyer 1954), n = 1 for poor performance, n = 3 for good performance, n >5 for very good, and n = 4 for ideal performance;
Vs = effective settling velocity, ft/hr.
t = residence time, hr;
h = average depth of the pond, ft.

Some Prmax values for some pollutants are summarized here:

Pollutant	Prmax (%)
TSS	100
BOD, COD, Zn,Cu	45
TP	70
TN	50
Pb	95

These removal rates do not include the effect of swales or sediment sumps in catch basins. Removal

[1] Water Quality Module of Stormwater Analysis Version 1.0 © 1996, by Desheng Wang, Ph.D., P.E.,

rates of trace metals can be different due to the form of the metal. The particulate forms of metals are easy to remove. The soluble forms of metals are usually more difficult to remove. However, significant parts of soluble metals appear to adsorb to sediment particles and settle out of the water column. 60% removal rate was estimated in a case when 80% of zinc is in soluble form (Schueler 1987). The following table shows the removal rates of selected pollutants for a typical extended infiltration pond with a water treatment volume of 2.5 times the average runoff volume.

Table A.1: Fact Sheet of Standard Extended Infiltration Ponds (SEDP) (Schueler 1987, 1992)

Contaminant	Removal Efficiency (%)	Remarks
TSS	78	Total suspended solids
TN	41	Total nitrogen
TP	51	Total phosphorus
BOD	40	Biological oxygen demand
COD	40	Chemical oxygen demand
Pb	72	Lead
Zn	40	Zinc
Cu	40	Copper
HCs	60	Hydrocarbons*
Bact	70	Bacteria*

* Based on field studies by EPA (1981), Grizzard et al. (1986).

The SEDP requires that a pond volume equal the runoff volume of a rainfall event with exceedance frequency 90%.

The summary of calculations is presented below.

Standard Pond Volume (Treatment Volume, in acre-ft) (Schueler 1987, 1992):

$$Vp=[(P)(Pj)(Rv)/12]A \quad (3)$$

Total Pollutant Load in lbs:

$$L=[(P)(Pj)(Rv)/12](A)\ (C)\ (2.72) \quad (4)$$

where, P=Rainfall depth (inches); Pj=correction factor, equals the accumulative frequency of rainfall events; Rv=runoff coefficient, =0.05 + 0.009I; I= Imperviousness (%); A = watershed area (Acre); L= pollutant load (lbs); C = pollutant concentration (mg/l).

Sediment forebay is designed to hold 5 years accumulation of TSS. Once a year or once every two years

cleanup of the forebay is recommended. In addition, 24 hrs or longer infiltration time is recommended to achieve predicted removal rate (Schueler 1987, Urbonas and Stahre 1993). Most coarse particles are supposed to be trapped by sediment forebay. For a given site condition, the area of the forebay can be determined by the following equation which was derived by the Washington State Department of Ecology from the Camp-Hazen equation (Washington State Department of Ecology, 1992 and Chen, 1975):

$$A_s = -(\frac{Q_o}{\omega}) * Ln(1 - E) \quad (5), \quad \text{where:}$$

A_s = sediment forebay or basin surface area (ft^2);

E = target removal efficiency of suspended solids;

ω = particle settling velocity; for target particle size (silt) use settling velocity = 0.0004 ft/sec for a site with imperviousness larger or equal to 75% and 0.0003 ft/sec for imperviousness < 75%;

Q_o = rate of outflow form the basin; which is equal to the water quality volume divided by the infiltration time (t_d).

Besides the above mentioned pollutants, it has been reported that an order of magnitude reduction in bacterial counts after 32 hours of infiltration occurs (Whipple and Hunter 1981). Also, about 60 - 70% removal of hydrocarbons was reported over the same interval.

In addition to the pond attenuation abilities, marshes are used to provide extra treatment and purification for the water passing through them. Tables A.2 and A.3 provide average removal rates for selected pollutants from typical marshes.

Table A.2 Uptake Potentials of Cattail (Typha latifolia) Marshes (Chan et al 1982)

Contaminant	Uptake (lbs/acre/yr)
TP	9.7 to 358.7
TN	456.3 to 2340.7
Cu	0.32
Zn	0.53
Mn	12.16

Table A.3 Uptake Potentials and Removal Rate of Free Water Surface Marshes (Reed 1990)

Contaminant	Uptake (lbs/acre/yr)	Removal Rate (%)
TSS	125 to 49,508	61 to 95
TP	19.2 to 400.6	31 to 80
TN	215 to 430.6	43 to 93
BOD	220 to 20,764	49 to 95

2. Catch Basins

Catch basins are to be equipped with sediment sumps and oil/grease traps. Regularly maintained and cleaned catch basins can remove significant amounts of pollutants. Table A.4 presents an average removal rate of selected pollutants from catch basin sumps (Aronson et al 1983).

Table A.4 Average Removal Rates of Catch Basins for Selected Contaminants

Contaminant	Average Removal Rate (%)
TSS	58
TN	17
P	4
TM	50

* P = Phosphates; TM = Total metals.

References:

[1] Aronson, G. L., et al. (1983). "*Evaluation of Catchbasin Performance for Urban Stormwater Pollution Control*," Municipal Environmental Research Laboratory, Office of Research and Development, U.S. EPA. EPA-600/2-83-043.

[2] Reed, S. C. (1990). "*Natural Systems for Wastewater Treatment - Manual of Practice FD-16,"* Water Pollution Control Federation.

[3] Shueler, T. (1987) *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs*, Dept. of Environmental Programs, Metropolitan Washington Council of Governments, Washington D. C.

[4] Shueler, T. (1992) *Design of Stormwater Wetland Systems: Guidelines for Creating Diverse and Effective Stormwater Wetland Systems in the Mid-Atlantic Region*, Anacostia Restoration Team, Dept. of Environmental Programs, Metropolitan Washington Council of Governments, Washington D. C.

[5] Urbonas, Ben, and Stahre, Peter (1993) *Stormwater --Best Management Practices and Infiltration for Water Quality, Drainage, and CSO Management*, PTR Prentice Hall, Englewood Cliffs, New Jersey.

[6] Walker, W. (1986). "*Phosphorus Removal by Urban Runoff Infiltration Basins,"* Presented at Lake and Reservoir Management Conference: Influence on Nonpoint Source Pollutants. North American Lake Management Society, Portland, Oregon, November 5-8, 1986.

[7] Wang, D. S., and Carr, B. J. (1996). "Pollutant Removal Rates for Stormwater Infiltration Ponds," Proceedings of 1996 AIH Conference, Boston.

[8] Claytor, R. A., and Schueler, T. T. (1996) *Design of Stormwater Filtering Systems*, the Center for Watershed Protection, Silver Spring, MD 20910.

TSS Removal Calcualtion Worksheet

				Revised:			
Project:	Farm Road Homes	Designed by:	dsw	Date:	27-Sep-23	Sheet:	1 of 1
Location:	65 Farm Road	chkd by:		Date:		Job:	J269-12
	Basin A	revision:		Date:			

A	B	C	D	E
BMP*	TSS Removal Rate	Starting TSS	Amount Removed (BxC)	Remaining Load (C - D)
DSCB	0.25	1	0.25	0.75
WQS	0.5	0.75	0.375	0.375
Oil/grit seperator	0.25	0.375	0.09375	0.28125
Infiltration Trench	0.8	0.28125	0.225	0.05625

Total TSS Removal= 0.94

* WQS = water quality swale; WQI = water Qality inlet; EDB = extended detention basin.
DSCB = deep sump catch basin; SW = sweeping; DW=drywell; IT = infiltration trench.
FB = sediment Forebay; CW = constructed wetland, RB = retention basin, WB = wet basin
IB = Infiltration Basin
Reference: MADEP (2008) Stormwater Management, Volume I & II.
** Rate calculated based on DEP default

TSS Removal Calcualtion Worksheet

					Revised:		
Project:	Farm Road Homes		Designed by:	dsw	Date:	27-Sep-23	Sheet: 1 of 1
Location:	65 Farm Road		chkd by:		Date:		Job: J269-12
	Basin B1, B2, C		revision:		Date:		

A	B	C	D	E
BMP*	TSS Removal Rate	Starting TSS	Amount Removed (BxC)	Remaining Load (C - D)
Grass channel	0.5	1	0.5	0.5
IT	0.8	0.5	0.4	0.1

Total TSS Removal= 0.90

* WQS = water quality swale; WQI = water Qality inlet; EDB = extended detention basin.
DSCB = deep sump catch basin; SW = sweeping; DW=drywell; IT = infiltration trench.
FB = sediment Forebay; CW = constructed wetland, RB = retention basin, WB = wet basin
IB = Infiltration Basin, GC = grass channels
Reference: MADEP (2008) Stormwater Management, Volume I & II.

Creative Land & Water Engineering, LLC
Environmental Science and Resource Management
P.O. Box 584, Southborough, MA 01772
Tel/Fax: (508)281-1694 Email: deshengw@yahoo.com

Subject: Groundwater Recharge | revision by: | **Date:** 8/27/2023
Water Quality Calcs. | **By:** dsw | **Date:**
65 Farm Road | **Chkd:** | **Date:**
Location: Sherborn, MA | **Job No.:** J269-12 | **Sheet:** 1

Rev. 3/1/2021

1. Land Use Break Down

Land Uses (Acres)

	Subbasin	Existing	Proposed	Existing	Proposed	Increment
1	Roof	0.153	1.069	0.153	1.069	0.916
2	Pave	0.650	1.614	0.650	1.614	0.964
3	Pervious	14.589	12.709			
	Total	15.392	15.392	0.803	2.683	1.880
	Imperviousness (%)			5.22	17.43	

2. Groundwater Recharge

Dry wells (2)

Infiltration time (hrs): 6
Diameter (ft): 6 width (ft): Depth (ft): 6 Pipe dia. (in):
Storage volume (cu.ft):
Infil. rate (cfs):
Infiltration volume (cu.ft): 0
Total volume (cu ft) : 0

Impervious area (acres):	A soil	B Soil	C Soil	D Soil	Total			
					0	acres	Provided	
DEP required GW recharge volume:					**0**	cu. ft larger than	**0**	cu. ft OK!

Crushed Gravel

Infiltration time (hrs): 6	Basins					
At elevation (ft): out INV	Basin A 209.5	Basin B1 217.2	Basin B2 210.2	Basin C 220.5		
Static Storage volume (cu.ft):	7435.00	2591	3276	2403	**15705**	
Infil. rate (cfs):	3.30E-01	0.498	0.3833	0.117		
Infiltration volume (cu.ft):	7128	10756.8	8279.28	2527.2	**28691.28**	
Total volume (cu ft) :	14563	13347.8	11555.28	4930.2	**44396.28**	

Impervious area (acres):	A soil	B Soil	C Soil	D Soil	Total			
	0.058	0.997	0.500	1.128	2.68	acres	Provided	
DEP required GW recharge volume:	126.00	1266.83	453.78	409.40	**2256.01**	cu. ft less than	**44396.28**	cu. ft OK!

Infiltration trenches:

Infiltration time (hrs): 6	Trench						
Depth (ft):	Trench 1	Trench 2	Trench 3	Trench 4	Trench 5	Trench 6	Total
Storage volume (cu.ft):							**0**
Infil. rate (cfs):							
Infiltration volume (cu.ft):	0	0	0	0	0	0	**0**
Total volume (cu ft) :	0	0	0	0	0	0	**0**

Impervious area (acres):	A soil	B Soil	C Soil	D Soil	Total			
					0.000	acres	Provided	
DEP required GW recharge volume:					**0**	cu. ft less than	**0**	cu. ft OK!

An Average Storm Event Runoff:

Precipitation (in): 0.7
Total Impervious area (acres): 2.68
Runoff Volume (cu. ft): **6817.02** This is a conservative average groundwater recharge volume for a average rain event.
Total infiltration capacity(cu.ft): 44396.28 larger than 6817.0212 cu. ft OK !

Conclusion 1: Therefore, the pratical average groundwater recharge compensation will be **6817.0212** cu.ft. larger than **2256.01** cu.ft as DEP required.

3. Average Site TSS Removal Rate

	Subbasin	Area (acres)	TSS removal (%)	A x TSS	
1	Basin A	4.698	94	441.5744	mixed
2	Basin B1	1.024	90	92.16	mixed
3	Basin B2	1.421	90	127.872	mixed
4	Basin C	0.896	90		mixed
	Total	7.142		661.6064	
	Total average removal rate		92.63 %		

Conclusion 2: The average total suspended solid removal rate is 92.63 % better than existing conditions

4. Water Quality Volume

Water quality rule 1 inches

	Impervious area	WQV req.	WQV provided	
Site Conditions	acres	cu. ft	cu. ft	
existing	0.803025941	none	none	
Proposed	2.682810376	9738.6017	44396.28	OK!

Conclusion 3: Therefore, the total stormwater quality volume for proposed condition will be **44396.28** cu.ft. larger than **9738.6017** cu.ft as DEP required.

DSW (c) 6/6/1999

Flow Distribution Design in the Front Parking Lot

65 Farm Road, Sherborn, MA — Revision:

Project: DMH#1 - distribution MH — **Date:** 9/28/2023

By: Creative Land & Water Eng. LLC — **Cal. by:** dsw

Chk by:

Rev.

