MASSDEVELOPMENT

SEPTEMBER 2020

Stormwater Management Plan

Shabokin Water Treatment Plant

WRIGHT-PIERCE
Engineering a Better Environment

SHABOKIN WATER TREATMENT PLANT

STORMWATER MANAGEMENT PLAN

MASSDEVELOPMENT

SEPTEMBER 2020

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SHABOKIN WATER TREATMENT PANT
STORMWATER MANAGEMENT PLAN

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SECTION 1

INTRODUCTION

The subject of this analysis involved the proposed Shabokin Water Treatment Plant (SWTP) site area located at the Shabokin Wellfield on Sheridan Road in Devens, MA. Devens is a regional enterprise zone and census-designated place in the Towns of Ayer and Shirley in Massachusetts in the area formerly known as Fort Devens. Raw water from Devens' Shabokin Well will be transferred to the new facility via a new raw water transmission main. The proposed treatment facility is located on a 147-acre parcel owned by the MDFA/Mirror Lake Conservation and is accessible via a paved drive off Sheridan Road. There is an existing treatment facility on the site, which treats water from the Shabokin Wellfield. The proposed water treatment facility will be located northeast of the existing facility. The proposed facility is located within the Zone I protection area for the well field.

The proposed improvements include construction of a new 1.44 MGD water treatment plant (WTP). The proposed treatment building will be set back approximately 340-feet from the road and will have a footprint of approximately 8,000 square feet. A driveway entrance is proposed with a limited amount of pavement on three sides of the building to allow access for bulk chemical delivery trucks and firetrucks. The proposed work results in approximately 27,911 SF (0.64 Ac) of additional impervious surfaces. The site grading has been designed to allow stormwater to flow to swales along the edges of the site and eventually into an infiltration basin just upstream of the site's natural stormwater discharge location.

1.1 STORMWATER MANAGEMENT PLAN APPROACH

This Stormwater Management Plan (SWMP) is prepared in accordance with the Massachusetts Stormwater Management Manual and the Massachusetts Department of Environmental Protection's Stormwater Checklist, which has been included in Appendix A. The following sections will address each stormwater standard to document compliance of the proposed project.

1.2 ORGANIZATION OF THE SWMP

This SWMP was prepared to comply with the requirements for the ten stormwater Standards as outlined in the Massachusetts Stormwater Handbook.

Standard #1: No New Untreated Discharges
Standard #2: Peak Rate Attenuation
Standard #3: Recharge
Standard #4: Water Quality
Standard #5: Land Uses with Higher Potential Pollutant Loads
Standard #6: Critical Areas
Standard #7: Re-developments and Other Projects
Standard #8: Construction Period Pollution Prevention & Erosion/Sedimentation Controls
Standard #9: Operation/Maintenance Plan
Standard #10 Prohibition of Illicit Discharges

This information is presented herein under the following report format:

Section 2: No New Untreated Discharges
Section 3: Peak Rate Attenuation
Section 4: Recharge
Section 5: Water Quality
Section 6: Land Uses with Higher Potential Pollutant Loads
Section 7: Critical Areas
Section 8: Re-Development and Other Projects
Section 9: Pollution Prevention & Erosion/Sedimentation Control Plan
Section 10: Operation/Maintenance Plan
Section 11: Prohibition of Illicit Discharges

SECTION 2

NO NEW UNTREATED DISCHARGES

2.1 EXISTING CONDITIONS

The existing Shabokin Wellfield and water treatment plant are located on Sheridan Road in Devens, MA. The proposed treatment plant building will be located on property owned by the MDFA/Mirror Lake Conservation, northeast of the existing treatment facility. The site is proposed on an existing cleared gravel pad surrounded by steep slopes and that drains to a wetlands area and ultimately to the Nashua River. The watershed area draining to the site is primarily woods with a small amount of development in the upper portion of the watershed. The soils on-site are primarily of the Hydrologic Soil Group (HSG) A and are highly permeable. As indicated by FEMA Flood maps of the area, the site is not located within a 100-year flood plain.

2.2 NEW STORMWATER CONVEYANCES

The stormwater plan has been designed to meet the requirements of the Massachusetts Stormwater Management Policy. As such, there are no untreated stormwater discharges proposed as part of this project. All stormwater leaving the site will receive pre-treatment and treatment for TSS through the use of sediment forebays and an infiltration basin.

SECTION 3

PEAK RATE ATTENUATION

Standard 2 of the Massachusetts Stormwater Standards requires new development projects to be designed so that post-development peak discharge rates do not exceed pre-development discharge rates. Pre- and post-development hydrologic models have been created to quantify peak flow rates leaving the site. The hydrologic analysis was performed using the SCS TR-20 methodology and HydroCAD version 10 computer modeling software was utilized to perform the computations. The rainfall data used to conduct the analysis was obtained from the Northeast Regional Climate Center (NRCC) and Natural Resources Conservation Service (NRCS) joint website "precip.net," which provides extreme precipitation data for New York and New England. The TR-20 analysis relies heavily on in-situ HSG classification, land cover type and time of concentration calculations.

3.1 WATERSHED CHARACTERISTICS

The total watershed draining to the site was delineated as five sub-catchment areas with a total area of approximately 33.4 acres. The natural drainage path conveys flows to an existing wetland near the entrance to the site which has a 12-inch outlet pipe crossing Sheridan Road. Figures 1 and 2 in Appendix B provide a visual representation of the pre- and post-development watershed delineations. Pre- and post-development peak flow rates have been analyzed at the wetland near the entrance to the site.

The overall watershed boundary did not change as a result of the proposed work. Based on the proposed development, the watershed area was analyzed based on the same five sub-catchment areas delineated for the pre-development scenario.

3.2 SOILS

Soils data for the proposed project area was obtained through the Natural Resource Conservation Service (NRCS) Soil Survey Geographic (SSURGO) database. Based on the information obtained, the watershed area is comprised almost entirely of HSG Type A soils with rapid infiltration rates. The following soil types were individually identified within the project area:

- Hinckley Sandy Loam;

- Pits, gravel;
- Quonset Loamy Sand;
- Freetown Muck;

The first three soil types listed above are described as excessively well drained sands and gravely sands with low runoff potential. The fourth soil type, Freetown muck, is classified as HSG B/D and is described as very poorly drained.

3.3 LAND COVER

Land cover classifications for the project site were selected and quantified based on measurements taken from aerial imagery. Each land cover designation was assigned a runoff curve number (CN), and a weighted curve number was calculated for entry into the HydroCAD model. A summary of the existing and proposed watershed characteristics is included in Tables 3-1 and 3-2.

TABLE 3-1

PRE-DEVELOPMENT WATERSHED CHARACTERISTICS

Sub-Catchment	Total Area (SF)	HSG A - Woods/Grass	HSG A/D - Brush	Impervious	Composite CN	TC (min)
1	196,325	174,477	0	21,848	47	22.9
2	94,567	94,567	0	0	44	9.9
3	769,356	633,377	115,267	20,712	50	26.1
4	258,111	252,219	0	5,892	45	19.5
5	134,309	125,974	0	8,335	46	17.1

TABLE 3-2

POST-DEVELOPMENT WATERSHED CHARACTERISTICS

Sub-Catchment	**Total Area (SF)**	**HSG A - Woods/Grass**	**HSG A/D - Brush**	**Impervious**	**Composite CN**	**TC (min)**
1	196,325	172,995	0	23,330	50	21.2
2	94,567	81,434	0	13,133	51	8.7
3	769,356	633,377	115,267	20,712	50	26.1
4	258,111	239,389	0	18,722	47	19.0
5	134,309	125,508	0	8,801	47	16.7

3.4 TIME OF CONCENTRATION

The time of concentration (Tc) for each watershed area was calculated using the SCS Lag/CN method by entering the average slope for the sub-catchment and the length of the longest flow path into the HydroCAD model. The longest flow path and average slope were determined through an analysis of the existing topography of the project area.

3.5 STORMWATER QUANTITY RESULTS

The site has been analyzed for pre- and post-development runoff corresponding to the 2, 10, 25, 50 and 100-year, 24-hour storms. Peak discharge rates into the roadside ditch are summarized in Table 3-3 and the HydroCAD results have been included in Appendix C.

TABLE 3-3

PRE- AND POST-DEVELOPMENT PEAK DISCHARGE RATES

Storm Event	Rainfall Depth (in)	Peak Discharge Rate (cfs)	
		Pre-Development	Post-Development
2-Year, 24-Hour	3.03	0.0	0.0
10-year, 24-Hour	4.50	0.6	0.1
25-Year, 24-Hour	5.63	2.5	2.6
50-Year, 24-Hour	6.68	4.5	4.8
100-Year, 24-Hour	7.93	6.5	6.6

Based on the results of the TR-20 analysis, a reduction in peak discharge rate was achieved for the 2-year and 10-year, 24-hour storms, however, a slight increase has been calculated for the 25-year, 50-year and 100-year, 24-hour storms.

SECTION 4

RECHARGE

4.1 GROUNDWATER RECHARGE

Standard 3 of the Massachusetts Stormwater Standards requires the loss of annual groundwater recharge to be eliminated or minimized through the use of infiltration measures. In order to comply with this standard, an infiltration basin has been designed in accordance with the Massachusetts Stormwater Handbook. Calculations for the required recharge volume and actual recharge volume are provided in Section 4.3.

4.2 SOIL TYPES

An important factor when designing an infiltration BMP for groundwater recharge is the existing soil types and classifications. As discussed in Section 3.2, soils in the area surrounding the proposed facility are classified by the NRCS as HSG Type A soils. The Rawls rate for infiltration per the Massachusetts Stormwater Handbook and HSG-A soils is 8.27 in/hr.

Geotechnical investigations completed by Summit Geoengineering Services seem to confirm the results of the NRCS SSURGO database. The saturated hydraulic conductivity of the underlying soils was quantified as 20-inches per hour near the location of the proposed infiltration basin. The closest geotechnical boring was performed within 25-feet of the proposed BMP and is assumed to be representative of the conditions within the actual location of the BMP.

4.3 INFILTRATION BEST MANAGEMENT PRACTICES

In order to satisfy Standard 3, an infiltration basin has been designed with a permanent storage capacity greater than the required recharge volume. The required recharge volume was calculated via the Simple Dynamic method based on the total area of pavement tributary to the infiltration basin. Tributary roof area has been excluded from this analysis because roof flows will be captured via roof leaders and infiltrated directly through subsurface drywells. Sizing calculations for the infiltration basin and subsurface drywells can be found in Section 5.

Required Recharge Volume (R_V):

- Target Depth Factor Associated with Hydrologic Soil Group = 0.6-inch
- Total Impervious Area = 19,843 SF
- R_v= 992 ft^3

Required BMP Sizing:

- Depth of BMP (D) = 1.5-feet
- Saturated Hydraulic Conductivity (K) = 8.27-inches per hour (Per 1982 Rawls Rate)
- Allowable Drawdown Time (T) = 2 hours
- Minimum Bottom Area (A) = R_V / (D + KT) = 345 ft^2
- Volume = A x D = 517 ft^2

Actual BMP Sizing:

- Bottom Area = 400 ft^2
- Volume = 1,007 ft^3

Based on the calculations provided, it is apparent that the proposed BMP has been designed to have a bottom area and volume greater than required per the simple dynamic sizing methodology.

72-Hour Drawdown Analysis:

Standard three requires the BMP to completely drain within 72-hours. The following calculations show that the drawdown time of the proposed BMP is approximately 3.6-hours.