Bottom of manhole:	225.25 ft		
INV of Inflow pipes (12"):	226.25 ft		
INV of Orifice to O/G :	226.1 ft	Opening dia.:	4 in
INV of O.V.F. Weir:	226.50 ft	Weir bottom width (Cipoletti):	1 ft
INV of O.V.F Pipe:	225.5 ft	OVF pipe dia.:	1.25 ft
INV of Orifice from O/G:	225.65 ft		15 in

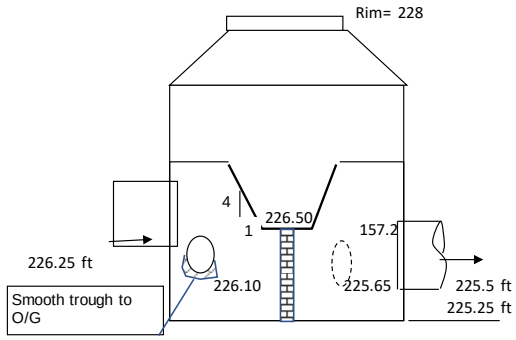
Treatment Flow Design Storm (0.5" or 1"): 1"

Component	Designed flow (cfs)	Elev. (ft)	Head (ft)	Designed Treatment Capacity (cfs)	Treatment ratio
Treatment Device:		226.50	0.23	0.20	1
Overflow weir:	0.2	226.50	0		
Total				0.20	

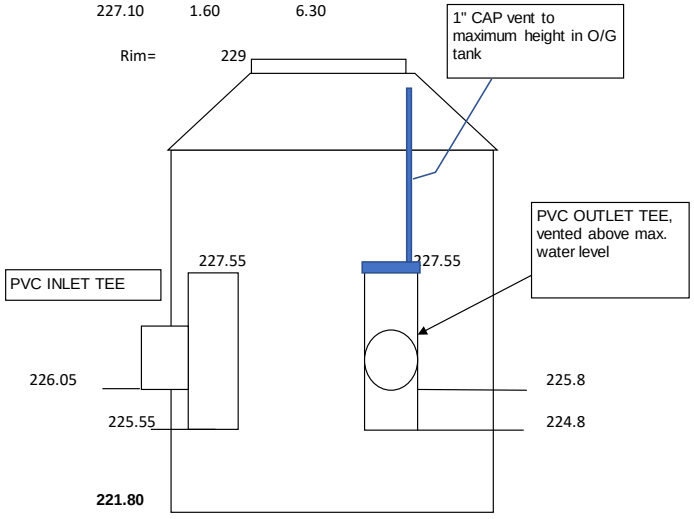
Overflow Flow Design Storm: 100-year

Component	Design flow (cfs)	Elev. (ft)	Head (ft)	Cal. Flow (cfs)	Treatment ratio
Treatment Device:		227.3	1.03	0.43	0.15
Overflow weir:	6	227.3	0.8	2.41	
Total				2.84	

Overflow pipe sizing: 227.10 1.60 6.30



DMH #1, Flow Distribution Manhole



ELEVATION VIEW (N.T.S.)

Oil/Grit Separator #1

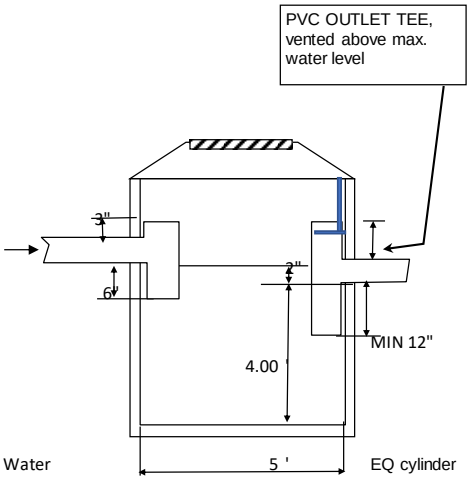
TSS Removal Calculations for Water Quality Inlet or Oil/Grit Separator

Project: Oil-Grit Separator #1 65 Farm Road, Sherborn, MA
User: DSW Date: 9/28/2023 Revision:
Creative Land & Water Engineering, LLC

Impervious Area:	0.120	acres	Target TSS removal:	80.00%	O/G volume		
Treatment Standard:	1	in	Initial Tank volume:	78.51	cu. ft.	587 gallon	Dia 5 ft
Treatment Volume:	435.6	cu. ft.	Initial depth:	4.00	ft	Dimension	Depth 4 ft
			End				
Total TSS Factor (NJ DEP):	0.8		depth:	2	ft	Interior	
Total TSS Factor (Sand):	0.85		O.V.F treatment ratio:	0.23			

	Particle size* d, μm	Distribution %	Specific Gravity	Settling Velocity Vs, ft/s	Effective Depth h, ft	Effective Treatment Time Td, min.	Average Dynamic Removal Rate %	Weighted Removal Rate	Total with CB
NJ DEP									
	1	5	2.65	0.0012	3	259.54	83.81%	4.19	
	4	15	2.65	0.0012	3	259.54	83.81%	12.57	
	29	25	2.65	0.0025	3	259.54	84.59%	21.15	
	75	15	2.65	0.0133	3	259.54	84.60%	12.69	
	175	30	2.65	0.0619	3	259.54	84.60%	25.38	
	375	5	2.65	0.1953	3	259.54	84.60%	4.23	
	750	5	2.65	0.4266	3	259.54	84.60%	4.23	
Average								**84.44%**	**88.33%**
	150	60	2.65	0.0475	3	259.54	88.45%	53.07	
Sand	400	20	2.65	0.2123	3	259.54	88.45%	17.69	
	2000	20	2.65	0.9417	3	259.54	88.45%	17.69	
								88.45%	

*Particle size distribution according to NJDEP (clay, silt, sand)
Removal rate = $1 - e^{-(Vs/h)Td}$



Assumption: 0.5" first flush contains 80-85% of the total TSS in runoff
1.0" runoff contains 90-95% of the total TSS in runoff
Bypass for above design flow should be provided to avoid resuspension.

Trt. Vol. / TSS Size	Treatment Factors 05"	1"
NJ DEP	0.8	0.9
Sand	0.85	0.95
OVFT	0.3	0.2

References:

Wang, D. and J. Carr (1996). "Pollutant Removal Rates for Stormwater Detention Ponds," Hydrology
Urbonas, Ben, and Stahre, Peter (1993). Stormwater - Best Management Practices and Detention for Water
U.S. EPA (1986) Methodology for Analysis of Detention Basins for Control of Urban Runoff Quality,

Flow Distribution Design in the Front Parking Lot

65 Farm Road, Sherborn, MA — Revision:

Project: DMH#1 - distribution MH — **Date:** 9/28/2023

By: Creative Land & Water Eng. LLC — **Cal. by:** dsw

Chk by:

Rev.

Bottom of manhole:	215.75 ft		
INV of Inflow pipes (12"):	221.75 ft		
INV of Orifice to O/G :	221.6 ft	Opening dia.:	4 in
INV of O.V.F. Weir:	222.15 ft	Weir bottom width (Cipoletti):	1 ft
INV of O.V.F Pipe:	216 ft	OVF pipe dia.:	1.25 ft
INV of Orifice from O/G:	220.5 ft		15 in

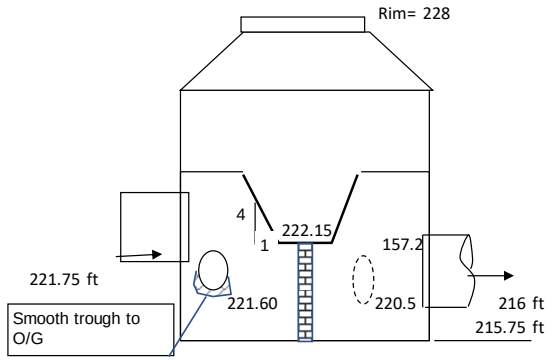
Treatment Flow Design Storm (0.5" or 1"): 1"

Component	Designed flow (cfs)	Elev. (ft)	Head (ft)	Designed Treatment Capacity (cfs)	Treatment ratio
Treatment Device:		222.15	0.38	0.26	1
Overflow weir:	0.25	222.15	0		
Total				0.26	

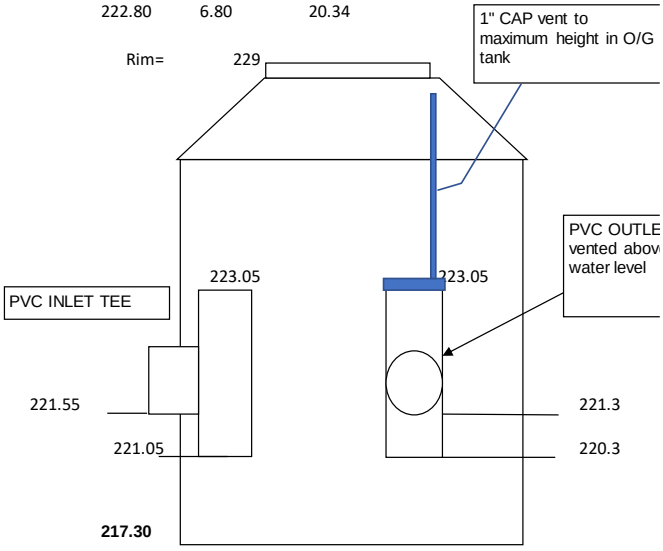
Overflow Flow Design Storm: 100-year

Component	Design flow (cfs)	Elev. (ft)	Head (ft)	Cal. Flow (cfs)	Treatment ratio
Treatment Device:		223	1.23	0.47	0.15
Overflow weir:	2	223	0.85	2.64	
Total				3.10	

Overflow pipe sizing: 222.80 6.80 20.34



DMH #3, Flow Distribution Manhole



ELEVATION VIEW (N.T.S.)

Oil/Grit Separator #2

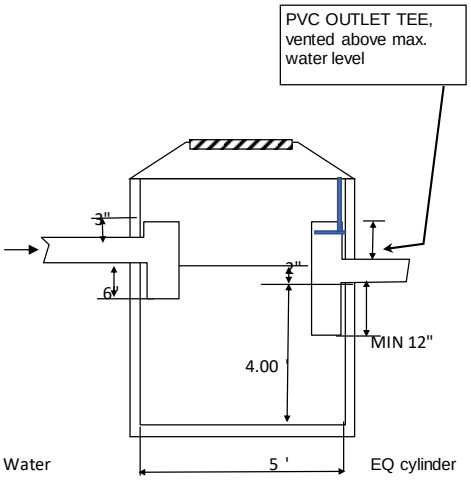
TSS Removal Calculations for Water Quality Inlet or Oil/Grit Separator

Project: Oil-Grit Separator #2 65 Farm Road, Sherborn, MA
User: DSW Date: 9/28/2023 Revision:
Creative Land & Water Engineering, LLC

Impervious Area:	0.280	acres	Target TSS removal:	80.00%	O/G volume		
Treatment Standard:	1	in	Initial Tank volume:	78.51	cu. ft.	587 gallon	Dia 5 ft
Treatment Volume:	1016.4	cu. ft.	Initial depth:	4.00	ft	Dimension	Depth 4 ft
			End				
Total TSS Factor (NJ DEP):	0.8		depth:	2	ft	Interior	
Total TSS Factor (Sand):	0.85		O.V.F treatment ratio:	0.23			

	Particle size* d, μm	Distribution %	Specific Gravity	Settling Velocity Vs, ft/s	Effective Depth h, ft	Effective Treatment Time Td, min.	Average Dynamic Removal Rate %	Weighted Removal Rate	Total with CB
NJ DEP									
	1	5	2.65	0.0012	3	111.23	73.18%	3.66	
	4	15	2.65	0.0012	3	111.23	73.18%	10.98	
	29	25	2.65	0.0025	3	111.23	83.29%	20.82	
	75	15	2.65	0.0133	3	111.23	84.60%	12.69	
	175	30	2.65	0.0619	3	111.23	84.60%	25.38	
	375	5	2.65	0.1953	3	111.23	84.60%	4.23	
	750	5	2.65	0.4266	3	111.23	84.60%	4.23	
Average								**81.99%**	**86.49%**
	150	60	2.65	0.0475	3	111.23	88.45%	53.07	
Sand	400	20	2.65	0.2123	3	111.23	88.45%	17.69	
	2000	20	2.65	0.9417	3	111.23	88.45%	17.69	
								88.45%	

*Particle size distribution according to NJDEP (clay, silt, sand)
Removal rate = $1 - e^{-(Vs/h)Td}$



Assumption: 0.5" first flush contains 80-85% of the total TSS in runoff
1.0" runoff contains 90-95% of the total TSS in runoff
Bypass for above design flow should be provided to avoid resuspension.

Trt. Vol. / TSS Size	Treatment Factors 05"	1"
NJ DEP	0.8	0.9
Sand	0.85	0.95
OVFT	0.3	0.2

References:
Wang, D. and J. Carr (1996). "Pollutant Removal Rates for Stormwater Detention Ponds," Hydrology
Urbonas, Ben, and Stahre, Peter (1993). Stormwater - Best Management Practices and Detention for Water
U.S. EPA (1986) Methodology for Analysis of Detention Basins for Control of Urban Runoff Quality,

APPENDIX D: INFILTRATION CALCULATIONS
by Desheng Wang, Ph.D., P.E., © 2000

This appendix presents the calculation method for an infiltration rate. The whole method includes: effective infiltration area, infiltration rate, and water quality benefit. It is noted that infiltration facilities should only be used in very permeable soils.

1.0 Effective Infiltration Area

To keep an infiltration facility functioning, the most important thing is to prevent sediment from entering the effective infiltration area. It is recommended that storm runoff be pretreated by sediment sumps before be discharged to the infiltration facility. If a basin does become severely clogged, partial or complete replacement of the structure may be required [1]. It is recommended that for an infiltration facility such as an infiltration basin/trench, only the sides of the basin/trench should be used as the effective infiltration area. The reason for this is that the bottom eventually is sealed by the accumulation of sediments. For a recharge galley or infiltration basin/trench filled with crushed stone, the bottom area can be counted as part of the effective area, providing there is a sump with access for sediment removal.

2.0 Design of the Basin/trench

There are two aspects to consider in the design of an infiltration basin/trench: one is the function in reducing runoff peak flow; the other is stormwater quality control. Water quality control is controlled by the volume of the basin/trench. The peak flow is controlled by the infiltration rate of the basin/trench. The infiltration rate of a basin/trench is determined by the on-site soil condition and the size of the basin/trench.

2.1 Volume of the Basin/trench

To maximize the pollutant attenuation, the volume of the infiltration basin/trench can be designed as large as possible. However, studies (Griffin et al., 1980; MD WRA, 1986) showed that a great port of pollutant loads is delivered during the early part of storms or the first flush of the storm. The first flush storm is the runoff due to the first half of an inch of rain. To store this part of runoff is the key to achieve better stormwater quality. Two basic rules are commonly used to determine the basin/trench volume for water quality benefit. The first rule is to size the basin/trench storage volume as 0.5 inches of runoff volume per impervious acre in the contributing watershed (MD WPA, 1986), using

$$V = 0.5 * A * Imp$$

where, V = Volume of the porous of the basin/trench (ac-in);
A = Watershed area (acre);
Imp = fraction of site imperviousness.