- T = R_v / (K * Bottom Area)
- T = 1,477 ft^3 / (8.27 in/hr * 1ft/12in * 400 ft^2) = 3.6 Hours

SECTION 5

WATER QUALITY

5.1 WATER QUALITY PROVISIONS

In order to comply with Standard 4, the proposed infiltration basin has been designed with a permanent storage volume greater than the required Water Quality Volume (WQV). The WQV was calculated based on the total area of proposed impervious surfaces across the site. In order to reduce the size of the proposed infiltration basin, stormwater originating from the roof will be captured via roof leaders and infiltrated directly through the use of subsurface drywells. The WQV was determined based on 0.5-inches of rainfall over the impervious surfaces. Pre-treatment has been provided for all inlets to the infiltration basin via sediment forebays.

5.1.1 Infiltration Basin Sizing

The required WQV for the infiltration basin was calculated based on 0.5-inches of rainfall on the impervious surfaces tributary to the BMP. The required WQV calculations are listed below:

- Tributary Impervious Area = 19,843 ft^2
- Treatment Depth = 0.5-inches
- Required WQV = 827 ft^3

The proposed infiltration basin has been designed with a bottom area of 538 ft^2 and a permanent storage volume of 1,335.4 ft^3. The volume of the infiltration basin has been calculated based on the average surface area of the permanent storage proposed within the BMP. Area measurements of the BMP have been provided in Table 5-1.

TABLE 5-1

INFILTRATION BASIN AREA MEASUREMENTS

Elevation (ft)	Area (ft^2)
241.0	400
242.5	943
Average Surface Area:	671.5

- Depth = 1.5 ft
- Proposed WQV = Average Surface Area x Depth = 1,007 ft^3

5.1.2 DRYWELL SIZING

Four drywells are proposed at various locations throughout the site to provide subsurface storage and infiltration for water originating from the roof of the facility. Each drywell has been sized to hold a storage volume equal to 0.5-inches of rainfall over the tributary roof area. Sizing calculations for the drywells can be found in Table 5-2:

TABLE 5-2

DRYWELL SIZING CALCULATIONS

Description	**#1**	**#2**	**#3**	**#4**
Tributary Roof Area (ft^2)	3,206	551	244	4,067
Required Volume (ft^3)	133.6	23.0	10.2	169.5
Proposed Length (ft)	20	8	5	25
Proposed Width (ft)	6	3	2	6
Proposed Depth (ft)	3	3	3	3
Crushed Stone Void Ratio	0.4	0.4	0.4	0.4
Storage Volume Provided (ft^3)	144.0	28.8	12.0	180

5.2 TSS REMOVAL BEST MANAGEMENT PRACTICES

TSS removal has been achieved using an infiltration basin combined with sediment forebays for pre-treatment. The TSS Removal worksheet indicates the total TSS removal of the BMP train to be 85%. The TSS worksheet has been provided in Appendix D.

SECTION 6

LAND USES WITH HIGHER POTENTIAL POLLUTANT LOADS

The Massachusetts Department of Environmental Protection has identified certain land uses which generate higher concentrations of pollutants than found in typical runoff. The construction of the new water treatment building and associated additional gravel area are not land uses which would trigger higher potential pollutant loads.

SECTION 7

CRITICAL AREAS

The entire site is located within the Zone II of the Shabokin Wellfield and part of the site is located within Zone I of the Shabokin Wellfield. This project is associated with the operation of the public water supply and therefore the design of the project has been designed to account for protection of the wellhead area. Wetland areas are also on the property. Proper distances from these critical natural systems are to be maintained.

During construction, the wetlands will be protected with the proper erosion controls as outlined in Section 9.

SECTION 8

RE-DEVELOPMENT AND OTHER PROJECTS

The proposed improvements to the Shabokin Well site do not qualify as a redevelopment project.

SECTION 9

CONSTRUCTION PERIOD POLLUTION PREVENTION & EROSION/SEDIMENTATION CONTROL PLAN

Prior to the start of any earthwork on the site, the sedimentation and erosion control barriers will be installed. Section 9.2 provides a listing of controls and a sequence of construction. The project is subject to a NPDES permit as the disturbance will be greater than 1 acre. For projects of this magnitude, the Contractor will be responsible for filing the NPDES permit and preparing the Stormwater Pollution Prevention Plan in accordance with the plans and specifications of the construction contract. The successful contractor will supply the needed SWPPP prior to beginning construction activities.

9.1 INSPECTION AND MAINTENANCE OF STORMWATER CONTROLS

Stormwater controls must be maintained in good operating condition until all disturbed soils are permanently stabilized. To ensure this, the erosion and sedimentation controls shall be inspected by the Resident Engineer once every two weeks and after every rainfall event of 0.5 inches or greater.

The following standard maintenance practices will apply to the erosion and sedimentation controls for the project:

- All erosion and sediment control measures will be properly maintained. If repairs or other maintenance is necessary, it will be initiated by the Contractor within 24 hours of report;
- 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;
- Built up sediment will be removed from silt fence when it has reached one-third the height of the fence and at end of the job;
- A stabilized construction entrance will be maintained at the entrance to the site throughout construction;
- Dust will be controlled by periodic street sweeping during the progress of the work;
- Erosion control measures will be maintained for disturbed areas of the site that have not been stabilized;

- Erosion control measures will be installed and maintained for the construction staging area, fueling area, stockpiles, and material storage areas until those areas have been stabilized after construction; and,
- Temporary and permanent seeding and planting will be inspected for bare spots, washouts, and healthy growth.

If the inspections reveal the need for additional control devices to prevent erosion and sedimentation, the Contractor will promptly install additional protection devices as required. Control devices in need of repair will be repaired promptly after identification. A stockpile of 300 linear feet of silt fence will be maintained on the site and under cover for emergency repairs and routine maintenance.

The Owner (or their representative) will be responsible for preparing an inspection and maintenance report (Attached in Appendix E) following each inspection and filing completed reports after maintenance action has taken place by the Contractor. The Contractor's superintendent will be responsible for maintenance and repair activities and completing and signing the maintenance action part of inspection and maintenance reports.

9.2 STORMWATER CONTROLS DURING THE CONSTRUCTION PERIOD

PROJECT SCHEDULE:

The project construction phasing will generally proceed in the following sequence:

1. Installation of sedimentation/erosion control barriers at the down-gradient limit of work.
2. Excavation and site preparation.
3. Building construction and pipe installation.
4. Loaming and hydroseeding disturbed areas as construction on those areas is completed.
5. Inspection of seeding success and removal of sedimentation/erosion control barriers once permanent stabilization has become established pursuant to the specifications and satisfaction of the Resident Engineer.

EROSION AND SEDIMENT CONTROLS:

1. Temporary stabilization measures shall be instituted to minimize effects of sedimentation and erosion during construction. Temporary Erosion Controls will be established at the site in accordance with specification section 31 25 00 included in Appendix F.
2. Permanent stabilization measures shall be employed to minimize effects of sedimentation and erosion after the completion of construction. Detailed information is included in Specification Section 32 92 18 – Loaming and Seeding attached in Appendix F.

SECTION 10

OPERATION/MAINTENANCE PLAN

The stormwater BMP's used at the Shabokin Water Treatment plant require a long-term operation and maintenance plan to insure proper function. The following sections address the maintenance requirements of each BMP and establish the responsibility for ensuring each task is completed.

10.1 RESPONSIBLE PARTY

The BMP's are not part of the public stormwater system and will, therefore be maintained by the plant operator. Contact info for the responsible party is listed below:

Jim Moore
Devens Utilities Manager
33 Andrews Parkway
Devens, MA 01434
(978) 906-4588

10.2 DESCRIPTION OF STORMWATER BMPS

Three types of BMP's are proposed to achieve the required level of stormwater treatment and infiltration. Drywells are proposed for infiltration of roof runoff and an infiltration basin is proposed for infiltration and treatment of surface runoff. Multiple sediment forebays are proposed for pretreatment of surface runoff flowing toward the infiltration basin.

10.2.1 Drywells

Drywells are small excavated pits, backfilled with crushed stone, and used to infiltrate uncontaminated runoff from roofs. The crushed stone backfill is completely wrapped in geotextile fabric to prevent fines from migrating into the stone fill. Roof runoff is captured via roof leaders and is piped directly into the drywell. The length and width of each drywell varies based on the size of the tributary roof area, but they are all three feet deep. Each drywell will have a monitoring well to determine the effectiveness of infiltration.

10.2.2 Infiltration Basins

Infiltration basins are stormwater runoff impoundments constructed over permeable soils to achieve infiltration and treatment of stormwater runoff. The basin floor consists of a 12-inch layer of Type B gravel, overlain by a 6-inch layer of loamy sand. Following instillation, the side slopes and bottom will be stabilized with a dense turf of water tolerant grass. The infiltration basin also contains a backup underdrain, an overflow structure, and an emergency spillway.

10.2.3 Sediment Forebays

A sediment forebay is a post-construction measure consisting of an excavated pit, bermed area and a stone weir designed to slow incoming stormwater runoff and facilitate gravity separation of suspended solids. All flow entering the infiltration basin will first be pretreated through a sediment forebay.

10.3 MAINTENANCE REQUIREMENTS

Maintenance requirements specific to each BMP have been established in accordance with the Massachusetts Stormwater Handbook. Table 10-1 details the long-term maintenance requirements for each BMP.

Table 10-1

LONG TERM MAINTENANCE SCHEDULE

BMP	Activity	Frequency
Drywell	1. Inspect drywell for proper stabilization and function; 2. Measure water depth at 24- and 48-hour frequencies following storms to confirm drawdown time;	1. Following major storms for the first 6-months; 2. Annually;
Infiltration Basin	1. Preventative maintenance; 2. Inspect to ensure proper functioning; 3. Inspect and clean pretreatment devices; 4. Mow side slopes and basin bottom; 5. Remove trash, debris and accumulated organic matter;	1. Twice per year; 2. After every major storm for the first 3-months, twice per year thereafter; 3. At least twice per year; 4. Twice per year; 5. Twice per year;
Sediment Forebay	1. Inspect sediment forebays for accumulated sediment and debris; 2. Remove sediment and debris.	1. Monthly; 2. Two to Four times per year;

Additional information related to the extent of each maintenance activity can be found in the Massachusetts Stormwater Handbook. All maintenance activities shall be documented by filling out the Inspection Maintenance Checklist and tracked on the Stormwater Maintenance Log which can be found in Appendix E.

SECTION 11

PROHIBITION OF ILLICIT DISCHARGES

Standard 10 of the Massachusetts Stormwater Standards prohibits all illicit discharges to the stormwater management system. In order to comply with this standard, appropriate disposal methods have been designed for all sanitary and process related waste. In addition, spill containment has been designed to capture spills from chemical deliveries. The Shabokin Water Treatment Plant will specifically prohibit the discharge of any illicit substance to the stormwater management system.