The second rule is to size the basin/trench so that it is capable of storing runoff produced from a one inch storm over the contributing watershed (Schueler 1987), using

$$V = 1.0\, R_v\, A$$

where, R_v = Runoff coefficient, R_v=0.05+0.009 (I); I = the percent of site imperviousness.

The expected pollutant removal rate for a basin/trench with this design volume is presented in the following table.

Table A.1: Estimated Long-term Pollutant Removal Rate (%) for Full Exfiltration Basin (Shueler 1987)

Pollutant	Removal Rate	
	Rule 1	**Rule 2**
Sediment	75%	90%
Total Phosphorus	50-55%	60-70%
Total Nitrogen	45-55%	55-60%
Trace Metals	75-80%	85-90%
BOD	70%	80%
Bacteria	75%	90%

If catch basins are all equipped with sediment sumps, the final pollutant removal rates are expected higher for both rules. Table A.2 presents average removal rates for selected pollutants from catch basin sumps (Aronson et al 1983).

Table A.4 Average Removal Rates of Catch Basins for Selected Contaminants

Contaminant	Average Removal Rate (%)
TSS	58
TN	17
P	4
TM	50

* P = Phosphates; TM = Total metals.

2.2 Infiltration Rate

It is important to know that there is an unsaturated zone underneath an infiltration basin/trench. However, it is not necessary to have this zone for infiltration to take place. In case of on-site sewage disposal design, this unsaturated zone is important for bio-treatment of waste water. In general, a 2 to 5 ft. separation from the water table to the bottom of the basin/trench is recommended or required by

state regulations (Finnemore, 1993). It is not necessary to have such a zone for a stormwater recharge basin/trench. The calculation method here is based on the permeability test which can be used for both saturated infiltration flow and flow penetration into the water table [4].

One of the most common on-site constant head test [4] uses the following formula to calculate soil

$$k = \frac{Q}{5.5rH}$$

permeability:
where, k = permeability,
Q = constant rate of flow into the test hole,
r = internal radius of casing, and
H = differential head of water.

This formula requires that the aquifer thickness underneath the pipe should be larger than 10r. From this formula, we can conclude that for a given soil condition, the infiltration rate will be proportional to the free water depth in the basin/trench. The most effective depth of free water in the basins/trenches was found to be four feet. Significantly lesser or greater depths resulted in reduced rates of infiltration, the former because of inadequate entrance head and the latter because of increasing weight-compaction of the soil (Baumann, 1965). Based on this formula, we can calculate the infiltration rate through bottom surface Q_1 can be calculated in the following ways.

For a circular surface:

$$Q_1 = 5.5\ rHk$$

For a rectangular surface with width B and length L, the above formula can be modified to account for the change in shape (Wang 1999):

$$Q_1 = 3.50\ kHB(0.5 + L/2B)$$

The infiltration rate through side surface Q_2 is calculated by Darcy's formula assuming the hydraulic gradient equals 1.0 [3] and assuming that the recharge galley does not penetrate the water table.

$$Q_2 = k\ A_s$$

Where, A_s = side surface area of the basin/trench, $= 2BrH$ for a circular section; $= 2(B+L)H$ for a rectangular section.

The total infiltration rate is the summation of rates through bottom surface and side surfaces:

$$Q = Q_1 + Q_2$$

3.0 Overflow Structure

Overflow structures should be installed at the end of the recharge basins/trenches. Typical overflow

structures are weirs. It is recommended that the overflow water leaves as sheet flow to the downgradient area to avoid possible erosion. Wells of small diameters should also be installed in the ends of each for dual purposes of (a) measurement of the distance to and sampling of ground water and (b) aiding in the expulsion of air as the mound rises. Trapped air may cause slow infiltration, especially when there is a large separation between the basin/trench and the normal water table.

4.0 Summary

This appendix presents the design method of an infiltration basin/trench. The design criteria include water flood control and water quality management. For a given hydrological condition (runoff hydrograph), the size of the basin/trench can be easily determined by the formulas given in this appendix. A computer program is designed to carry out the computations. Flood routing can be further applied to a determined larger flood when overflows may occur.

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Subject: Groundwater Recharge | revision by: | **Date:** 8/27/2023
Water Quality Calcs. | **By:** dsw | **Date:**
65 Farm Road | **Chkd:** | **Date:**
Location: Sherborn, MA | **Job No.:** J269-12 | **Sheet:** 1

Rev. 3/1/2021

1. Land Use Break Down

Land Uses (Acres)

	Subbasin	Existing	Proposed	Existing	Proposed	Increment
1	Roof	0.153	1.069	0.153	1.069	0.916
2	Pave	0.650	1.614	0.650	1.614	0.964
3	Pervious	14.589	12.709			
	Total	15.392	15.392	0.803	2.683	1.880
	Imperviousness (%)			5.22	17.43	

2. Groundwater Recharge

Dry wells (2)

Infiltration time (hrs): 6
Diameter (ft): 6 width (ft): Depth (ft): 6 Pipe dia. (in):
Storage volume (cu.ft):
Infil. rate (cfs):
Infiltration volume (cu.ft): 0
Total volume (cu ft) : 0

Impervious area (acres):	A soil	B Soil	C Soil	D Soil	Total			
					0	acres	Provided	
DEP required GW recharge volume:					**0**	cu. ft	larger than **0** cu. ft	OK!

Crushed Gravel

Infiltration time (hrs): 6		Basins						
At elevation (ft):	out INV	Basin A 209.5	Basin B1 217.2	Basin B2 210.2	Basin C 220.5			
Static Storage volume (cu.ft):		7435.00	2591	3276	2403	**15705**		
Infil. rate (cfs):		3.30E-01	0.498	0.3833	0.117			
Infiltration volume (cu.ft):		7128	10756.8	8279.28	2527.2	**28691.28**		
Total volume (cu ft) :		14563	13347.8	11555.28	4930.2	**44396.28**		

Hydrological soil group	A soil (0.6)	B Soil (0.:	C Soil	D Soil	Total				
DEP required GW recharge (in):	0.6	0.35	0.25	0.1					
Impervious area (acres):	0.058	0.997	0.500	1.128	2.68	acres	Provided		
DEP required GW recharge volume:	126.00	1266.83	453.78	409.40	**2256.01**	cu. ft	less than	**44396.28** cu. ft	OK!

Infiltration trenches:

Infiltration time (hrs): 6		Trench						
Depth (ft):		Trench 1	Trench 2	Trench 3	Trench 4	Trench 5	Trench 6	Total
Storage volume (cu.ft):								**0**
Infil. rate (cfs):								
Infiltration volume (cu.ft):		0	0	0	0	0	0	**0**
Total volume (cu ft) :		0	0	0	0	0	0	**0**

Impervious area (acres):	A soil	B Soil	C Soil	D Soil	Total				
					0.000	acres	Provided		
DEP required GW recharge volume:					**0**	cu. ft	less than	**0** cu. ft	OK!

An Average Storm Event Runoff:

Precipitation (in):	0.7		
Total Impervious area (acres):	2.68		
Runoff Volume (cu. ft):	**6817.02**	This is a conservative average groundwater recharge volume for a average rain event.	
Total infiltration capacity(cu.ft):	44396.28	larger than 6817.0212 cu. ft	OK !

Conclusion 1: Therefore, the pratical average groundwater recharge compensation will be **6817.0212** cu.ft. larger than **2256.01** cu.ft as DEP required.

3. Average Site TSS Removal Rate

	Subbasin	Area (acres)	TSS removal (%)	A x TSS	
1	Basin A	4.698	94	441.5744	mixed
2	Basin B1	1.024	90	92.16	mixed
3	Basin B2	1.421	90	127.872	mixed
4	Basin C	0.896	90		mixed
	Total	7.142		661.6064	
	Total average removal rate		92.63 %		

Conclusion 2: The average total suspended solid removal rate is 92.63 % better than existing conditions

4. Water Quality Volume

Water quality rule 1 inches

Site Conditions	Impervious area (acres)	WQV req. (cu. ft)	WQV provided (cu. ft)	
existing	0.803	none	none	
Proposed	2.683	9738.6017	44396.28	OK!

Conclusion 3: Therefore, the total stormwater quality volume for proposed condition will be **44396.28** cu.ft. larger than **9738.6017** cu.ft as DEP required.

DSW

CALCULATIONS OF STORMWATER QUALITY CONTROL

revision:

Project:	**Homes at Farm Road**	Street:	Farm Road	User:	DSW	Date:	27-Sep-23
Site:	**65 Farm Road**	Town:	**Sherborn**			Job:	J269-12
County:	**Middlesex**	State:	**MA**	Check:		Sheet:	1 of 1

Input Report:

P=Rainfall depth (inches): Pj=Correction factor: 0.9000

		C=Concentration (mg/l):					
Event	1.250						
Annual	45.000		Resid. (R)	Comm. (C)	Nonurban (N)	Constr. (S)	User define(U)
I=Imperviousness (%):		TSS	101.0000	69.0000	70.0000	10000.0000	505.0000
Pre-Development	5.220	TN	1.9000	1.1800	0.9650		9.5000
Post-Development	17.430	TP	0.3830	0.2010	0.1210		1.9150
Watershed condition:		BOD	10.0000	9.3000	9.0000		50.0000
Pre-Development	R	COD	73.0000	57.0000	40.0000		365.0000
Post-Development	N	Pb	0.1440	0.1040	0.0300		0.7200
A=Watershed area (Acres):		Zn	0.1350	0.2260	0.1950		0.6750
Pre-Development	15.392	Cu	0.0330	0.0290	0.0300		0.1650
Post-Development	15.392						

Designed Pond:

Volume (ac-ft)	1.019	Mean depth (ft):	7.500
Area (Acres)	0.364	Eff. sett. vel. (ft/hr):	1.600
Residence Time (hrs)	72.000	Turbulence factor:	5.000
Forebay Trap Efficiciency (%)	25.000		

Output Report:

	Predevelopment	Postdevelopment
Site Condition:	Residential	Nonurban
Rv=	0.097	0.21
Standard Vp (Ac-ft):	0.140	0.30
Effective treatment ratio:		8.54
Min. Sediment Forebay (cu. ft):		4414.40
Sediment Forebay area (sq. ft.)	1000.000	1000.00
Sediment forebay depth (ft)	2.000	4.41
Residence time coef.:		1.00

	Predevelopment	Postdevelopment		Removal efficiency (%)	Conc. (mg/l)
Annual Nutrients (lbs/yr):		Before treated	After treatment	Predicted *	Predicated
TSS	1384.017	2046.130	98.602	95.181	3.373
TN	26.036	28.207	14.783	47.591	0.506
TP	5.248	3.537	1.180	66.627	0.040
BOD	137.031	263.074	150.395	42.831	5.145
COD	1000.329	1169.217	668.424	42.831	22.867
Pb	1.973	0.877	0.084	90.422	0.003
Zn	1.850	5.700	3.259	42.831	0.111
Cu	0.452	0.877	0.501	42.831	0.017

*After average results from U.S. EPA (1986), and adapted to reflect modifications of Walker (1986).

Nutrient Removal by Plant Uptake**

Contaminant	Uptake (lbs/acre/yr)		Ave uptake (lbs/yr)	Ave. removal (%)	Reference Total Removal (%)
TSS	125 to 49508		9029.879	78.000	98.940
TN	215 to 430.6		117.456	68.000	83.229
TP	19.2 to 400.6		76.375	55.500	85.149
BOD	220 to 20764		3817.681	72.000	83.993

* *After average results from Reed (1990).

TSS Removal Calcualtion Worksheet

					Revised:		
Project:	Farm Road Homes		Designed by:	dsw	Date:	27-Sep-23	Sheet: 1 of 1
Location:	65 Farm Road		chkd by:		Date:		Job: J269-12
	Basin A		revision:		Date:		

A	B	C	D	E
BMP*	TSS Removal Rate	Starting TSS	Amount Removed (BxC)	Remaining Load (C - D)
DSCB	0.25	1	0.25	0.75
WQS	0.5	0.75	0.375	0.375
Oil/grit seperator	0.25	0.375	0.09375	0.28125
Infiltration Trench	0.8	0.28125	0.225	0.05625

Total TSS Removal= 0.94

* WQS = water quality swale; WQI = water Qality inlet; EDB = extended detention basin.
DSCB = deep sump catch basin; SW = sweeping; DW=drywell; IT = infiltration trench.
FB = sediment Forebay; CW = constructed wetland, RB = retention basin, WB = wet basin
IB = Infiltration Basin
Reference: MADEP (2008) Stormwater Management, Volume I & II.
** Rate calculated based on DEP default

TSS Removal Calcualtion Worksheet

					Revised:		
Project:	Farm Road Homes		Designed by:	dsw	Date:	27-Sep-23	Sheet: 1 of 1
Location:	65 Farm Road		chkd by:		Date:		Job: J269-12
	Basin B1, B2, C		revision:		Date:		

A	B	C	D	E
BMP*	TSS Removal Rate	Starting TSS	Amount Removed (BxC)	Remaining Load (C - D)
Grass channel	0.5	1	0.5	0.5
IT	0.8	0.5	0.4	0.1

Total TSS Removal= 0.90

* WQS = water quality swale; WQI = water Qality inlet; EDB = extended detention basin.
DSCB = deep sump catch basin; SW = sweeping; DW=drywell; IT = infiltration trench.
FB = sediment Forebay; CW = constructed wetland, RB = retention basin, WB = wet basin
IB = Infiltration Basin, GC = grass channels
Reference: MADEP (2008) Stormwater Management, Volume I & II.