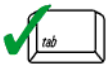
Appendix A – Stormwater Checklist

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

☒ No disturbance to any Wetland Resource Areas

☒ Site Design Practices (e.g. clustered development, reduced frontage setbacks)

☐ Reduced Impervious Area (Redevelopment Only)

☒ Minimizing disturbance to existing trees and shrubs

☐ LID Site Design Credit Requested:

- ☐ Credit 1
- ☐ Credit 2
- ☐ Credit 3

☒ Use of "country drainage" versus curb and gutter conveyance and pipe

☐ Bioretention Cells (includes Rain Gardens)

☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)

☐ Treebox Filter

☐ Water Quality Swale

☐ Grass Channel

☐ Green Roof

☒ Other (describe): Infiltration Basins and Drywells

Standard 1: No New Untreated Discharges

☒ No new untreated discharges

☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth

☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☐ Static ☒ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

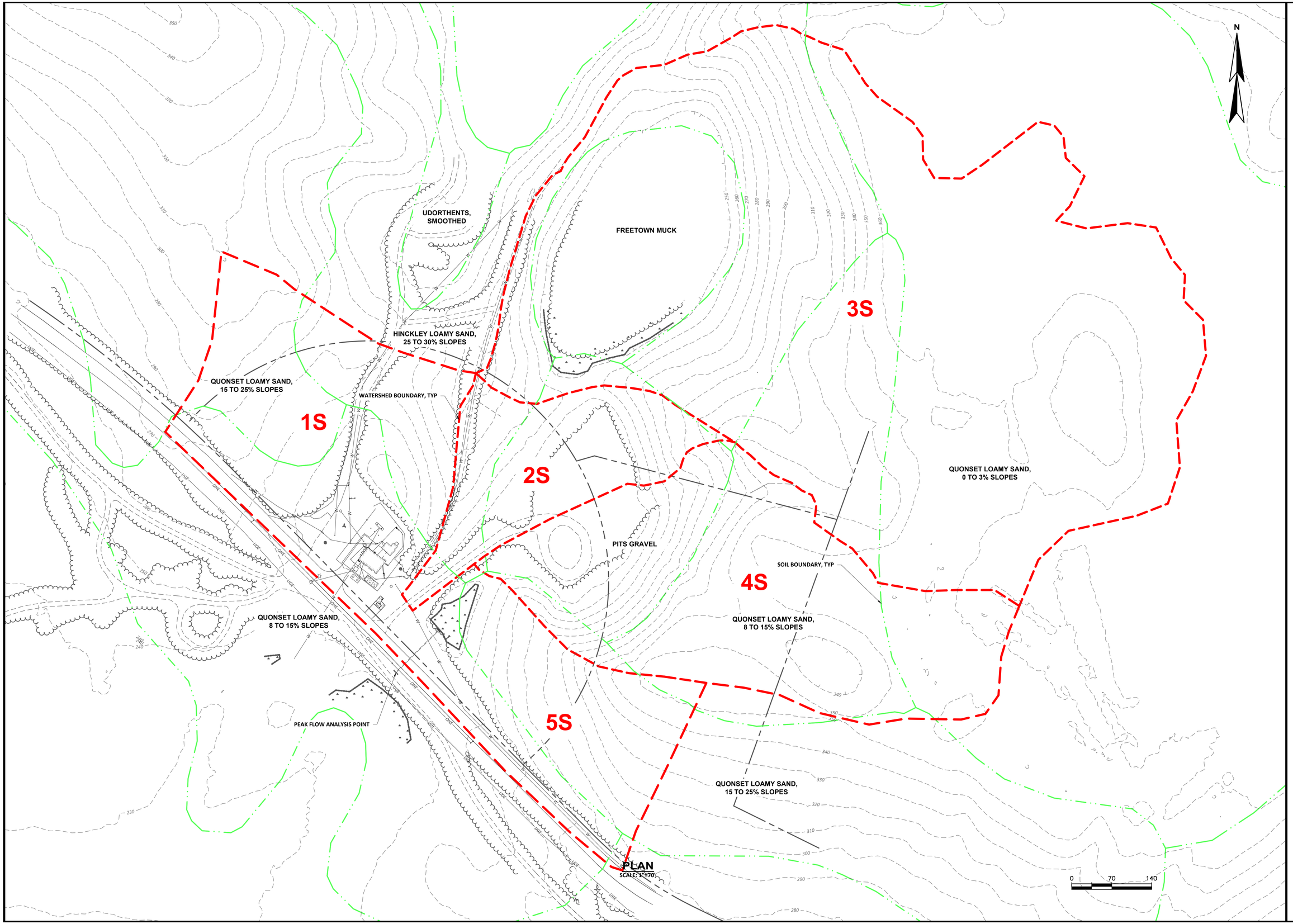
Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

Appendix B – Watershed Figures



NO	SUBMISSIONS/REVISIONS	APP'D	DATE
	ISSUED FOR PERMITTING	J.CRA	09/20
1			
2			
3			
4			
5			

DESIGNED BY: C.DAI
CAD COORD:
CAD: D.MET
CHECKED BY:
DATE:
APPROVED BY:
DATE:
PROJECT NO: 14083

WRIGHT-PIERCE
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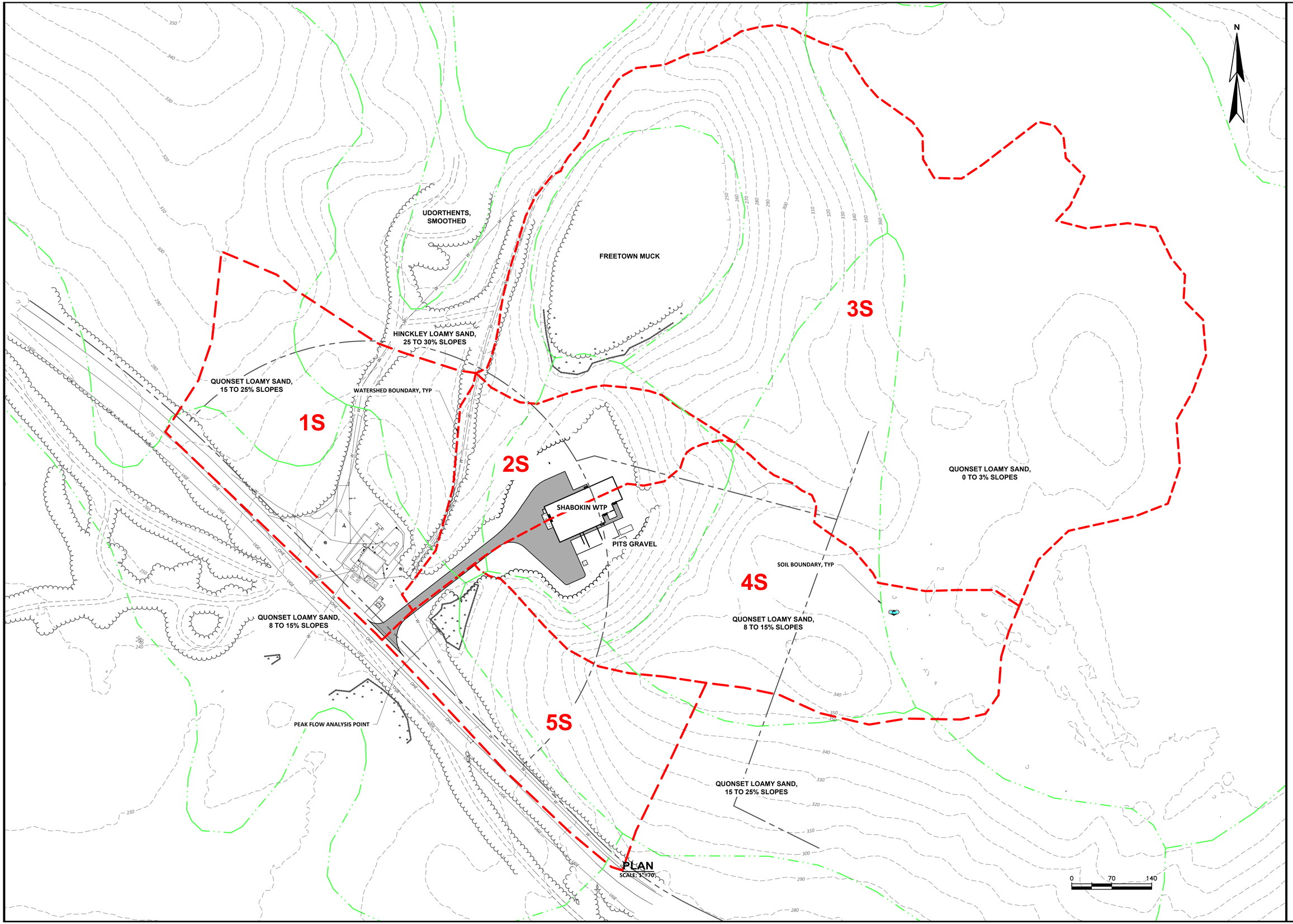
MASSDEVELOPMENT
DEVENS, MASSACHUSETTS
SHABOKIN WATER TREATMENT PLANT

FIGURE 1 - PRE-DEVELOPMENT

DRAWING
PD-1



NO	SUBMISSIONS/REVISIONS	APP'D	DATE
1	ISSUED FOR PERMITTING	J.CRA	09/20
2			
3			
4			
5			

DESIGNED BY:.. C.DAI
CAD COORD:
CAD:.. D.MET
CHECKED BY:..
DATE:..
APPROVED BY:..
DATE:..
PROJECT NO:.. 14083

WRIGHT-PIERCE
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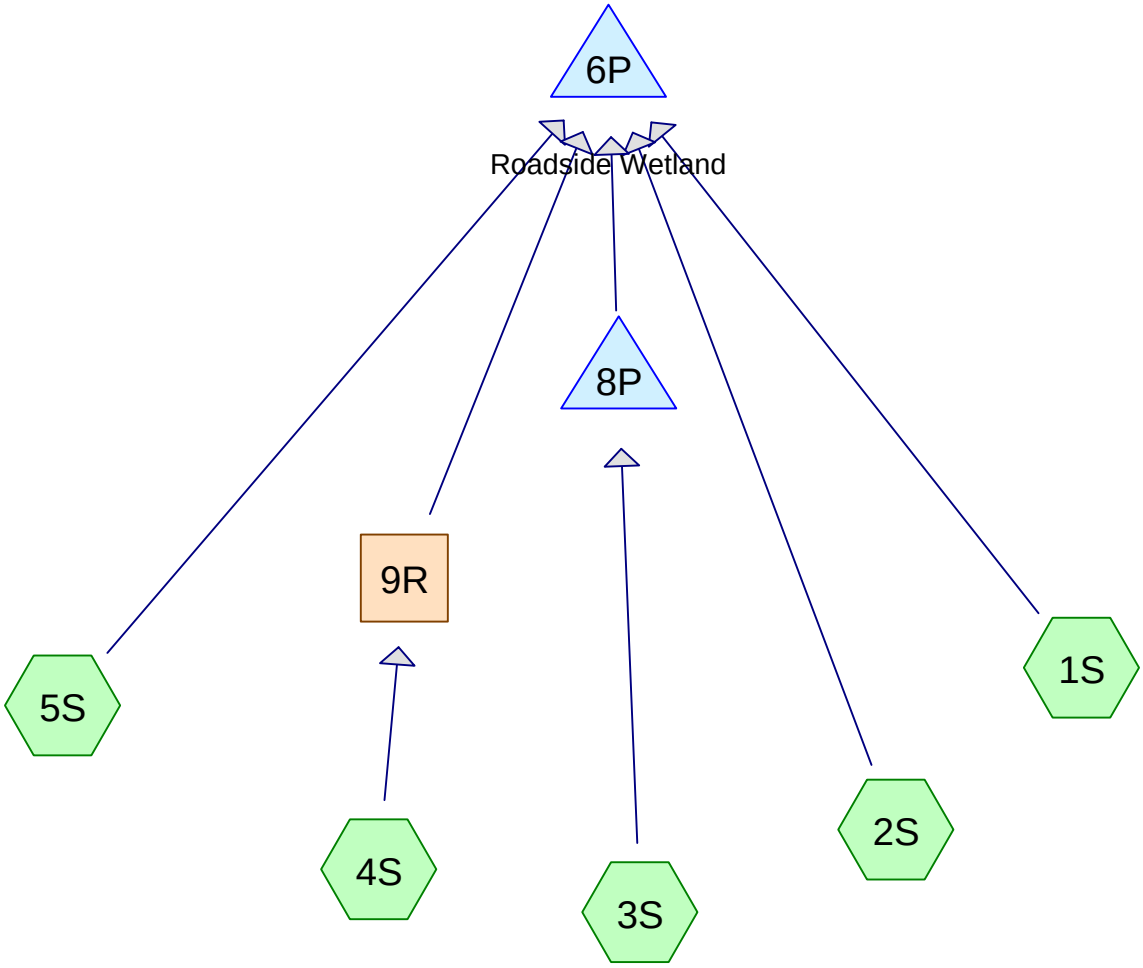
MASSDEVELOPMENT
DEVENS, MASSACHUSETTS
SHABOKIN WATER TREATMENT PLANT

FIGURE 2 - POST-DEVELOPMENT

DRAWING
PD-2

Appendix C – HydroCAD Results



Subcat Reach Pond Link

Routing Diagram for Shabokin Pre-Development
Prepared by Wright-Pierce, Printed 8/27/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.646	77	Brush, Fair, HSG D (3S)
0.707	76	Gravel roads, HSG A (1S, 2S, 4S)
0.802	98	Pavement (3S, 4S, 5S)
29.193	43	Woods/grass comb., Fair, HSG A (1S, 2S, 3S, 4S, 5S)
33.348	**48**	**TOTAL AREA**

Summary for Subcatchment 1S:

Runoff = 0.02 cfs @ 20.43 hrs, Volume= 0.019 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
174,477	43	Woods/grass comb., Fair, HSG A
21,848	76	Gravel roads, HSG A
196,325	47	Weighted Average
196,325		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	825	0.0820	0.60		**Lag/CN Method,**

Summary for Subcatchment 2S:

Runoff = 0.01 cfs @ 24.00 hrs, Volume= 0.003 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

Area (sf)	CN	Description
91,466	43	Woods/grass comb., Fair, HSG A
3,101	76	Gravel roads, HSG A
94,567	44	Weighted Average
94,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	445	0.1930	0.75		**Lag/CN Method,**

Summary for Subcatchment 3S:

Runoff = 0.17 cfs @ 14.70 hrs, Volume= 0.142 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	633,362	43	Woods/grass comb., Fair, HSG A
	115,260	77	Brush, Fair, HSG D
*	20,691	98	Pavement
	769,313	50	Weighted Average
	748,622		97.31% Pervious Area
	20,691		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4S:

Runoff = 0.02 cfs @ 24.00 hrs, Volume= 0.013 af, Depth= 0.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	246,376	43	Woods/grass comb., Fair, HSG A
*	5,892	98	Pavement
	5,843	76	Gravel roads, HSG A
	258,111	45	Weighted Average
	252,219		97.72% Pervious Area
	5,892		2.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	858	0.1330	0.73		**Lag/CN Method,**

Summary for Subcatchment 5S:

Runoff = 0.01 cfs @ 23.73 hrs, Volume= 0.010 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	125,974	43	Woods/grass comb., Fair, HSG A
*	8,335	98	Pavement
	134,309	46	Weighted Average
	125,974		93.79% Pervious Area
	8,335		6.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	796	0.1460	0.78		**Lag/CN Method,**

Summary for Reach 9R:

Inflow Area = 5.925 ac, 2.28% Impervious, Inflow Depth = 0.03" for 2-yr event
Inflow = 0.02 cfs @ 24.00 hrs, Volume= 0.013 af
Outflow = 0.02 cfs @ 24.30 hrs, Volume= 0.013 af, Atten= 0%, Lag= 18.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Max. Velocity= 0.35 fps, Min. Travel Time= 16.4 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 19.5 min

Peak Storage= 21 cf @ 24.03 hrs
Average Depth at Peak Storage= 0.02'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 21.36 cfs

Custom cross-section, Length= 346.0' Slope= 0.0050 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 246.00', Outlet Invert= 244.27'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,076	21.36

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.348 ac, 2.40% Impervious, Inflow Depth = 0.02" for 2-yr event
Inflow = 0.06 cfs @ 24.00 hrs, Volume= 0.045 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 235.63' @ 35.85 hrs Surf.Area= 3,194 sf Storage= 1,950 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=235.00' (Free Discharge)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 8P:

Inflow Area = 17.661 ac, 2.69% Impervious, Inflow Depth = 0.10" for 2-yr event
Inflow = 0.17 cfs @ 14.70 hrs, Volume= 0.142 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 248.06' @ 25.50 hrs Surf.Area= 98,754 sf Storage= 6,164 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Subcatchment 1S:

Runoff = 0.42 cfs @ 12.62 hrs, Volume= 0.140 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

Area (sf)	CN	Description
174,477	43	Woods/grass comb., Fair, HSG A
21,848	76	Gravel roads, HSG A
196,325	47	Weighted Average
196,325		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	825	0.0820	0.60		**Lag/CN Method,**

Summary for Subcatchment 2S:

Runoff = 0.12 cfs @ 12.55 hrs, Volume= 0.047 af, Depth= 0.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

Area (sf)	CN	Description
91,466	43	Woods/grass comb., Fair, HSG A
3,101	76	Gravel roads, HSG A
94,567	44	Weighted Average
94,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	445	0.1930	0.75		**Lag/CN Method,**

Summary for Subcatchment 3S:

Runoff = 2.70 cfs @ 12.54 hrs, Volume= 0.736 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	633,362	43	Woods/grass comb., Fair, HSG A
	115,260	77	Brush, Fair, HSG D
*	20,691	98	Pavement
	769,313	50	Weighted Average
	748,622		97.31% Pervious Area
	20,691		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4S:

Runoff = 0.37 cfs @ 12.64 hrs, Volume= 0.146 af, Depth= 0.30"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	246,376	43	Woods/grass comb., Fair, HSG A
*	5,892	98	Pavement
	5,843	76	Gravel roads, HSG A
	258,111	45	Weighted Average
	252,219		97.72% Pervious Area
	5,892		2.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	858	0.1330	0.73		**Lag/CN Method,**

Summary for Subcatchment 5S:

Runoff = 0.25 cfs @ 12.59 hrs, Volume= 0.086 af, Depth= 0.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	125,974	43	Woods/grass comb., Fair, HSG A
*	8,335	98	Pavement
	134,309	46	Weighted Average
	125,974		93.79% Pervious Area
	8,335		6.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	796	0.1460	0.78		**Lag/CN Method,**

Summary for Reach 9R:

Inflow Area = 5.925 ac, 2.28% Impervious, Inflow Depth = 0.30" for 10-yr event
Inflow = 0.37 cfs @ 12.64 hrs, Volume= 0.146 af
Outflow = 0.36 cfs @ 12.80 hrs, Volume= 0.146 af, Atten= 3%, Lag= 9.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Max. Velocity= 1.01 fps, Min. Travel Time= 5.7 min
Avg. Velocity = 0.62 fps, Avg. Travel Time= 9.4 min

Peak Storage= 123 cf @ 12.70 hrs
Average Depth at Peak Storage= 0.11'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 21.36 cfs

Custom cross-section, Length= 346.0' Slope= 0.0050 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 246.00', Outlet Invert= 244.27'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,076	21.36

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.348 ac, 2.40% Impervious, Inflow Depth = 0.15" for 10-yr event
Inflow = 1.06 cfs @ 12.67 hrs, Volume= 0.419 af
Outflow = 0.55 cfs @ 14.16 hrs, Volume= 0.365 af, Atten= 48%, Lag= 89.4 min
Primary = 0.55 cfs @ 14.16 hrs, Volume= 0.365 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 236.11' @ 14.16 hrs Surf.Area= 3,428 sf Storage= 3,526 cf

Plug-Flow detention time= 138.5 min calculated for 0.365 af (87% of inflow)
Center-of-Mass det. time= 84.7 min (1,113.7 - 1,029.1)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.55 cfs @ 14.16 hrs HW=236.11' (Free Discharge)
1=Culvert (Inlet Controls 0.55 cfs @ 2.07 fps)

Summary for Pond 8P:

Inflow Area = 17.661 ac, 2.69% Impervious, Inflow Depth = 0.50" for 10-yr event
Inflow = 2.70 cfs @ 12.54 hrs, Volume= 0.736 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 248.32' @ 25.50 hrs Surf.Area= 99,448 sf Storage= 32,052 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Subcatchment 1S:

Runoff = 1.34 cfs @ 12.38 hrs, Volume= 0.292 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

Area (sf)	CN	Description
174,477	43	Woods/grass comb., Fair, HSG A
21,848	76	Gravel roads, HSG A
196,325	47	Weighted Average
196,325		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	825	0.0820	0.60		**Lag/CN Method,**

Summary for Subcatchment 2S:

Runoff = 0.47 cfs @ 12.20 hrs, Volume= 0.109 af, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

Area (sf)	CN	Description
91,466	43	Woods/grass comb., Fair, HSG A
3,101	76	Gravel roads, HSG A
94,567	44	Weighted Average
94,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	445	0.1930	0.75		**Lag/CN Method,**

Summary for Subcatchment 3S:

Runoff = 7.33 cfs @ 12.40 hrs, Volume= 1.423 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	633,362	43	Woods/grass comb., Fair, HSG A
	115,260	77	Brush, Fair, HSG D
*	20,691	98	Pavement
	769,313	50	Weighted Average
	748,622		97.31% Pervious Area
	20,691		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4S:

Runoff = 1.33 cfs @ 12.38 hrs, Volume= 0.325 af, Depth= 0.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	246,376	43	Woods/grass comb., Fair, HSG A
*	5,892	98	Pavement
	5,843	76	Gravel roads, HSG A
	258,111	45	Weighted Average
	252,219		97.72% Pervious Area
	5,892		2.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	858	0.1330	0.73		**Lag/CN Method,**

Summary for Subcatchment 5S:

Runoff = 0.86 cfs @ 12.29 hrs, Volume= 0.184 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	125,974	43	Woods/grass comb., Fair, HSG A
*	8,335	98	Pavement
	134,309	46	Weighted Average
	125,974		93.79% Pervious Area
	8,335		6.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	796	0.1460	0.78		**Lag/CN Method,**

Summary for Reach 9R:

Inflow Area = 5.925 ac, 2.28% Impervious, Inflow Depth = 0.66" for 25-yr event
Inflow = 1.33 cfs @ 12.38 hrs, Volume= 0.325 af
Outflow = 1.32 cfs @ 12.50 hrs, Volume= 0.325 af, Atten= 1%, Lag= 7.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Max. Velocity= 1.57 fps, Min. Travel Time= 3.7 min
Avg. Velocity = 0.79 fps, Avg. Travel Time= 7.3 min

Peak Storage= 290 cf @ 12.44 hrs
Average Depth at Peak Storage= 0.23'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 21.36 cfs

Custom cross-section, Length= 346.0' Slope= 0.0050 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 246.00', Outlet Invert= 244.27'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,076	21.36