Between April 2021 and April 2023, we evaluated more than forty two (42) soil test pits throughout the site to collect soil, groundwater and ledge information. Soils on site were found very permeable with percolation rate ranging from less than 2 mpi to 7 mpi at 65 Farm Road. In the northwest and northeast area, there are significant ledge outcrops and will not be develop and not tested. The soil evaluation is summarized in Table D.1. The testing confirmed NRCS soil rating well. Given that the percolation rate in tested pits are ranging from less than 2 mpi to 7 mpi at the project site, it is ranging 8.57 in/hr to 30 in/hr. The Rawl's rate of 8.27 in/hour is used for infiltration design.

Table D.1 Stormwater and Roadway Soil Testing Summary

Date	Test Pit	G.S. Elev. Surveyed (Ft)	Estimated HGW (Ft)	Estimated HGW Elev (Ft)	Soil Texture, C layer	Depth to Ledge measured (Ft)	Notes
4/4/2023	TP Unit 1/2	214.45	4	210.45	L.S.-M.S.	7	
4/4/2023	TP Unit 3/4	215.67	4	211.67	M.S.	8	
4/4/2023	TP Unit 5/6 (1)	217.34	5.5	211.84	M.S.	8	
4/4/2023	TP Unit 5/6 (2)	216.29	4	212.29	M.S.-L.S.	72"/60"	ledge is sloped
-	TP Unit 7/8 (Ex 1)	216.86	Existing well by others				Ex. Obs. Well
	TP Unit 7/8 (Ex 2)*	216.75					Ex. Obs. Well
	TP Unit 7/8 (Ex 3)	216.61					Ex. Obs. Well
	Dug Well	216.40	10.75	205.65	L.S.	13	Dug Well
11/9/2021	DHTP 4-2*	217.92	11.5	206.42	S.L.-L.S.	12	
4/21/2021	55-9N*	215.25	10	205.25	L.S.	10+	
-	65-7	219.16	-	-	-	-	to be tested
4/21/2021	65-10*	215.87	9.67	206.20	L.S.	12	
4/20/2021	65-10A*	220.60	10	210.60	M.L.S.	11	
4/21/2021	65-10D*	219.90	14	205.90	L.S.	14	
4/3/2023	SWTP 1	216.79	3	213.79	M.S.	-	Hand augered to 42"
4/3/2023	SWTP 2*	217.25	-	-	-	-	to be tested due to ConCOM
4/4/2023	SWTP 3*	224.50	10+	214.50	L.S.	10	
-	SWTP 4*	235.00	-	-	-	-	Not tested. On Ledge outcrop
4/3/2023	SWTP 5*	215.50	10+	205.50	M.L.S.	10	
4/3/2023	SWTP 6*	226.75	4	222.75	M.L.S.	5	
3/29/2023	TP R1	216.48	3	213.48	M.S-.L.S.	-	Auguer test
	TP R2	216.67	3	213.67	M.L.S.	-	Auguer test
4/3/2023	TP R3	219.71	4	215.71	M.L.S.	4	
4/3/2023	TP R4*	224.50	4	220.50	S.L.	3.5	
4/3/2023	TP R5	218.06	4.67	213.39	S.L.-L.S.	8	
4/3/2023	TP R6*	223.60	7	216.60	L.S.	7	
4/3/2023	TP R7*	227.75	6	221.75	L.S.	6.67	
4/4/2023	TP R 8/10*	229.30	6	223.30	M.L.S.	7	ledge pitch from 3' to 7'
4/3/2023	TP R8*	227.80	5	222.80	M.L.S.	5	
4/4/2023	TP R9*	228.30	9	219.30	M.L.S.	9	ledge undulate 3' to 9'
4/3/2023	TP R10*	228.20	5	223.20	M.L.S.	6	
4/3/2023	TP R11*	230.75	6	224.75	F.M.S.	8	
4/3/2023	TP R12*	235.75	4	231.75	S.L.	6	
4/3/2023	TP R13*	231.00	2.33	228.67	Broken Ledge	4	
4/3/2023	TP R14*	231.00	4	227.00	F.M.S.	9.5	
4/3/2023	TP Unit 22/23*	231.00	5	226.00	Co.M.L.S.	10	
4/4/2023	TP Unit 26/27*	232.50	7	225.50	L.S.	7	
4/3/2023	TP 65-5*	226.8	6	220.80	L.S.	6	
11/10/2021	SL-TP-1*	212.3	6+	206.3	L.S.	6+	
11/10/2021	SL-TP-2	218.31	9+	209.31	M.L.S.	9+	
11/10/2021	SL-TP-3	221.53	10	211.53	Co.M.L.S.	11.33+	
11/10/2021	SL-TP-4	220.22	10	210.22	M.L.S.	10+	
Total	42 soil test pit						
	Notes: * Ground surface elevation is estimated based on topo plan; otherwise is surveyed.						

Table D.2. BOH witnessed soil testing

Test Pit	Soil Type	Total depth, inches	Perc. Rate, mpi	Approx. GS elev, ft	Top of pipe elev., ft	Water depth below GS, ft			
						Outstanding pipe, in	4/23/2021	4/27/2021	Note
55 Farm Road - Area 1, Front									
DHTP 55-2	Till/LS	218	6	210.20	211.7	18	16.33	16.42	well/log
DHTP 55-3	Till/LS	240	3	214.75	217.5	33	21.92	21.92	well/log
DHTP 55-4	Till/LS	216	-	213.77	215.6	22	17.83	17.75	well
DHTP 55-5	Till/LS	180	-	202.33	204	20	9.17	9.67	well
DHTP 55-5A	Till/LS	132	-	201.67	203	16	7.83	8.17	well
DHTP 55-5B	Till/LS	132	-	197.60	199.6	24	4.50	4.92	well
DHTP 55-5C	Till/LS	144	11	203.77	205.1	16	9.92	10.17	well/log
55 Farm Road - Area 2, Back									
DHTP 55-10	Till/LS	135	-	196.92	200	37	11.25	11.25	well/log
DHTP 55-10An	Till/LS	174	-	192.10	194.1	24	13.00	13.00	well/log
DHTP 55-11	Till/LS	192	4	201.00	203	24	15.42	15.58	Well/log
DHTP 55-11An	Till/LS	216	3	193.92	197.5	43	15.42	16.25	well/log
DHTP-55-11B	Till/LS	120	DH						log
65 Farm Road - Area 3, Front									
DHTP 65-10	Till/LS	144	-	215.87	217.7	22	9.67	9.83	
DHTP 65-10A	Till/LS	132	4	220.60	222.6	24	10.00	10.50	Well/log
DHTP 65-10B (Ex)	Till/LS	156	-	215.90	216.4	6	10.75	11.08	well
DHTP 65-10C	Till/LS	156	7	217.53	219.7	26	12.50	12.58	well/log
DHTP 65-10D (3-1)	Till/LS	168	2	212.90	213.4	6	14.00	14.00	well/log
DHTP 65-10E(No P)	Till/LS	96	-	No Pipe					log

Test Pit	**Soil Texture**	**Total depth, inches**	**Perc. Rate, mpi**	**Approx. GS elev, ft**	**Top of pipe elev., ft**	**Water depth below GS, ft**			**Note**
						Outstanding pipe, in	**11/24/2021**	**4/27/2021**	
55 Farm Road - Lot 5 (Back)									
DHTP 5-1	Till/LS	174	-	195.04	196.62	19	12.92		well/log
DHTP 5-2	Till/LS	209.88	5	200.77	203.02	27	15.24		well/log
DHTP 5-3	Till/LS	199.92	3	198.04	198.79	9	15.91		well/log
Lot 4									
DHTP 4-1	Till/LS	158.64		222.86	227.03	50.00	10.00		well/log
DHTP 4-2	Till/LS	183.84	5.00	217.92	220.92	36.00	11.50		well/log
DHTP 65-10A	Till/LS	132.00	4.00	220.60	222.60	24.00	11.11	10.50	well/log
House of Lot 3									
SL-TP4 (house)	Till/LS	126	-	221.41	221.91	6	10.00		well/log

Note: Test pits 55-2, 55-3, 55-4, 55-10, 55-10An, 55-11, 55-11An, 65-10D, 4-1, 5-1, 5-2, and 5-3 were found dry and did not reflect the true water table rather for reference.

Appendix E: OPERATION AND MAINTENANCE PLAN FOR STORMWATER BMPs

	During Construction	Post-construction
BMB Owner:	Fenix Partners Farm Road Development, LLC Robert W. Murchison, Manager 177 Lake Street, Sherborn, MA 01770 C. 617-308-1961. e-mail: bob.murchison@me.com	Fenix Partners Farm Road Development, LLC Robert W. Murchison, Manager 177 Lake Street, Sherborn, MA 01770 C. 617-308-1961. e-mail: bob.murchison@me.com
Party of Plan Responsibility:	Fenix Partners Farm Road Development, LLC Robert W. Murchison, Manager 177 Lake Street, Sherborn, MA 01770 C. 617-308-1961. e-mail: bob.murchison@me.com	Fenix Partners Farm Road Development, LLC Robert W. Murchison, Manager 177 Lake Street, Sherborn, MA 01770 C. 617-308-1961. e-mail: bob.murchison@me.com
Signature		

The stormwater management system is depicted in the engineering plan by Creative Land & Water Engineering, LLC: Stormwater Management Plan, The Farm Road Homes, September 28, 2023

Illicit discharges into stormwater management system per 310 CMR 1.04 are perpetually prohibited and agreed to be implemented by the owner. No sewer pipes or floor drains will be connected to the drainage network. All wastewater will be connected to a dedicated private onsite septic system as approved.

Personnel Training – All contracted personnel retained for work on site will be given a copy of this Plan and will receive training in applicable practices and implementation to prevent pollutants from entering the stormwater system

*The plan includes **Housekeeping and Reporting, Routine Operation and Maintenance (long-term pollution source control, pavement sweeping, landscaping, stormwater structure) Emergency Action or Accidental Spill Plan, Mosquito Control in sumps.** A typical O&M recording form is also created for reference use.*

Housekeeping and Reporting

The property owner or designated property manager will be responsible for carrying out this

operation and maintenance, i.e., long-term pollution prevention plan. All maintenance conducted shall be recorded and the records shall be kept on site for at least 3 year for auditing by approving authorities or relevant **Town officials**. See attached record forms for reference.

Routine Operation and Maintenance

Sediment and Erosion Control

1. During construction, **weekly or biweekly** inspection of erosion control straw wattles/hay bales and silt fences should be conducted by a qualified staff of the responsible party or an independent sediment and erosion control expert hired by the responsible party. Any displaced straw wattles or broken siltation fences should be restored or repaired immediately. All silt fences and straw wattles shall be installed at minimum **30 feet** from wetlands or 5 feet from the property line unless permitted by Sherborn Conservation Commission.

Long-term Pollution Source Control

2. All potential pollution materials shall be stored properly inside and under cover
    a. Fuel (other than in vehicles or equipment), if any, will be stored for machinery or motor use in fire proof cabinet and inspected routinely
    b. Fertilizers, herbicides, and pesticides, if any, will be stored inside in secured cabinet or bins
    c. House cleaning chemical(s) shall be stored in secured cabinet(s)
    d. De-icing materials, if any, shall be waterproof covered, or stored inside.
    e. Snow shall be plowed and stored in vegetated area or dedicated parking spaces where runoff from snowmelt will be collected and treated by the parking lot drainage system. In case of large snow storm, excessive snow shall be trucked off site and disposed in the town snow dump.
    f. All hazardous materials (battery, light bulbs, etc.) shall be recycled or disposed in accordance with the State and Town requirements.
    g. Pet waste, if any, shall be collected and disposed properly in accordance with **Town** policy. **No pet wastes shall be dumped in the drainage system.** Residents and visitors will be encouraged to pick up after their pets with signage along lawn areas

Pavement Sweeping/General Landscape Maintenance

3. The driveway and parking lot shall be swept quarterly (by high efficiency vacuum sweeper or regenerative air sweeper) or monthly (Mechanical weeper, rotary broom), or per the Town of Sherborn standard practice.
4. During growing season, the lawn and landscaping for each house will be mowed and maintained weekly or biweekly depending on the growth and weather condition. All landscape debris will be removed from lawn or landscaping and parking area and disposed of off site or used for compost.
5. The use of fertilizers shall be limited to slow-release, low nitrogen granular fertilizers.

Drainage/Stormwater Structure(s)

6. a)The catch basins and oil/grit separators, discharge level spreaders should be inspected at least four times per year and at the end of the foliage and snow removal seasons. Sediment must be removed four times a year or whenever the **depth of deposits is greater than or equal to one half the depth from the lowest pipe invert in the basin.** Catch basin sediment should be cleaned by clamshell buckets or vacuum truck. Debris over the level spreader shall be cleaned up. b) Oil/Grit separator should be inspected monthly and cleanout at least twice per year or as needed per inspection. c) All polluted water or sediments removed from the system should be disposed of in accordance with all applicable local, state and federal laws and regulations. d) The regular manholes shall be inspected annually to check if any settlement and damage for repair. All accumulated sediment and debris in the subsurface infiltration structures and level spreaders should be removed and disposed. Note and repair any erosion or low spots observed on level spreaders. **After the construction completed**, the observation port of the infiltration trenches, distribution manholes, oil/grit separators and the discharge level spreaders should also be inspected at least four times a year for the first year following the catch basin inspection schedule, which can be reduced to annual after have a

understanding of the operation condition as expected. The parking lot will be swept twice a year: one before hurricane season, the other in the spring after snowmelt, or per the **Town of Sherborn** standard practice.

7. Install oil trap elbows in all deep sump catchbasins. It is recommended that the vertical length of the oil trap below the outlet invert be at least 12 inches. All catch basins shall be protected with filter fabric during construction time to prevent siltation to infiltration trenches.

Emergency Reaction or Accidental Spill Plan

In case of an accident in the parking lot or driveways, where significant gasoline or other petroleum products are released, the following procedure must be followed.

Step. 1. First of all, plug the outlet pipe from the catch basin to the manhole and the outlet pipe from the manhole to infiltration trench. Immediately notify **Sherborn** Fire Department, Board of Health, Conservation Commission, and the Mass. Department of Environmental Protection (DEP). **Sherborn** is in the Northeast Region of DEP, and their main office is presently at 205B Lowell Street, Wilmington, Massachusetts 01887 and their phone number is (978)694-3200.