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.348 ac, 2.40% Impervious, Inflow Depth = 0.33" for 25-yr event
Inflow = 3.81 cfs @ 12.42 hrs, Volume= 0.910 af
Outflow = 2.48 cfs @ 12.85 hrs, Volume= 0.856 af, Atten= 35%, Lag= 25.3 min
Primary = 2.48 cfs @ 12.85 hrs, Volume= 0.856 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 236.66' @ 12.85 hrs Surf.Area= 4,028 sf Storage= 5,593 cf

Plug-Flow detention time= 74.5 min calculated for 0.856 af (94% of inflow)
Center-of-Mass det. time= 46.7 min (1,027.5 - 980.8)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.48 cfs @ 12.85 hrs HW=236.66' (Free Discharge)
1=Culvert (Inlet Controls 2.48 cfs @ 3.27 fps)

Summary for Pond 8P:

Inflow Area = 17.661 ac, 2.69% Impervious, Inflow Depth = 0.97" for 25-yr event
Inflow = 7.33 cfs @ 12.40 hrs, Volume= 1.423 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 248.62' @ 25.50 hrs Surf.Area= 100,245 sf Storage= 61,978 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Subcatchment 1S:

Runoff = 2.65 cfs @ 12.33 hrs, Volume= 0.468 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

Area (sf)	CN	Description
174,477	43	Woods/grass comb., Fair, HSG A
21,848	76	Gravel roads, HSG A
196,325	47	Weighted Average
196,325		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	825	0.0820	0.60		**Lag/CN Method,**

Summary for Subcatchment 2S:

Runoff = 1.20 cfs @ 12.13 hrs, Volume= 0.183 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

Area (sf)	CN	Description
91,466	43	Woods/grass comb., Fair, HSG A
3,101	76	Gravel roads, HSG A
94,567	44	Weighted Average
94,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	445	0.1930	0.75		**Lag/CN Method,**

Summary for Subcatchment 3S:

Runoff = 12.89 cfs @ 12.37 hrs, Volume= 2.196 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	633,362	43	Woods/grass comb., Fair, HSG A
	115,260	77	Brush, Fair, HSG D
*	20,691	98	Pavement
	769,313	50	Weighted Average
	748,622		97.31% Pervious Area
	20,691		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4S:

Runoff = 2.95 cfs @ 12.29 hrs, Volume= 0.538 af, Depth= 1.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	246,376	43	Woods/grass comb., Fair, HSG A
*	5,892	98	Pavement
	5,843	76	Gravel roads, HSG A
	258,111	45	Weighted Average
	252,219		97.72% Pervious Area
	5,892		2.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	858	0.1330	0.73		**Lag/CN Method,**

Summary for Subcatchment 5S:

Runoff = 1.83 cfs @ 12.24 hrs, Volume= 0.300 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	125,974	43	Woods/grass comb., Fair, HSG A
*	8,335	98	Pavement
	134,309	46	Weighted Average
	125,974		93.79% Pervious Area
	8,335		6.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	796	0.1460	0.78		**Lag/CN Method,**

Summary for Reach 9R:

Inflow Area = 5.925 ac, 2.28% Impervious, Inflow Depth = 1.09" for 50-yr event
Inflow = 2.95 cfs @ 12.29 hrs, Volume= 0.538 af
Outflow = 2.90 cfs @ 12.38 hrs, Volume= 0.538 af, Atten= 2%, Lag= 5.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Max. Velocity= 2.02 fps, Min. Travel Time= 2.9 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 6.3 min

Peak Storage= 498 cf @ 12.33 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 21.36 cfs

Custom cross-section, Length= 346.0' Slope= 0.0050 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 246.00', Outlet Invert= 244.27'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,076	21.36

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.348 ac, 2.40% Impervious, Inflow Depth = 0.54" for 50-yr event
Inflow = 7.99 cfs @ 12.33 hrs, Volume= 1.490 af
Outflow = 4.47 cfs @ 12.80 hrs, Volume= 1.436 af, Atten= 44%, Lag= 28.1 min
Primary = 4.47 cfs @ 12.80 hrs, Volume= 1.436 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 237.64' @ 12.80 hrs Surf.Area= 5,083 sf Storage= 10,032 cf

Plug-Flow detention time= 54.5 min calculated for 1.436 af (96% of inflow)
Center-of-Mass det. time= 36.5 min (992.4 - 955.9)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.47 cfs @ 12.80 hrs HW=237.64' (Free Discharge)
1=Culvert (Inlet Controls 4.47 cfs @ 5.70 fps)

Summary for Pond 8P:

Inflow Area = 17.661 ac, 2.69% Impervious, Inflow Depth = 1.49" for 50-yr event
Inflow = 12.89 cfs @ 12.37 hrs, Volume= 2.196 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 248.96' @ 25.50 hrs Surf.Area= 101,134 sf Storage= 95,648 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Subcatchment 1S:

Runoff = 4.54 cfs @ 12.31 hrs, Volume= 0.713 af, Depth= 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

Area (sf)	CN	Description
174,477	43	Woods/grass comb., Fair, HSG A
21,848	76	Gravel roads, HSG A
196,325	47	Weighted Average
196,325		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.9	825	0.0820	0.60		**Lag/CN Method,**

Summary for Subcatchment 2S:

Runoff = 2.33 cfs @ 12.11 hrs, Volume= 0.290 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

Area (sf)	CN	Description
91,466	43	Woods/grass comb., Fair, HSG A
3,101	76	Gravel roads, HSG A
94,567	44	Weighted Average
94,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.9	445	0.1930	0.75		**Lag/CN Method,**

Summary for Subcatchment 3S:

Runoff = 20.54 cfs @ 12.35 hrs, Volume= 3.249 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	633,362	43	Woods/grass comb., Fair, HSG A
	115,260	77	Brush, Fair, HSG D
*	20,691	98	Pavement
	769,313	50	Weighted Average
	748,622		97.31% Pervious Area
	20,691		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4S:

Runoff = 5.41 cfs @ 12.26 hrs, Volume= 0.839 af, Depth= 1.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	246,376	43	Woods/grass comb., Fair, HSG A
*	5,892	98	Pavement
	5,843	76	Gravel roads, HSG A
	258,111	45	Weighted Average
	252,219		97.72% Pervious Area
	5,892		2.28% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.5	858	0.1330	0.73		**Lag/CN Method,**

Summary for Subcatchment 5S:

Runoff = 3.24 cfs @ 12.22 hrs, Volume= 0.462 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	125,974	43	Woods/grass comb., Fair, HSG A
*	8,335	98	Pavement
	134,309	46	Weighted Average
	125,974		93.79% Pervious Area
	8,335		6.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.1	796	0.1460	0.78		**Lag/CN Method,**

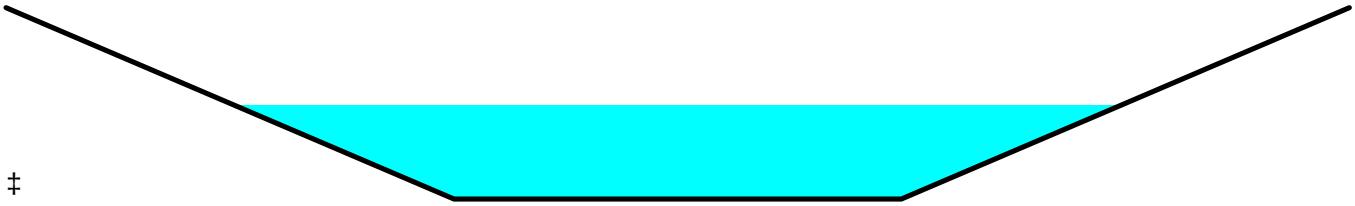
Summary for Reach 9R:

Inflow Area = 5.925 ac, 2.28% Impervious, Inflow Depth = 1.70" for 100-yr event
Inflow = 5.41 cfs @ 12.26 hrs, Volume= 0.839 af
Outflow = 5.33 cfs @ 12.34 hrs, Volume= 0.839 af, Atten= 1%, Lag= 4.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Max. Velocity= 2.42 fps, Min. Travel Time= 2.4 min
Avg. Velocity = 1.03 fps, Avg. Travel Time= 5.6 min

Peak Storage= 764 cf @ 12.30 hrs
Average Depth at Peak Storage= 0.49'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 21.36 cfs

Custom cross-section, Length= 346.0' Slope= 0.0050 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 246.00', Outlet Invert= 244.27'



‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,076	21.36

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.348 ac, 2.40% Impervious, Inflow Depth = 0.83" for 100-yr event
Inflow = 14.28 cfs @ 12.30 hrs, Volume= 2.304 af
Outflow = 6.51 cfs @ 12.83 hrs, Volume= 2.251 af, Atten= 54%, Lag= 32.1 min
Primary = 6.51 cfs @ 12.83 hrs, Volume= 2.251 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 239.20' @ 12.83 hrs Surf.Area= 6,773 sf Storage= 19,285 cf

Plug-Flow detention time= 47.7 min calculated for 2.249 af (98% of inflow)
Center-of-Mass det. time= 36.0 min (971.8 - 935.8)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=6.51 cfs @ 12.83 hrs HW=239.20' (Free Discharge)
1=Culvert (Inlet Controls 6.51 cfs @ 8.28 fps)

Summary for Pond 8P:

Inflow Area = 17.661 ac, 2.69% Impervious, Inflow Depth = 2.21" for 100-yr event
Inflow = 20.54 cfs @ 12.35 hrs, Volume= 3.249 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.03 hrs
Peak Elev= 249.41' @ 25.50 hrs Surf.Area= 102,332 sf Storage= 141,517 cf