Step 2. If any of those three agencies so direct, a clean up firm shall be immediately contacted. If the materials have remained trapped in the catch basin and manhole, then the catch basin shall be pumped out. If the volume of the spill is such that materials have flowed out of the catch basin sump or the trench, then corrective actions will be extended to the receiving **water** and beyond. For an oil release in excess of on site storage capacity, a floating boom shall be used to prevent oil release from spreading in any receiving area. For materials which are partially soluble in water, e.g., components of gasoline, then DEP or clean-up firm recommendations shall be followed. These might include, but are not limited to (1) pumping out the entire trench, (2) air stripping, or (3) excavation of an interceptor basin to allow air stripping in the downgradient soils. Since the technology of containment and control is steadily advancing, clean-up and recovery technology shall be specified on site just after the spill.

Mosquito Control in Sumps

In general, mosquito breeding occurs in standing water that lasts five days or more. The catch basin during high groundwater season may have standing water. Thus mosquito control may be needed. In case of mosquitoes breeding in the catch basin, there are many methods available to control them including biological control and chemical control. Biological controls are preferred since the biological controls specifically target mosquito larvae and are harmless to humans, unlike many chemicals even at standard does. It is not recommended any chemicals be used in the inlet box or the catch basins due to their frequent flushing and water quality issues in the receiving waters. The following is the recommended biological control.

Bacillus thuringiensis israeliensus (Bti) is an effective control for mosquitoes and flies and is widely used in various forms in U.S. This is a bacterium, which kills larvae of target insects. Commercial Bti is considered safe to add to drinking water (WRRI 1989) and is available at most hardware stores.

Cost Estimation

The cost of cleaning up each catch basin and oil/grit separator is estimated to be $100 per unit; No significant sediment is expected in the manholes and outflow control box. Checking and clean debris in the distribution manhole is the expected maintenance, which shall cost no more than $50 each time if any. The total estimated cost for each clean up is $2600 as detailed in the following:

Annual Maintenance Budget

BMPs	Cost per item	Quantity	Total
Road/Parking sweeping	$ 200.00	2	$ 400.00
Storm water basin/outlet	$ 50.00	4	$ 200.00
Catchbasin	$ 100.00	13	$1300.00
Distribution manhole	$ 50.00	2	$ 100.00
Oil/grit separator	$ 100.00	2	$200.00
Others – inspection – level spreader	$50	1	$ 50.00
Roof grit trap MH	$100	0	0
Swale	$50	5	$250
Regular DMH	$50	2	$100
Total			$ 2600.00

Summary

The maintenance steps outlined above are sufficient to prevent sediment accumulation from affecting the long term performance of the BMP system. If maintenance is not conducted, then the detention basin and catch basin will be filled up with sediment, which will impede the function of stormwater treatment. Routine maintenance is the most cost-effective in the long run.

If you have any questions about the plan, please feel free to contact us.

Sincerely,

Creative Land & Water Engineering, LLC
by

Desheng Wang, Ph.D. P.E.
Senior Environmental/Hydraulic Engineer

Operation/Maintenance Form

Project Site:
Operator: **Date of O/M:**

BMPs	Location	Description of Maintenance
Street Parking sweeping		**Note sediment condition, clean as needed**
Infiltration Basin (4)		**Mow twice a year, remove clip and debris on outflow structure and spillway**
Catchbasins (13)		**Check sediment depth and floating materials**
Distribution manholes (2)		**Check flow path condition**
Oil/grit separators (2)		**Check sediment and oil trapped and clean as needed**
Outflow level spreader (1)		**Clean leaves and debris on surface.** Note and repair any erosion or low spots observed on level spreaders.
Roof runoff grit trap (0)		**Check sediment level and clean as needed**
Swales (5)		**Mow regularly, biweekly**
Regular DMH (2)		**Check for any cover damage or paving settlement, repair as needed**
Others		**Any uncovered in above**

Notes: 1) Sediment deposit depth and other pollutants shall be recorded in structural BMPs for record, such as, 12" of sediment is cleaned out of the Catchbasin #. 2)The O/M staff can expand the form on separate sheet for different BMPs items. 3) Inspections shall be conducted four times for the first year after construction as spelled out in the plan and can be reduced to annual after gaining understanding of the site operation conditions as expected.

References:

[1] J. McLean (1995) "Mosquitoes in Constructed Wetlands -- A Management Bugaboo," Watershed Protection Techniques, Vol. 1, No. 4, Center for Watershed Protection, 203-208.

[2] Water Resources Research Institute (1989) Report No. 247: Proceedings of Workshop on Management of Aquatic Weeds and Mosquitoes in Impoundments, March 14-15, 1989 UNC Charlotte.

[3] Mian, L. S., Mulla, M. S., and Wilson, B. A. (1986) "Studies of Potential Biological Control Agents of Immature Mosquitoes in Sewage Wastewater in Southern California," J. Am. Mosquito Control Assoc. 2(3), 329-335.

[4] MA DEP *Stormwater Management Standards - Stormwater Management Handbook*, 2008

Stormwater Pollution Prevention Plan
For Construction Activities
at
65 Farm Road, Sherborn, MA

September 28, 2023

Prepared for:

Robert W. Murchison, Manager
Fenix Partners Farm Road Development, LLC
177 Lake Street, Sherborn, MA 01770
C. 617-308-1961

Prepared by:

Creative Land & Water Engineering, LLC
P.O. Box 584
Southborough, MA 01772
Tel. 508-281-1694

SITE DESCRIPTION			
Project Name and Location (Latitude, Longitude, or Address)	**Farm Road Homes, Sherborn, MA** **42.24051º N** **-71.35776º W**	Owner Name and Address:	Robert W. Murchison, Manager Fenix Partners Farm Road Development, LLC 177 Lake Street, Sherborn, MA 01770 C. 617-308-1961
Description: (Purpose and Types of Soil Disturbing Activities)	A residential subdivision development consisting of 32 total units (16 single family units and 8 duplex units). . Soil disturbing activities will include installation of a stabilized construction entrance; installation of erosion control line; clearing and grubbing; stabilization of rough drive and parking lot with gravel; excavation for infiltration trenches, utilities, building foundations; construction of driveways, and buildings; grading; and preparation for final planting and seeding. The underlying subsoils at the site are Scarboro mucky fine sandy loam (HSG A), Charlton-Hollis-Rock Outcrop complex (HSG B), Hollis-Rock outcrop-Charlton complex (HSG D), Woodbridge fine sandy loam (HSG C), and Canton fine sandy loam (HSGbased on NRCS soil survey and on-site inspection.		
Runoff Coefficient:	The final coefficient of runoff for the site will be c = 0.30.		
Site Area:	The site is 14 acres. About 6.58 acres will be disturbed by construction activities.		
Sequence of Major Activities			
The order of activities will be as follows: 1. Install stabilized construction entrance. 2. Install erosion control line. 3. Clear & grub for overall site preparation 4. Excavate infiltration trenches; temporarily seed these areas 5. Excavate foundation hole and install foundations. 6. Install roadway & associated utilities (i.e. retaining walls, sewer, water, catch basins, & conveyance pipes). 7. Complete grading for driveway, parking lot; install subbase and binder in driveway and parking lot. 8. Install infiltration trenches. 9. Construct the four houses.		10. Stabilize exposed soils & stockpiles within 14 days of last construction activity in a given area. 11. Complete grading for landscape area permanently seed and plant. 12. Complete final paving. 13. Remove accumulated sediment from sediment forebay, infiltration basin, catch basins, distribution manhole 14. Clean all catch basins and install hoods. . When all construction is complete and all exposed soils are stabilized, remove erosion control line. Reseed any areas disturbed by its removal.	

Name of Receiving Waters:	**Charles River**

CONTROLS

Erosion and Sediment Controls

Stabilization Practices

Temporary Stabilization – Silt fence and/or straw wattles or hay bales containing no invasive plants shall be installed along the downgradient of disturbed area. Sediment basins can be installed in area of natural flow concentrates. Silt bag or equal protection measures shall be installed in catch basins in the existing roadway receiving runoff from the project site. The soil stockpiles and disturbed portions of the site where construction activity temporarily ceases for at least 21 days will be stabilized with temporary seed and mulch no later than 14 days from the last construction activity in that area. The temporary seed shall be hydroseeded or hand spread with Rye (grain) applied at the rate of 120 pounds per acre. Prior seeding, 2,000 pounds of ground agricultural limestone and 1,000 pounds of 10-10-10 fertilizer shall be applied to each acre to be stabilized. If hand spread seeding applied, each area shall be mulched with 4,000 pounds per acre of straw. The straw mulch is to be tacked into place by a disk with blades set nearly straight. Areas of the site which are to be paved will be temporarily stabilized by applying geotextile and stone sub-base until bituminous pavement can be applied.

Permanent Stabilization – Disturbed portions of the site where construction activities permanently cease shall be stabilized with permanent seed no later than 14 days after the last construction activity by hydroseeding and landscaping planting and mulching.

Structural Practices

Flow diverting dikes, swales, and sediment basins will be installed where is needed to retain sediment on site.

Storm Water Management

Stormwater management will be achieved by road drainage system (catchbasins, manholes, and pipes), **four stormwater basins** with oil/grit separator or grass swale pretreatment.

OTHER CONTROLS

Waste Disposal:

Waste Materials
Construction debris will be stored in dumpster and disposed in accordance with applied local, state and federal regulations.

Hazardous Waste
All hazardous waste materials will be disposed of in the manner specified by local or state regulations or by the manufacturer. Site personnel will be instructed in these practices and **a dedicated personnel/General contractor** , the individual who manages day-to-day site operations, will be responsible for seeing that these practices are followed by qualified subcontractors certified by OHSA.

Sanitary Waste
All sanitary waste will be collected by the portable units and managed by certified sanitary waste management contractor.

Offsite Vehicle Tracking:

A stabilized construction entrance will be provided to help reduce vehicle tracking of sediments. The paved street adjacent to the site entrance will be swept daily to remove any excess mud, dirt or rock tracked from the site. Dump trucks hauling material from the construction site will be covered with a tarpaulin.

TIMING OF CONTROLS/MEASURES

As indicated in the Sequence of Major Activities. Sediment and erosion control measures and devices will be constructed prior to clearing or grading of any other portions of the site. Areas where construction activity ceases for more than 21 days will be stabilized with a temporary seed and mulch within 14 days of the last disturbance. Once construction ceases permanently in an area, it will be stabilized with permanent seed and mulch. After the entire site is stabilized, the accumulated sediment will be removed from the sediment basin/trap and all measures will be removed.

CERTIFICATION OF COMPLIANCE WITH FEDERL, STATE, AND LOCAL REGULATIONS

The storm water pollution prevention plan reflects requirements for storm water management and erosion and sediment control. To ensure compliance, this plan was prepared in accordance with the MA DEP Stormwater Management Policy and the requirements of National Pollution Discharge Elimination System (NPDES).

MAINTENANCE/INSPECTION PROCEDURES

Erosion and Sediment Control Inspection and Maintenance Practices

These are the inspection and maintenance practices that will be used to maintain erosion and sediment controls.

- Less than one half of the site will be denuded at one time.
- All control measures will be inspected at least once each week and following any storm event of 0.5 inches or greater.
- All measures will be maintained in good working order; if a repair is necessary, it will be initiated within 24 hours of report.
- Built up sediment will be removed from silt fence when it has reached one third the height of the fence.
- Silt fence will be inspected for depth of sediment, tears, to see if the fabric is securely attached to the fence posts, and to see that the fence posts are firmly in the ground.
- The sediment basin will be inspected for depth, and built up sediment will be removed when it reaches 10 percent of the design capacity or at the end of the job.
- Diversion dike will be inspected and any breaches promptly repaired.

- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.

- A maintenance inspection report will be made after each inspection. A copy of the report form to be completed by the inspector is attached.

- Designated site superintendent, will select three individuals who will be responsible for inspections, maintenance and repair activities, and filling out the inspection and maintenance report.

- Personnel selected for inspection and maintenance responsibilities will receive training from the dedicated **expert consultant.** They will be trained in all the inspection and maintenance practices necessary for keeping the erosion and sediment controls used onsite in good working order.

Non-Storm Water Discharges

If any of the following non-storm water discharges would occur from the site during the construction period:

- Water from water line flushing.

- Pavement wash waters (where no spills or leaks of toxic or hazardous materials have occurred).

- Uncontaminated groundwater (from dewatering excavation).

All non-storm water discharges should be directed to the sediment basin prior to discharge.

INVENTORY FOR POLLUTION PREVENTION PLAN

The materials of substances listed below are expected to be present onsite during construction:

- Concrete
- Detergents
- Paints
- Metal materials
- Tar or bituminous concrete
- Fertilizers
- Petroleum Based Products
- Cleaning Solvents
- Wood
- Masonry Block
- Roofing Shingles

SPILL PREVENTION

Material Management Practices

The following are the material management practices that will be used to reduce the risk of spills or other exposure of materials and substances to storm water runoff.

Good Housekeeping:

The following good housekeeping practices will be followed onsite during the construction project.

- Effort will be made to restock only enough product required to do the job
- All materials stored onsite will be stored in a neat, orderly manner in their appropriate containers, if possible, under a roof or other enclosure
- Products will be kept in their original containers with the original manufacturer's label
- Substances will not be mixed with one another unless recommended by the manufacturer
- Whenever possible, all of a product will be used up before disposing of the container
- Manufacturers' recommendations for proper use and disposal will be followed
- The site superintendent will inspect daily to ensure proper use and disposal of materials

Hazardous Products:

These practices are used to reduce the risks associated with hazardous materials.

- Products will be kept in original containers unless they are not re-sealable
- Original labels and material safety data will be retained; they contain important product information
- If surplus product must be disposed of, manufacturers' or local and state recommended methods for proper disposal will be followed.

Product Specific Practices

The following specific practices will be followed onsite:

Petroleum Products:

All onsite vehicles will be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Any asphalt substances used onsite will be applied according to the manufacturer's recommendations.

Fertilizers:

Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. Storage will be in a covered shed. The contents of any partially used bags of fertilizer will be transferred to a sealable plastic bin to avoid spills.

Paints:

All containers will be tightly sealed and stored when not required for use. Excess paint will not be discharged to the storm sewer system but will be properly disposed of according to manufacturers' instructions or state and local regulations.

Concrete Trucks:

Concrete trucks will not be allowed to wash out or discharge surplus concrete or drum wash water without proper treatment. Capturing and filtering the rinsate will be provided before discharge.

Spill Control Practices

In addition to the good housekeeping and material management practices discussed in the previous sections of this plan, the following practices will be followed for spill prevention and cleanup:

- Manufacturers' recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.

- Materials and equipment necessary for spill cleanup will be kept in the material storage area onsite. Equipment and materials will include but not be limited to brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust, and plastic and metal trash containers specifically for this purpose.

- All spills will be cleaned up immediately after discovery.

- The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

- Spills of toxic of hazardous material will be reported to the appropriate state or local government agency, regardless of the size.

- The spill prevention plan will be adjusted to include measures to prevent this type of spill from reoccurring and how to clean up the spill if there is another one. A description of the spill, what caused it, and the cleanup measures will also be included.

- The site superintendent responsible for the day-to-day site operations will be the spill prevention and cleanup coordinator. He/she will designate at least three other site personnel who will receive spill prevention and cleanup training. These individuals will each become responsible for a particular phase of prevention and cleanup. The names of responsible spill personnel will be posted in the material storage area and in the office trailer onsite.

POLLUTION PREVENTION PLAN CERTIFICATION

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.

Signed: 

Desheng Wang, Ph.D., P.E.
Creative Land&Water Engineering, LLC
P.O. Box 584
Southborough, MA 01772
Tel. 508281-1694

Date:10/4/2023

CONTRACTOR'S CERTIFICATION

I certify under penalty of law that I understand the terms and conditions of the general National Pollutant Discharge Elimination System (NPDES) permit that authorizes the storm water discharges associated with industrial activity from the construction site identified as part of this certification.

Signature	For	Responsible for
_____ Bob Murchinson Date:_____	Robert W. Murchison, Manager Fenix Partners Farm Road Development, LLC 177 Lake Street, Sherborn, MA 01770 C. 617-308-1961	General Contractor Temporary and Permanent Stabilization Stabilized Construction Entrance, Earth Dikes, Sediment Basin

Inspection Report – Farm Road Homes
EPA Tracking Number:
DEP File #:

The report shall be completed Within 24 hours of completing each inspection

Purpose

This Inspection Report presents our field inspection results required in Part 4.1.7 of the CGP, and the Order of Conditions issued by Sherborn Conservation Commission, MA dated xxxx. You must retain in your records copies of all inspection reports in accordance with the requirements in Part 4.1.7.3 of the 2012 CGP. These reports must be retained for at least **3 years** from the date your permit coverage expires or is terminated.

Overview of Inspection Requirements

This Construction operation is covered under the 2012 CGP and subject to the following requirements in Part 4:

Inspection Frequency *(see Part 4.1.4)*
We will conduct inspections either:

- Once every 7 calendar days; or
- Once every 14 calendar days and within 24 hours of a storm event of 0.25 inches or greater.

The inspection frequency may be increased if the site discharges to a sensitive water. See Part 4.1.3. The inspection frequency may be decreased to account for stabilized areas, or drought-stricken conditions, or for frozen conditions. See Part 4.1.4.

Areas to Be Inspected *(see Part 4.1.5)*
During each inspection, the following areas will be inspected:

- Cleared, graded, or excavated areas of the site;
- Stormwater controls (e.g., perimeter controls, sediment basins, inlets, exit points etc.) and pollution prevention practices (e.g., pollution prevention practices for vehicle fueling/maintenance and washing, construction product storage, handling, and disposal, etc.) at the site;
- Material, waste, or borrow areas covered by the permit, and equipment storage and maintenance areas;
- Areas where stormwater flows within the site;
- Stormwater discharge points; and
- Areas where stabilization has been implemented.

Inspection Checklist *(see Part 4.1.6)*
During our site inspection, we are required to check:

- Whether stormwater controls or pollution prevention practices require maintenance or corrective action, or whether new or modified controls are required;
- For the presence of conditions that could lead to spills, leaks, or other pollutant accumulations and discharges;
- Whether there are visible signs of erosion and sediment accumulation at points of discharge and to the channels and streambanks that are in the immediate vicinity of the discharge;
- If a stormwater discharge is occurring at the time of the inspection, whether there are obvious, visual signs of pollutant discharges; and
- If any permit violations have occurred on the site.

Summary of Inspection Findings

General Information (see reverse for instructions)					
Name of Project	**Farm Road Homes**	**CGP Tracking No.**		**Inspection Date**	
Inspector Name, Title & Contact Information	Desheng Wang – Environmental Monitor Creative Land & Water Engineering, LLC, P.O. Box 584, Southborough, MA 01772 Tel. 774-454-0266, Email: deshengw@yahoo.com or desheng@claweng.com				
Present Phase of Construction					
Inspection Location (if multiple inspections are required, specify location where this inspection is being conducted)					

Inspection Frequency *(Note: you may be subject to different inspection frequencies in different areas of the site. Check all that apply.)*

Standard Frequency: ☐ Weekly ☐ Every 14 days and within 24 hours of a 0.25" rain

Increased Frequency: ☐ Every 7 days and within 24 hours of a 0.25" rain (for areas of sites discharging to sediment or nutrient-impaired waters or to waters designated as Tier 2, Tier 2.5, or Tier 3)

Reduced Frequency:

- ☐ Once per month (for stabilized areas)
- ☐ Once per month and within 24 hours of a 0.25" rain (for arid, semi-arid, or drought-stricken areas during seasonally dry periods or during drought)
- ☐ Once per month (for frozen conditions where earth-disturbing activities are being conducted)

Was this inspection triggered by a 0.25" storm event? ☐ Yes ☐ No

If yes, how did you determined whether a 0.25" storm event has occurred?

☐ Rain gauge on site ☐ Weather station representative of site. Specify weather station source:

Total rainfall amount that triggered the inspection (in inches)**:**

Unsafe Conditions for Inspection

Did you determine that any portion of your site was unsafe for inspection per CGP Part 4.1.5? ☐ Yes ☐ No

If "yes", complete the following:

- Describe the conditions that prevented you from conducting the inspection in this location:

- Location(s) where conditions were found:

Condition and Effectiveness of Erosion and Sediment (E&S) Controls (CGP Part 2.1) (see reverse for instructions)				
Type/Location of E&S Control [Add an additional sheet if necessary]	**Repairs or Other Maintenance Needed?***	**Corrective Action Required?***	**Date on Which Maintenance or Corrective Action First Identified?**	**Notes**
1. Entrance	☐Yes ☐No	☐Yes ☐No		
2. Siltfence/socks/wattles	☐Yes ☐No	☐Yes ☐No		
3. Sediment trap (stoage, overflow …)	☐Yes ☐No	☐Yes ☐No		
4. Mulch over exposed area	☐Yes ☐No	☐Yes ☐No		
5.	☐Yes ☐No	☐Yes ☐No		
6.	☐Yes ☐No	☐Yes ☐No		
7.	☐Yes ☐No	☐Yes ☐No		
8.	☐Yes ☐No	☐Yes ☐No		
9.	☐Yes ☐No	☐Yes ☐No		
10.	☐Yes ☐No	☐Yes ☐No		

*** Note:** The permit differentiates between conditions requiring repairs and maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition and requires repairs if controls are not operating as intended. Corrective actions are triggered only for specific, more serious conditions, which include: 1) A required stormwater control was never installed, was installed incorrectly, or not in accordance with the requirements in Part 2 and/or 3; 2) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements in Part 3.1; 3) One of the prohibited discharges in Part 2.3.1 is occurring or has occurred; or 4) EPA requires corrective actions as a result of a permit violation found during an inspection carried out under Part 4.2. If a condition on your site requires a corrective action, you must also fill out a corrective action form found at www.epa.gov/npdes/stormwater/swppp. See Part 5 of the permit for more information.

Condition and Effectiveness of Pollution Prevention (P2) Practices (CGP Part 2.3) (see reverse for instructions)				
Type/Location of P2 Practices [Add an additional sheet if necessary]	**Repairs or Other Maintenance Needed?***	**Corrective Action Required?***	**Date on Which Maintenance or Corrective Action First Identified?**	**Notes**
1. Storage area	☐Yes ☐No	☐Yes ☐No		
2. Fueling area	☐Yes ☐No	☐Yes ☐No		
3. Wash discharge area	☐Yes ☐No	☐Yes ☐No		
4.	☐Yes ☐No	☐Yes ☐No		
5.	☐Yes ☐No	☐Yes ☐No		
6.	☐Yes ☐No	☐Yes ☐No		
7.	☐Yes ☐No	☐Yes ☐No		
8.	☐Yes ☐No	☐Yes ☐No		
9.	☐Yes ☐No	☐Yes ☐No		
10.	☐Yes ☐No	☐Yes ☐No		

*** Note:** The permit differentiates between conditions requiring repairs and maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition and requires repairs if controls are not operating as intended. Corrective actions are triggered only for specific, more serious conditions, which include: 1) A required stormwater control was never installed, was installed incorrectly, or not in accordance with the requirements in Part 2 and/or 3; 2) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements in Part 3.1; 3) One of the prohibited discharges in Part 2.3.1 is occurring or has occurred; or 4) EPA requires corrective actions as a result of a permit violation found during an inspection carried out under Part 4.2. If a condition on your site requires a corrective action, you must also fill out a corrective action form found at www.epa.gov/npdes/stormwater/swppp. See Part 5 of the permit for more information.

Stabilization of Exposed Soil (CGP Part 2.2) (see reverse for instructions)			
Stabilization Area **[Add an additional sheet if necessary]**	**Stabilization Method**	**Have You Initiated Stabilization?**	**Notes**
1. Entrance		☐ YES ☐ NO If yes, provide date:	
2. Stormwater infiltration trenches		☐ YES ☐ NO If yes, provide date:	
3. Buffer zone		☐ YES ☐ NO If yes, provide date:	
4. Parking lot		☐ YES ☐ NO If yes, provide date:	
5.		☐ YES ☐ NO If yes, provide date:	

Description of Discharges (CGP Part 4.1.6.6) (see reverse for instructions)	
Was a stormwater discharge or other discharge occurring from any part of your site at the time of the inspection? ☐ Yes ☐ No **If "yes", provide the following information for each point of discharge:**	
Discharge Location **[Add an additional sheet if necessary]**	**Observations**
1. Sediment trap	Describe the discharge: At points of discharge and the channels and banks of surface waters in the immediate vicinity, are there any visible signs of erosion and/or sediment accumulation that can be attributed to your discharge? ☐ Yes ☐ No If yes, describe what you see, specify the location(s) where these conditions were found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue:
2. Silt fence or silt socks, straw wattles	Describe the discharge: At points of discharge and the channels and banks of surface waters in the immediate vicinity, are there any visible signs of erosion and/or sediment accumulation that can be attributed to your discharge? ☐ Yes ☐ No If yes, describe what you see, specify the location(s) where these conditions were found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue:

Contractor or Subcontractor Certification and Signature
(see reverse for instructions)

"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."

Signature of Contractor or Subcontractor: _____ **Date:**

Printed Name and Affiliation: _____

Certification and Signature by Permittee
(see reverse for instructions)

"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."

Signature of Permittee or "Duly Authorized Representative":  **Date: 10/4/2023**

Printed Name and Affiliation: **Desheng Wang, Creative Land & Water Engineering, LLC**

- The signed and dated written authorization is attached here and included in the SWPPP. A copy must be submitted to EPA, if requested.

Delegation of Authority

I, Bob Murchinson (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the 65 Farm Road, Sherborn, MA 01746 construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

Desheng Wang, Ph.D., P.E. - Environmental Monitor
Creative Land & Water Engineering, LLC
P.O. Box 584
Southboro, MA 01772
Tel. 774-454-0266 Email: deshengw@yahoo.com

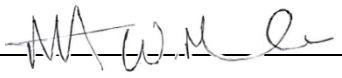
By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in Appendix I of EPA's Construction General Permit (CGP), and that the designee above meets the definition of a "duly authorized representative" as set forth in Appendix I.

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.