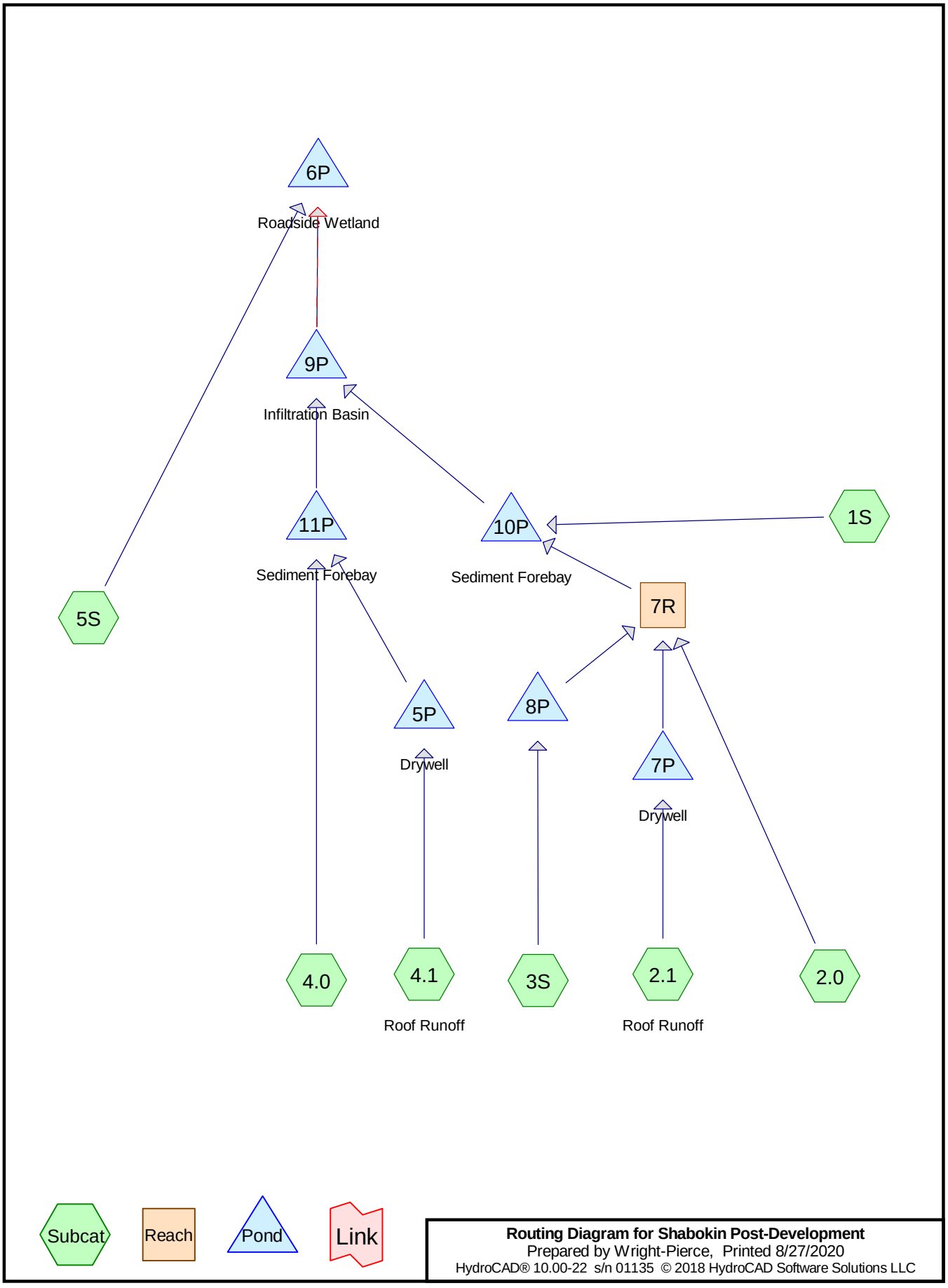
Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)



Routing Diagram for Shabokin Post-Development
Prepared by Wright-Pierce, Printed 8/27/2020

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.387	98	(2.1, 4.1, 5S)
2.646	77	Brush, Fair, HSG D (3S)
1.556	98	Pavement (1S, 2.0, 3S, 4.0)
28.759	43	Woods/grass comb., Fair, HSG A (1S, 2.0, 3S, 4.0, 5S)
33.349	**49**	**TOTAL AREA**

Summary for Subcatchment 1S:

Runoff = 0.04 cfs @ 14.63 hrs, Volume= 0.036 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	172,995	43	Woods/grass comb., Fair, HSG A
*	23,330	98	Pavement
	196,325	50	Weighted Average
	172,995		88.12% Pervious Area
	23,330		11.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	825	0.0820	0.65		**Lag/CN Method,**

Summary for Subcatchment 2.0:

Runoff = 0.02 cfs @ 15.67 hrs, Volume= 0.014 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	81,434	43	Woods/grass comb., Fair, HSG A
*	10,113	98	Pavement
	91,547	49	Weighted Average
	81,434		88.95% Pervious Area
	10,113		11.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	445	0.1930	0.86		**Lag/CN Method,**

Summary for Subcatchment 2.1: Roof Runoff

Runoff = 0.22 cfs @ 12.04 hrs, Volume= 0.016 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
*	3,020	98	
	3,020		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 3S:

Runoff = 0.17 cfs @ 14.76 hrs, Volume= 0.142 af, Depth= 0.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	633,376	43	Woods/grass comb., Fair, HSG A
	115,267	77	Brush, Fair, HSG D
*	20,712	98	Pavement
	769,355	50	Weighted Average
	748,643		97.31% Pervious Area
	20,712		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4.0:

Runoff = 0.03 cfs @ 23.75 hrs, Volume= 0.018 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	239,438	43	Woods/grass comb., Fair, HSG A
*	13,625	98	Pavement
	253,063	46	Weighted Average
	239,438		94.62% Pervious Area
	13,625		5.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	858	0.1330	0.75		**Lag/CN Method,**

Summary for Subcatchment 4.1: Roof Runoff

Runoff = 0.37 cfs @ 12.04 hrs, Volume= 0.027 af, Depth= 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
*	5,048	98	
	5,048		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 5S:

Runoff = 0.02 cfs @ 20.43 hrs, Volume= 0.013 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 2-yr Rainfall=3.03"

	Area (sf)	CN	Description
	125,508	43	Woods/grass comb., Fair, HSG A
*	8,801	98	
	134,309	47	Weighted Average
	125,508		93.45% Pervious Area
	8,801		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	795	0.1460	0.80		**Lag/CN Method,**

Summary for Reach 7R:

Inflow Area = 19.833 ac, 3.92% Impervious, Inflow Depth = 0.02" for 2-yr event
Inflow = 0.22 cfs @ 12.05 hrs, Volume= 0.026 af
Outflow = 0.14 cfs @ 12.12 hrs, Volume= 0.026 af, Atten= 35%, Lag= 4.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.66 fps, Min. Travel Time= 10.2 min
Avg. Velocity = 0.30 fps, Avg. Travel Time= 22.5 min

Peak Storage= 86 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.07'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.50 cfs

Custom cross-section, Length= 400.0' Slope= 0.0037 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 244.00', Outlet Invert= 242.50'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,400	18.50

Summary for Pond 5P: Drywell

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 2.80" for 2-yr event
Inflow = 0.37 cfs @ 12.04 hrs, Volume= 0.027 af
Outflow = 0.36 cfs @ 12.05 hrs, Volume= 0.022 af, Atten= 1%, Lag= 0.6 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.36 cfs @ 12.05 hrs, Volume= 0.022 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 248.90' @ 12.05 hrs Surf.Area= 131 sf Storage= 239 cf

Plug-Flow detention time= 163.2 min calculated for 0.022 af (82% of inflow)
Center-of-Mass det. time= 75.7 min (835.9 - 760.2)

Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	290 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 724 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
245.00	156	0	0
248.00	156	468	468
250.00	100	256	724

Device	Routing	Invert	Outlet Devices
#1	Primary	248.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	245.00'	**20.000 in/hr Exfiltration over Horizontal area above 245.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 156 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=245.00' (Free Discharge)
2=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.36 cfs @ 12.05 hrs HW=248.90' TW=244.03' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.36 cfs @ 2.15 fps)

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.349 ac, 5.83% Impervious, Inflow Depth = 0.00" for 2-yr event
Inflow = 0.02 cfs @ 20.43 hrs, Volume= 0.013 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 235.18' @ 24.95 hrs Surf.Area= 3,057 sf Storage= 557 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=235.00' (Free Discharge)
1=Culvert (Controls 0.00 cfs)

Summary for Pond 7P: Drywell

Inflow Area = 0.069 ac,100.00% Impervious, Inflow Depth = 2.80" for 2-yr event
Inflow = 0.22 cfs @ 12.04 hrs, Volume= 0.016 af
Outflow = 0.22 cfs @ 12.05 hrs, Volume= 0.012 af, Atten= 1%, Lag= 0.6 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.22 cfs @ 12.05 hrs, Volume= 0.012 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.29' @ 12.05 hrs Surf.Area= 121 sf Storage= 196 cf

Plug-Flow detention time= 199.9 min calculated for 0.012 af (74% of inflow)

Center-of-Mass det. time= 93.6 min (853.9 - 760.2)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 600 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
246.00	150	0	0
249.00	150	450	450
250.00	50	100	550
251.00	50	50	600

Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	246.00'	**20.000 in/hr Exfiltration over Horizontal area above 246.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 150 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=246.00' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.22 cfs @ 12.05 hrs HW=249.29' TW=244.06' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.22 cfs @ 1.84 fps)

Summary for Pond 8P:

Inflow Area = 17.662 ac, 2.69% Impervious, Inflow Depth = 0.10" for 2-yr event
Inflow = 0.17 cfs @ 14.76 hrs, Volume= 0.142 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 248.06' @ 25.47 hrs Surf.Area= 98,754 sf Storage= 6,167 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' TW=244.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 9P: Infiltration Basin

Inflow Area = 30.265 ac, 5.75% Impervious, Inflow Depth = 0.04" for 2-yr event
Inflow = 0.46 cfs @ 12.07 hrs, Volume= 0.098 af
Outflow = 0.12 cfs @ 12.52 hrs, Volume= 0.098 af, Atten= 74%, Lag= 27.2 min
Discarded = 0.12 cfs @ 12.52 hrs, Volume= 0.098 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 241.67' @ 12.52 hrs Surf.Area= 642 sf Storage= 348 cf

Plug-Flow detention time= 46.2 min calculated for 0.098 af (100% of inflow)
Center-of-Mass det. time= 46.2 min (1,102.6 - 1,056.4)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	8,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	400	0	0
242.50	943	1,007	1,007
244.00	1,647	1,943	2,950
245.00	10,000	5,824	8,773

Device	Routing	Invert	Outlet Devices
#1	Secondary	244.00'	**6.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	243.50'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	241.00'	**20.000 in/hr Exfiltration over Horizontal area above 241.00'** Conductivity to Groundwater Elevation = 237.00' Excluded Horizontal area = 400 sf

Discarded OutFlow Max=0.12 cfs @ 12.52 hrs HW=241.67' (Free Discharge)
↑—**3=Exfiltration** (Controls 0.12 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=241.00' TW=235.00' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=241.00' TW=235.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond 10P: Sediment Forebay

Inflow Area = 24.340 ac, 5.39% Impervious, Inflow Depth = 0.03" for 2-yr event
Inflow = 0.14 cfs @ 12.12 hrs, Volume= 0.062 af
Outflow = 0.13 cfs @ 12.14 hrs, Volume= 0.062 af, Atten= 6%, Lag= 1.1 min
Primary = 0.13 cfs @ 12.14 hrs, Volume= 0.062 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 241.75' @ 12.22 hrs Surf.Area= 75 sf Storage= 37 cf

Plug-Flow detention time= 9.4 min calculated for 0.062 af (99% of inflow)
Center-of-Mass det. time= 6.1 min (1,069.7 - 1,063.6)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	9,406 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	25	0	0
243.00	160	185	185
244.00	796	478	663
245.00	1,545	1,171	1,834
246.00	1,800	1,673	3,506
247.00	10,000	5,900	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	241.50'	**15.0" Round Culvert** L= 98.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.50' / 241.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=0.13 cfs @ 12.14 hrs HW=241.73' TW=241.47' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.13 cfs @ 1.23 fps)

Summary for Pond 11P: Sediment Forebay

Inflow Area = 5.925 ac, 7.23% Impervious, Inflow Depth = 0.08" for 2-yr event
Inflow = 0.36 cfs @ 12.05 hrs, Volume= 0.040 af
Outflow = 0.36 cfs @ 12.06 hrs, Volume= 0.036 af, Atten= 1%, Lag= 0.6 min
Primary = 0.36 cfs @ 12.06 hrs, Volume= 0.036 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.03' @ 12.06 hrs Surf.Area= 598 sf Storage= 196 cf

Plug-Flow detention time= 84.9 min calculated for 0.036 af (90% of inflow)
Center-of-Mass det. time= 37.3 min (1,033.7 - 996.5)

Volume	Invert	Avail.Storage	Storage Description
#1	243.00'	5,318 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
243.00	90	0	0
244.00	273	182	182
245.00	10,000	5,137	5,318