Name: **Bob Murchinson**

Company: Robert W. Murchison, Manager
Fenix Partners Farm Road Development, LLC
177 Lake Street, Sherborn, MA 01770
C. 617-308-1961

Manager

Signature: 

Date: **9/27/2023**

Appendix G: Groundwater Mounding Analysis

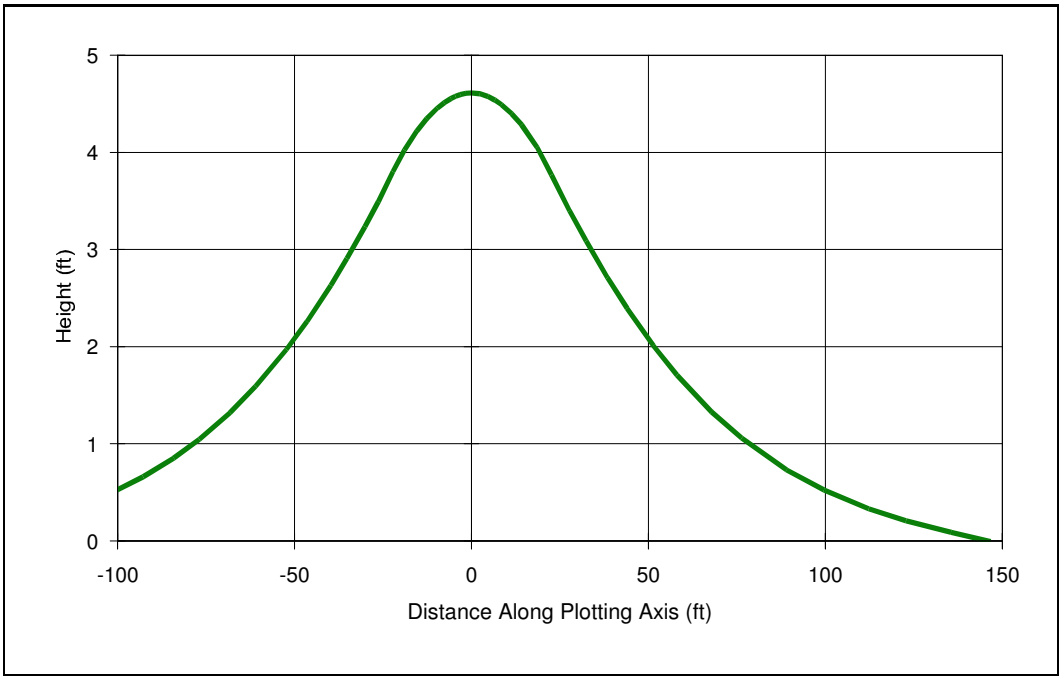
This Appendix contains the detailed groundwater mounding analysis results by Hantush method. Given that the percolation rates in tested pits are ranging from less than 2 mpi to 7 mpi at the project site, it is equivalent to 8.57 in/hr to 30 in/hr. The Rawl's rate of 8.27 in/hour is used for infiltration design. We have found the onsite rock is weathered in Basin B2 and had percolation less than 2 mpi (30 in/hr). Basin A area has percolation in about 5 mpi. Basin B1 had a medium sand soil. Basin C is not tested but augered sand. The nearby IVW has a depth more than 16 ft depth. The aquifer depth is estimated based on the overall site assessment and MGIS surficial geology map (up to 50 ft) including weathered rocks.

Table G.1. Summary of Groundwater Mounding Analysis

Parameters	Stormwater - 100 Year					Note
Recharge area	Basin A	Basin B1	Basin B2	Basin C		All Basins will be dewatered in less than three days.
Dimension, Length, ft	296.72	89.83	70.30	163.07		
Dimension, Width, ft	32	35	42.6	15		
Area, sq. ft	9494.92	3143.95	2994.90	2446.01		
Recharge Vol. Cu ft (per day or event)	27442.8	15681.6	12196.8	7840.8		
Duration, day	1	1	1	1		
Recharge rate, cu ft/day/sq. ft	2.89	4.99	4.07	3.21		
Dewater time, day	3	3	3	3		
GW Separation, ft	4	2	4.5	4		
Distance to wetland, ft	146	50	291	60		
Maximum mounding height, ft	4.61	5.59	4.72	2.87		
Estimated effective Max MH, ft	**4.122**	**2.718**	**4.544**	**2.87**		
Impact mounding height by other systems, ft	**0**	**0**	**0**	**0**		
Combined Mound height, ft	**4.61**	**5.59**	**4.72**	**2.87**		
3-day residual height, ft	0.47	0.69	0.75	0.55		
5-day residual height, ft	**0.26**	**0.41**	**0.41**	**0.24**		
Estimated effective 3d MH, ft	**0.47**	**0.45**	**0.75**	**0.55**		
Estimated effective 5d MH, ft	**0.26**	**0.15**	**0.27**	**0.26**		
Bottom of Basin, ft	**208**	**216**	**204.5**	**219**		
Top of stones, ft						
EHGW, ft	204	214	200	215		
	average					
Bottom aquifer, ft	**184**	**196**	**180**	**199**		
3 day elevation, ft	**204.47**	**214.69**	**200.75**	**215.55**		
Flood routing elev, ft	211.950	217.780	211.550	220.960		
Top of grade, ft	212.5	218.5	212.5	221.5		
Aquafer depth, ft	20	18	20	16		
Hydraulic Conductivity, ft/day	16.42	25.92	25.92	16.42		

* mounded water tables for stormwater management area are at 3-day.

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin A

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:19:58 PM

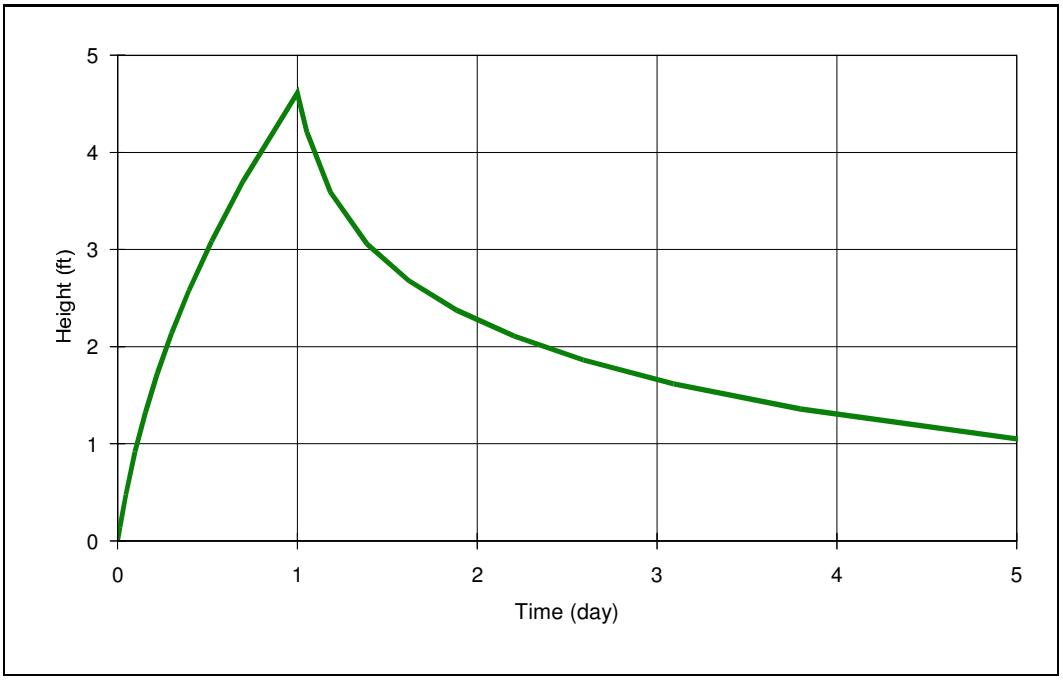
INPUT PARAMETERS

Application rate: 2.89 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 16.42 ft/day
Initial saturated thickness: 20 ft
Length of application area: 296.72 ft
Width of application area: 32 ft
Constant head boundary used at: 146 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 16 ft
positive Y: 16 ft
Total volume applied: 27440.67 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-70.7	-70.7	-100	0.53
-59.5	-59.5	-84	0.85
-48.2	-48.2	-68	1.32
-37	-37	-52	1.97
-28.1	-28.1	-40	2.63
-21.3	-21.3	-30	3.23
-15.7	-15.7	-22	3.8
-11	-11	-15	4.22
-6.9	-6.9	-10	4.45
-4.1	-4.1	-6	4.55
-2.2	-2.2	-3	4.59
0	0	0	4.61
3.3	3.3	5	4.57
6	6	8	4.49
10	10	14	4.28
16	16	23	3.77
22.9	22.9	32	3.09
31.1	31.1	44	2.39
41.1	41.1	58	1.71
54	54	76	1.06
70.4	70.4	100	0.53
86.8	86.8	123	0.21
103.2	103.2	146	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin A

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:20:07 PM

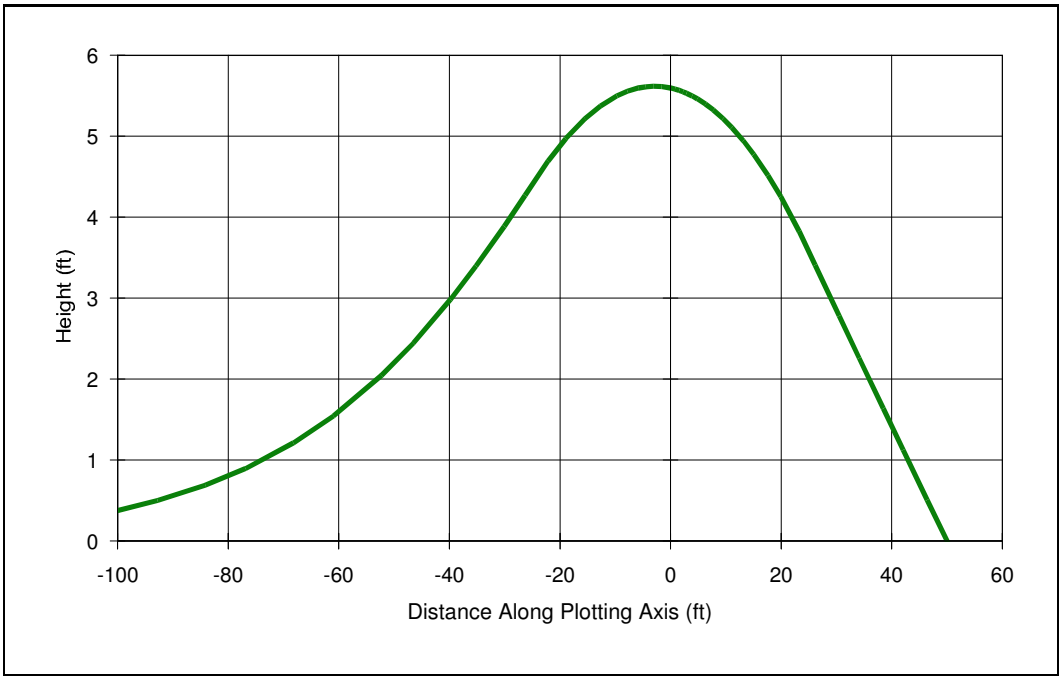
INPUT PARAMETERS

Application rate: 2.89 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 16.42 ft/day
Initial saturated thickness: 20 ft
Length of application area: 296.72 ft
Width of application area: 32 ft
Constant head boundary used at: 146 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 27440.67 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.14
0	0.48
0.1	0.92
0.2	1.33
0.2	1.73
0.3	2.14
0.4	2.58
0.5	3.08
0.7	3.7
1	4.61
1.1	4.21
1.2	3.59
1.4	3.06
1.6	2.68
1.9	2.37
2.2	2.11
2.6	1.86
3.1	1.62
3.8	1.36
5	1.05

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B1

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:29:44 PM

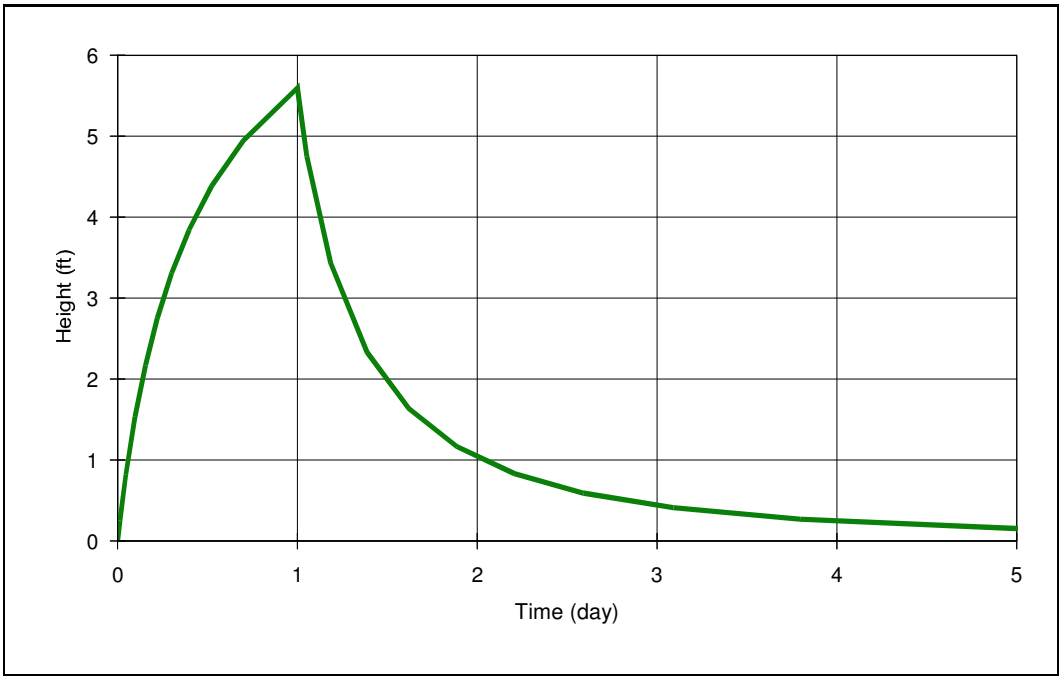
INPUT PARAMETERS

Application rate: 4.99 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 25.92 ft/day
Initial saturated thickness: 18 ft
Length of application area: 89.83 ft
Width of application area: 35 ft
Constant head boundary used at: 50 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 17.5 ft
positive Y: 17.5 ft
Total volume applied: 15688.81 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-70.7	-70.7	-100	0.38
-59.5	-59.5	-84	0.69
-48.2	-48.2	-68	1.21
-37	-37	-52	2.04
-28.1	-28.1	-40	2.98
-21.3	-21.3	-30	3.88
-15.7	-15.7	-22	4.69
-11	-11	-15	5.22
-6.9	-6.9	-10	5.5
-4.1	-4.1	-6	5.59
-2.2	-2.2	-3	5.62
0	0	0	5.59
1.1	1.1	2	5.56
2.1	2.1	3	5.53
3.4	3.4	5	5.46
5.5	5.5	8	5.32
7.8	7.8	11	5.11
10.6	10.6	15	4.77
14.1	14.1	20	4.25
18.5	18.5	26	3.41
24.1	24.1	34	2.26
29.7	29.7	42	1.12
35.4	35.4	50	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B1

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:29:53 PM

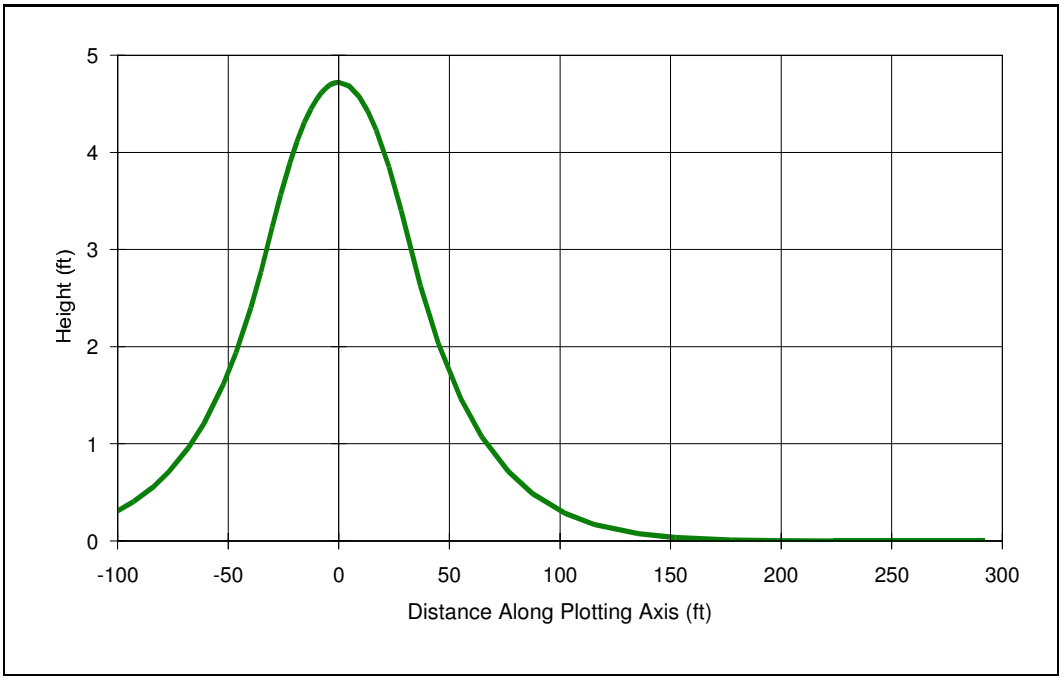
INPUT PARAMETERS

Application rate: 4.99 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 25.92 ft/day
Initial saturated thickness: 18 ft
Length of application area: 89.83 ft
Width of application area: 35 ft
Constant head boundary used at: 50 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 15688.81 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.25
0	0.82
0.1	1.53
0.2	2.17
0.2	2.76
0.3	3.31
0.4	3.84
0.5	4.38
0.7	4.94
1	5.59
1.1	4.75
1.2	3.44
1.4	2.33
1.6	1.64
1.9	1.17
2.2	0.84
2.6	0.59
3.1	0.41
3.8	0.27
5	0.15

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B2

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:39:11 PM

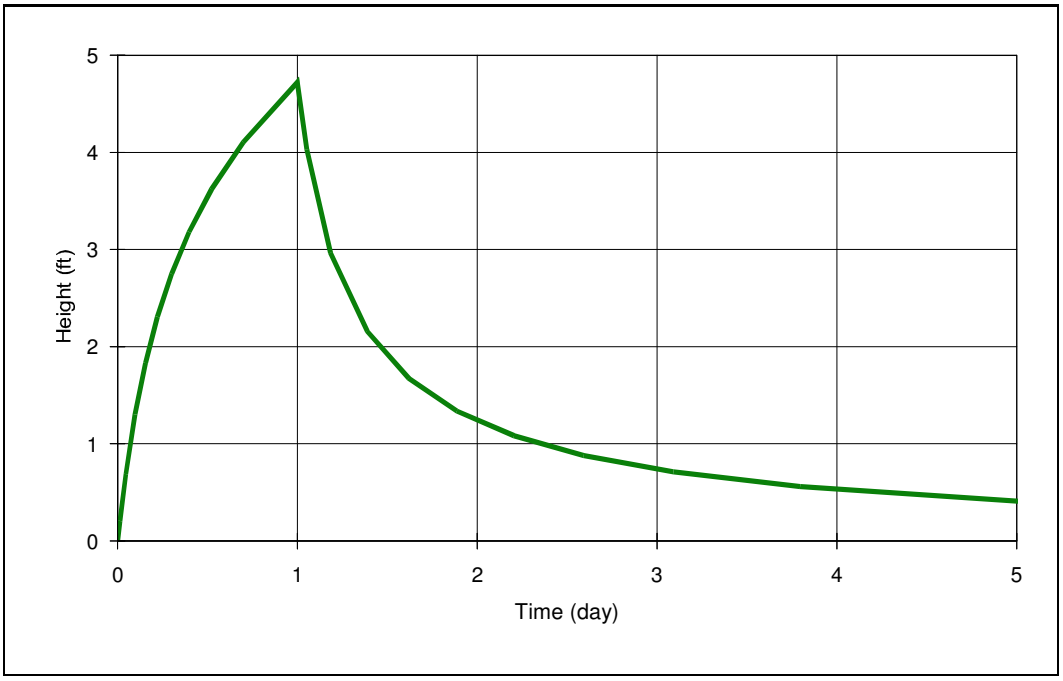
INPUT PARAMETERS

Application rate: 4.07 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 25.92 ft/day
Initial saturated thickness: 20 ft
Length of application area: 70.3 ft
Width of application area: 42.6 ft
Constant head boundary used at: 291 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 21.3 ft
positive Y: 21.3 ft
Total volume applied: 12188.75 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-70.7	-70.7	-100	0.31
-59.5	-59.5	-84	0.55
-48.2	-48.2	-68	0.95
-37	-37	-52	1.61
-28.1	-28.1	-40	2.4
-21.3	-21.3	-30	3.22
-15.7	-15.7	-22	3.89
-11	-11	-15	4.31
-6.9	-6.9	-10	4.56
-4.1	-4.1	-6	4.66
-2.2	-2.2	-3	4.7
0	0	0	4.72
6.5	6.5	9	4.57
11.9	11.9	17	4.23
19.9	19.9	28	3.4
31.9	31.9	45	2.03
45.6	45.6	65	1.08
61.9	61.9	88	0.49
81.9	81.9	116	0.17
107.6	107.6	152	0.04
140.3	140.3	198	0
173.1	173.1	245	0
205.8	205.8	291	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin B2

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:40:01 PM

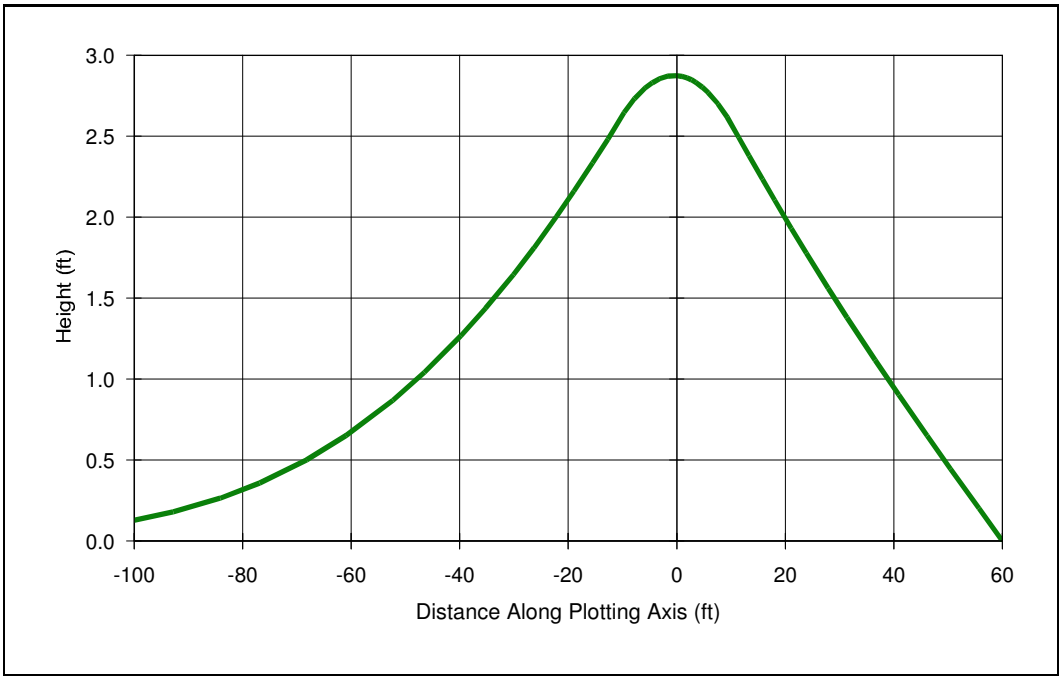
INPUT PARAMETERS

Application rate: 4.07 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 25.92 ft/day
Initial saturated thickness: 20 ft
Length of application area: 70.3 ft
Width of application area: 42.6 ft
Constant head boundary used at: 291 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 12188.75 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.21
0	0.69
0.1	1.3
0.2	1.83
0.2	2.31
0.3	2.75
0.4	3.18
0.5	3.62
0.7	4.1
1	4.72
1.1	4.03
1.2	2.97
1.4	2.16
1.6	1.67
1.9	1.34
2.2	1.08
2.6	0.88
3.1	0.71
3.8	0.56
5	0.41

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin C

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:42:57 PM

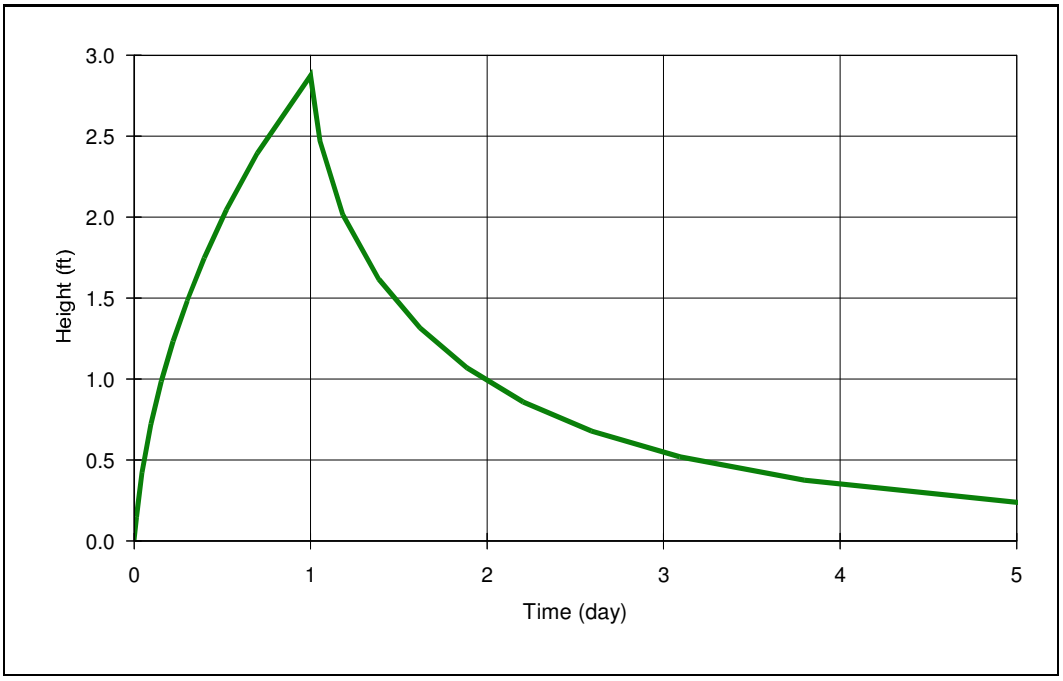
INPUT PARAMETERS

Application rate: 3.21 c.ft/day/sq. ft
Duration of application: 1 days
Fillable porosity: 0.26
Hydraulic conductivity: 16.42 ft/day
Initial saturated thickness: 16 ft
Length of application area: 163.07 ft
Width of application area: 15 ft
Constant head boundary used at: 60 ft
Plotting axis from Y-Axis: 45 degrees
Edge of recharge area:
positive X: 7.5 ft
positive Y: 7.5 ft
Total volume applied: 7851.821 c.ft

MODEL RESULTS

X (ft)	Y (ft)	Plot Axis (ft)	Mound Height (ft)
-70.7	-70.7	-100	0.13
-59.5	-59.5	-84	0.26
-48.2	-48.2	-68	0.5
-37	-37	-52	0.87
-28.1	-28.1	-40	1.27
-21.3	-21.3	-30	1.64
-15.7	-15.7	-22	2
-11	-11	-15	2.34
-6.9	-6.9	-10	2.64
-4.1	-4.1	-6	2.8
-2.2	-2.2	-3	2.85
0	0	0	2.87
1.3	1.3	2	2.86
2.5	2.5	3	2.83
4.1	4.1	6	2.77
6.6	6.6	9	2.62
9.4	9.4	13	2.38
12.8	12.8	18	2.1
16.9	16.9	24	1.78
22.2	22.2	31	1.38
28.9	28.9	41	0.9
35.7	35.7	50	0.44
42.4	42.4	60	0

Groundwater Mounding Analysis (Hantush's Method using Glover's Solution)



COMPANY: CLAWE

PROJECT: Farm Road - Basin C

ANALYST: Desheng Wang

DATE: 9/26/2023 TIME: 2:43:12 PM

INPUT PARAMETERS

Application rate: 3.21 c.ft/day/sq. ft
Duration of application: 1 day
Total simulation time: 5 day
Fillable porosity: 0.26
Hydraulic conductivity: 16.42 ft/day
Initial saturated thickness: 16 ft
Length of application area: 163.07 ft
Width of application area: 15 ft
Constant head boundary used at: 60 ft
Groundwater mounding @
X coordinate: 0 ft
Y coordinate: 0 ft
Total volume applied: 7851.82 cft

MODEL RESULTS

Time (day)	Mound Height (ft)
0	0
0	0.15
0	0.42
0.1	0.72
0.2	0.98
0.2	1.23
0.3	1.48
0.4	1.75
0.5	2.04
0.7	2.4
1	2.87
1.1	2.47
1.2	2.01
1.4	1.62
1.6	1.32
1.9	1.07
2.2	0.86
2.6	0.68
3.1	0.52
3.8	0.38
5	0.24