Device	Routing	Invert	Outlet Devices
#1	Primary	244.00'	**25.0' long x 4.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.36 2.52 2.70 2.68 2.67 2.67 2.65 2.66 2.66 2.67 2.70 2.70 2.72 2.75 2.81 2.93 3.10

Primary OutFlow Max=0.36 cfs @ 12.06 hrs HW=244.03' TW=241.28' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.36 cfs @ 0.43 fps)

Summary for Subcatchment 1S:

Runoff = 0.73 cfs @ 12.42 hrs, Volume= 0.188 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	172,995	43	Woods/grass comb., Fair, HSG A
*	23,330	98	Pavement
	196,325	50	Weighted Average
	172,995		88.12% Pervious Area
	23,330		11.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	825	0.0820	0.65		**Lag/CN Method,**

Summary for Subcatchment 2.0:

Runoff = 0.34 cfs @ 12.18 hrs, Volume= 0.080 af, Depth= 0.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	81,434	43	Woods/grass comb., Fair, HSG A
*	10,113	98	Pavement
	91,547	49	Weighted Average
	81,434		88.95% Pervious Area
	10,113		11.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	445	0.1930	0.86		**Lag/CN Method,**

Summary for Subcatchment 2.1: Roof Runoff

Runoff = 0.31 cfs @ 12.04 hrs, Volume= 0.025 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	3,020	98	
	3,020		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 3S:

Runoff = 2.71 cfs @ 12.55 hrs, Volume= 0.736 af, Depth= 0.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	633,376	43	Woods/grass comb., Fair, HSG A
	115,267	77	Brush, Fair, HSG D
*	20,712	98	Pavement
	769,355	50	Weighted Average
	748,643		97.31% Pervious Area
	20,712		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4.0:

Runoff = 0.46 cfs @ 12.61 hrs, Volume= 0.161 af, Depth= 0.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	239,438	43	Woods/grass comb., Fair, HSG A
*	13,625	98	Pavement
	253,063	46	Weighted Average
	239,438		94.62% Pervious Area
	13,625		5.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	858	0.1330	0.75		**Lag/CN Method,**

Summary for Subcatchment 4.1: Roof Runoff

Runoff = 0.51 cfs @ 12.04 hrs, Volume= 0.041 af, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
*	5,048	98	
	5,048		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 5S:

Runoff = 0.30 cfs @ 12.56 hrs, Volume= 0.096 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 10-yr Rainfall=4.50"

	Area (sf)	CN	Description
	125,508	43	Woods/grass comb., Fair, HSG A
*	8,801	98	
	134,309	47	Weighted Average
	125,508		93.45% Pervious Area
	8,801		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	795	0.1460	0.80		**Lag/CN Method,**

Summary for Reach 7R:

Inflow Area = 19.833 ac, 3.92% Impervious, Inflow Depth = 0.06" for 10-yr event
Inflow = 0.50 cfs @ 12.11 hrs, Volume= 0.100 af
Outflow = 0.45 cfs @ 12.22 hrs, Volume= 0.100 af, Atten= 11%, Lag= 6.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.99 fps, Min. Travel Time= 6.7 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 15.3 min

Peak Storage= 181 cf @ 12.22 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.50 cfs

Custom cross-section, Length= 400.0' Slope= 0.0037 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 244.00', Outlet Invert= 242.50'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,400	18.50

Summary for Pond 5P: Drywell

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.51 cfs @ 12.04 hrs, Volume= 0.041 af
Outflow = 0.50 cfs @ 12.05 hrs, Volume= 0.036 af, Atten= 2%, Lag= 0.8 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.50 cfs @ 12.05 hrs, Volume= 0.036 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.03' @ 12.05 hrs Surf.Area= 127 sf Storage= 245 cf

Plug-Flow detention time= 126.7 min calculated for 0.036 af (88% of inflow)
Center-of-Mass det. time= 60.6 min (811.9 - 751.3)

Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	290 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 724 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
245.00	156	0	0
248.00	156	468	468
250.00	100	256	724

Device	Routing	Invert	Outlet Devices
#1	Primary	248.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	245.00'	**20.000 in/hr Exfiltration over Horizontal area above 245.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 156 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=245.00' (Free Discharge)
2=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.50 cfs @ 12.05 hrs HW=249.03' TW=244.04' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.50 cfs @ 2.53 fps)

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.349 ac, 5.83% Impervious, Inflow Depth = 0.04" for 10-yr event
Inflow = 0.79 cfs @ 12.78 hrs, Volume= 0.123 af
Outflow = 0.09 cfs @ 16.21 hrs, Volume= 0.069 af, Atten= 88%, Lag= 205.4 min
Primary = 0.09 cfs @ 16.21 hrs, Volume= 0.069 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 235.89' @ 16.21 hrs Surf.Area= 3,273 sf Storage= 2,777 cf

Plug-Flow detention time= 390.9 min calculated for 0.069 af (56% of inflow)
Center-of-Mass det. time= 230.6 min (1,189.8 - 959.2)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=0.09 cfs @ 16.21 hrs HW=235.89' (Free Discharge)
1=Culvert (Inlet Controls 0.09 cfs @ 1.30 fps)

Summary for Pond 7P: Drywell

Inflow Area = 0.069 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.31 cfs @ 12.04 hrs, Volume= 0.025 af
Outflow = 0.30 cfs @ 12.04 hrs, Volume= 0.021 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.30 cfs @ 12.04 hrs, Volume= 0.021 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.35' @ 12.04 hrs Surf.Area= 115 sf Storage= 199 cf

Plug-Flow detention time= 160.1 min calculated for 0.021 af (83% of inflow)

Center-of-Mass det. time= 76.5 min (827.9 - 751.3)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 600 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
246.00	150	0	0
249.00	150	450	450
250.00	50	100	550
251.00	50	50	600

Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	246.00'	**20.000 in/hr Exfiltration over Horizontal area above 246.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 150 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=246.00' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.30 cfs @ 12.04 hrs HW=249.35' TW=244.08' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.30 cfs @ 2.03 fps)

Summary for Pond 8P:

Inflow Area = 17.662 ac, 2.69% Impervious, Inflow Depth = 0.50" for 10-yr event
Inflow = 2.71 cfs @ 12.55 hrs, Volume= 0.736 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 248.32' @ 25.47 hrs Surf.Area= 99,448 sf Storage= 32,056 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' TW=244.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 9P: Infiltration Basin

Inflow Area = 30.265 ac, 5.75% Impervious, Inflow Depth = 0.19" for 10-yr event
Inflow = 1.46 cfs @ 12.42 hrs, Volume= 0.481 af
Outflow = 1.18 cfs @ 12.80 hrs, Volume= 0.481 af, Atten= 19%, Lag= 22.9 min
Discarded = 0.61 cfs @ 12.80 hrs, Volume= 0.453 af
Primary = 0.57 cfs @ 12.80 hrs, Volume= 0.028 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 243.61' @ 12.80 hrs Surf.Area= 1,464 sf Storage= 2,344 cf

Plug-Flow detention time= 55.9 min calculated for 0.481 af (100% of inflow)
Center-of-Mass det. time= 55.9 min (1,047.5 - 991.6)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	8,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	400	0	0
242.50	943	1,007	1,007
244.00	1,647	1,943	2,950
245.00	10,000	5,824	8,773

Device	Routing	Invert	Outlet Devices
#1	Secondary	244.00'	**6.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	243.50'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	241.00'	**20.000 in/hr Exfiltration over Horizontal area above 241.00'** Conductivity to Groundwater Elevation = 237.00' Excluded Horizontal area = 400 sf

Discarded OutFlow Max=0.61 cfs @ 12.80 hrs HW=243.61' (Free Discharge)
3=Exfiltration (Controls 0.61 cfs)

Primary OutFlow Max=0.57 cfs @ 12.80 hrs HW=243.61' TW=235.27' (Dynamic Tailwater)
2=Orifice/Grate (Weir Controls 0.57 cfs @ 1.09 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=241.00' TW=235.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 10P: Sediment Forebay

Inflow Area = 24.340 ac, 5.39% Impervious, Inflow Depth = 0.14" for 10-yr event
Inflow = 1.12 cfs @ 12.37 hrs, Volume= 0.288 af
Outflow = 0.98 cfs @ 12.37 hrs, Volume= 0.288 af, Atten= 12%, Lag= 0.0 min
Primary = 0.98 cfs @ 12.37 hrs, Volume= 0.288 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 243.64' @ 12.80 hrs Surf.Area= 565 sf Storage= 416 cf

Plug-Flow detention time= 12.6 min calculated for 0.288 af (100% of inflow)
Center-of-Mass det. time= 11.6 min (991.2 - 979.6)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	9,406 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	25	0	0
243.00	160	185	185
244.00	796	478	663
245.00	1,545	1,171	1,834
246.00	1,800	1,673	3,506
247.00	10,000	5,900	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	241.50'	**15.0" Round Culvert** L= 98.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.50' / 241.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=0.53 cfs @ 12.37 hrs HW=242.84' TW=242.83' (Dynamic Tailwater)
↑—**1=Culvert** (Outlet Controls 0.53 cfs @ 0.50 fps)

Summary for Pond 11P: Sediment Forebay

Inflow Area = 5.925 ac, 7.23% Impervious, Inflow Depth = 0.40" for 10-yr event
Inflow = 0.54 cfs @ 12.56 hrs, Volume= 0.198 af
Outflow = 0.54 cfs @ 12.56 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.5 min
Primary = 0.54 cfs @ 12.56 hrs, Volume= 0.193 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.04' @ 12.56 hrs Surf.Area= 700 sf Storage= 203 cf

Plug-Flow detention time= 19.2 min calculated for 0.193 af (98% of inflow)
Center-of-Mass det. time= 9.3 min (992.2 - 982.8)

Volume	Invert	Avail.Storage	Storage Description
#1	243.00'	5,318 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
243.00	90	0	0
244.00	273	182	182
245.00	10,000	5,137	5,318

Device	Routing	Invert	Outlet Devices
#1	Primary	244.00'	**25.0' long x 4.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.36 2.52 2.70 2.68 2.67 2.67 2.65 2.66 2.66 2.67 2.70 2.70 2.72 2.75 2.81 2.93 3.10

Primary OutFlow Max=0.54 cfs @ 12.56 hrs HW=244.04' TW=243.38' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.54 cfs @ 0.49 fps)

Summary for Subcatchment 1S:

Runoff = 2.05 cfs @ 12.32 hrs, Volume= 0.363 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	172,995	43	Woods/grass comb., Fair, HSG A
*	23,330	98	Pavement
	196,325	50	Weighted Average
	172,995		88.12% Pervious Area
	23,330		11.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	825	0.0820	0.65		**Lag/CN Method,**

Summary for Subcatchment 2.0:

Runoff = 1.17 cfs @ 12.10 hrs, Volume= 0.158 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	81,434	43	Woods/grass comb., Fair, HSG A
*	10,113	98	Pavement
	91,547	49	Weighted Average
	81,434		88.95% Pervious Area
	10,113		11.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	445	0.1930	0.86		**Lag/CN Method,**

Summary for Subcatchment 2.1: Roof Runoff

Runoff = 0.37 cfs @ 12.04 hrs, Volume= 0.031 af, Depth= 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
*	3,020	98	
	3,020		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 3S:

Runoff = 7.33 cfs @ 12.39 hrs, Volume= 1.423 af, Depth= 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	633,376	43	Woods/grass comb., Fair, HSG A
	115,267	77	Brush, Fair, HSG D
*	20,712	98	Pavement
	769,355	50	Weighted Average
	748,643		97.31% Pervious Area
	20,712		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4.0:

Runoff = 1.57 cfs @ 12.33 hrs, Volume= 0.347 af, Depth= 0.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	239,438	43	Woods/grass comb., Fair, HSG A
*	13,625	98	Pavement
	253,063	46	Weighted Average
	239,438		94.62% Pervious Area
	13,625		5.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	858	0.1330	0.75		**Lag/CN Method,**

Summary for Subcatchment 4.1: Roof Runoff

Runoff = 0.62 cfs @ 12.04 hrs, Volume= 0.052 af, Depth= 5.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
*	5,048	98	
	5,048		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 5S:

Runoff = 1.02 cfs @ 12.26 hrs, Volume= 0.200 af, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 25-yr Rainfall=5.63"

	Area (sf)	CN	Description
	125,508	43	Woods/grass comb., Fair, HSG A
*	8,801	98	
	134,309	47	Weighted Average
	125,508		93.45% Pervious Area
	8,801		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	795	0.1460	0.80		**Lag/CN Method,**

Summary for Reach 7R:

Inflow Area = 19.833 ac, 3.92% Impervious, Inflow Depth = 0.11" for 25-yr event
Inflow = 1.47 cfs @ 12.08 hrs, Volume= 0.185 af
Outflow = 1.28 cfs @ 12.15 hrs, Volume= 0.185 af, Atten= 13%, Lag= 4.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.41 fps, Min. Travel Time= 4.7 min
Avg. Velocity = 0.51 fps, Avg. Travel Time= 13.2 min

Peak Storage= 362 cf @ 12.15 hrs
Average Depth at Peak Storage= 0.24'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.50 cfs

Custom cross-section, Length= 400.0' Slope= 0.0037 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 244.00', Outlet Invert= 242.50'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,400	18.50

Summary for Pond 5P: Drywell

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 5.39" for 25-yr event
Inflow = 0.62 cfs @ 12.04 hrs, Volume= 0.052 af
Outflow = 0.60 cfs @ 12.05 hrs, Volume= 0.047 af, Atten= 3%, Lag= 0.9 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.60 cfs @ 12.05 hrs, Volume= 0.047 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.15' @ 12.05 hrs Surf.Area= 124 sf Storage= 252 cf

Plug-Flow detention time= 107.3 min calculated for 0.047 af (90% of inflow)
Center-of-Mass det. time= 52.2 min (799.3 - 747.1)

Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	290 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 724 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
245.00	156	0	0
248.00	156	468	468
250.00	100	256	724

Device	Routing	Invert	Outlet Devices
#1	Primary	248.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	245.00'	**20.000 in/hr Exfiltration over Horizontal area above 245.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 156 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=245.00' (Free Discharge)
2=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.60 cfs @ 12.05 hrs HW=249.15' TW=244.05' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.60 cfs @ 3.04 fps)

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.349 ac, 5.83% Impervious, Inflow Depth = 0.18" for 25-yr event
Inflow = 4.50 cfs @ 12.42 hrs, Volume= 0.510 af
Outflow = 2.62 cfs @ 12.82 hrs, Volume= 0.456 af, Atten= 42%, Lag= 24.4 min
Primary = 2.62 cfs @ 12.82 hrs, Volume= 0.456 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 236.71' @ 12.82 hrs Surf.Area= 4,081 sf Storage= 5,791 cf

Plug-Flow detention time= 100.0 min calculated for 0.455 af (89% of inflow)
Center-of-Mass det. time= 52.0 min (919.9 - 867.9)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=2.62 cfs @ 12.82 hrs HW=236.71' (Free Discharge)
1=Culvert (Inlet Controls 2.62 cfs @ 3.36 fps)

Summary for Pond 7P: Drywell

Inflow Area = 0.069 ac,100.00% Impervious, Inflow Depth = 5.39" for 25-yr event
Inflow = 0.37 cfs @ 12.04 hrs, Volume= 0.031 af
Outflow = 0.36 cfs @ 12.04 hrs, Volume= 0.027 af, Atten= 1%, Lag= 0.5 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.36 cfs @ 12.04 hrs, Volume= 0.027 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.40' @ 12.04 hrs Surf.Area= 110 sf Storage= 201 cf

Plug-Flow detention time= 138.1 min calculated for 0.027 af (87% of inflow)

Center-of-Mass det. time= 67.0 min (814.0 - 747.1)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 600 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
246.00	150	0	0
249.00	150	450	450
250.00	50	100	550
251.00	50	50	600

Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	246.00'	**20.000 in/hr Exfiltration over Horizontal area above 246.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 150 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=246.00' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.36 cfs @ 12.04 hrs HW=249.40' TW=244.17' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.36 cfs @ 2.16 fps)

Summary for Pond 8P:

Inflow Area = 17.662 ac, 2.69% Impervious, Inflow Depth = 0.97" for 25-yr event
Inflow = 7.33 cfs @ 12.39 hrs, Volume= 1.423 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 248.62' @ 25.47 hrs Surf.Area= 100,245 sf Storage= 61,982 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' TW=244.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 9P: Infiltration Basin

Inflow Area = 30.265 ac, 5.75% Impervious, Inflow Depth = 0.37" for 25-yr event
Inflow = 4.33 cfs @ 12.40 hrs, Volume= 0.938 af
Outflow = 4.30 cfs @ 12.44 hrs, Volume= 0.938 af, Atten= 1%, Lag= 2.4 min
Discarded = 0.70 cfs @ 12.44 hrs, Volume= 0.628 af
Primary = 3.60 cfs @ 12.44 hrs, Volume= 0.310 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 243.88' @ 12.44 hrs Surf.Area= 1,590 sf Storage= 2,755 cf

Plug-Flow detention time= 41.3 min calculated for 0.937 af (100% of inflow)
Center-of-Mass det. time= 41.3 min (1,000.7 - 959.4)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	8,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	400	0	0
242.50	943	1,007	1,007
244.00	1,647	1,943	2,950
245.00	10,000	5,824	8,773

Device	Routing	Invert	Outlet Devices
#1	Secondary	244.00'	**6.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	243.50'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	241.00'	**20.000 in/hr Exfiltration over Horizontal area above 241.00'** Conductivity to Groundwater Elevation = 237.00' Excluded Horizontal area = 400 sf

Discarded OutFlow Max=0.70 cfs @ 12.44 hrs HW=243.88' (Free Discharge)
3=Exfiltration (Controls 0.70 cfs)

Primary OutFlow Max=3.60 cfs @ 12.44 hrs HW=243.88' TW=236.02' (Dynamic Tailwater)
2=Orifice/Grate (Weir Controls 3.60 cfs @ 2.01 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=241.00' TW=235.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 10P: Sediment Forebay

Inflow Area = 24.340 ac, 5.39% Impervious, Inflow Depth = 0.27" for 25-yr event
Inflow = 3.07 cfs @ 12.27 hrs, Volume= 0.548 af
Outflow = 2.65 cfs @ 12.42 hrs, Volume= 0.548 af, Atten= 14%, Lag= 9.2 min
Primary = 2.65 cfs @ 12.42 hrs, Volume= 0.548 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.20' @ 12.43 hrs Surf.Area= 947 sf Storage= 839 cf

Plug-Flow detention time= 11.4 min calculated for 0.547 af (100% of inflow)
Center-of-Mass det. time= 10.9 min (959.2 - 948.3)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	9,406 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	25	0	0
243.00	160	185	185
244.00	796	478	663
245.00	1,545	1,171	1,834
246.00	1,800	1,673	3,506
247.00	10,000	5,900	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	241.50'	**15.0" Round Culvert** L= 98.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.50' / 241.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=2.65 cfs @ 12.42 hrs HW=244.20' TW=243.88' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 2.65 cfs @ 2.16 fps)

Summary for Pond 11P: Sediment Forebay

Inflow Area = 5.925 ac, 7.23% Impervious, Inflow Depth = 0.80" for 25-yr event
Inflow = 1.74 cfs @ 12.31 hrs, Volume= 0.394 af
Outflow = 1.74 cfs @ 12.32 hrs, Volume= 0.390 af, Atten= 0%, Lag= 0.8 min
Primary = 1.74 cfs @ 12.32 hrs, Volume= 0.390 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.10' @ 12.32 hrs Surf.Area= 1,201 sf Storage= 252 cf

Plug-Flow detention time= 10.8 min calculated for 0.390 af (99% of inflow)
Center-of-Mass det. time= 5.4 min (959.6 - 954.3)

Volume	Invert	Avail.Storage	Storage Description
#1	243.00'	5,318 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
243.00	90	0	0
244.00	273	182	182
245.00	10,000	5,137	5,318

Device	Routing	Invert	Outlet Devices
#1	Primary	244.00'	**25.0' long x 4.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.36 2.52 2.70 2.68 2.67 2.67 2.65 2.66 2.66 2.67 2.70 2.70 2.72 2.75 2.81 2.93 3.10

Primary OutFlow Max=1.74 cfs @ 12.32 hrs HW=244.10' TW=243.84' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 1.74 cfs @ 0.73 fps)

Summary for Subcatchment 1S:

Runoff = 3.61 cfs @ 12.28 hrs, Volume= 0.560 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	172,995	43	Woods/grass comb., Fair, HSG A
*	23,330	98	Pavement
	196,325	50	Weighted Average
	172,995		88.12% Pervious Area
	23,330		11.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	825	0.0820	0.65		**Lag/CN Method,**

Summary for Subcatchment 2.0:

Runoff = 2.19 cfs @ 12.09 hrs, Volume= 0.247 af, Depth= 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	81,434	43	Woods/grass comb., Fair, HSG A
*	10,113	98	Pavement
	91,547	49	Weighted Average
	81,434		88.95% Pervious Area
	10,113		11.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	445	0.1930	0.86		**Lag/CN Method,**

Summary for Subcatchment 2.1: Roof Runoff

Runoff = 0.42 cfs @ 12.04 hrs, Volume= 0.037 af, Depth= 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
*	3,020	98	
	3,020		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 3S:

Runoff = 12.90 cfs @ 12.38 hrs, Volume= 2.196 af, Depth= 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	633,376	43	Woods/grass comb., Fair, HSG A
	115,267	77	Brush, Fair, HSG D
*	20,712	98	Pavement
	769,355	50	Weighted Average
	748,643		97.31% Pervious Area
	20,712		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4.0:

Runoff = 3.31 cfs @ 12.27 hrs, Volume= 0.565 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	239,438	43	Woods/grass comb., Fair, HSG A
*	13,625	98	Pavement
	253,063	46	Weighted Average
	239,438		94.62% Pervious Area
	13,625		5.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	858	0.1330	0.75		**Lag/CN Method,**

Summary for Subcatchment 4.1: Roof Runoff

Runoff = 0.71 cfs @ 12.04 hrs, Volume= 0.062 af, Depth= 6.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
*	5,048	98	
	5,048		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 5S:

Runoff = 2.07 cfs @ 12.23 hrs, Volume= 0.320 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 50-yr Rainfall=6.68"

	Area (sf)	CN	Description
	125,508	43	Woods/grass comb., Fair, HSG A
*	8,801	98	
	134,309	47	Weighted Average
	125,508		93.45% Pervious Area
	8,801		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	795	0.1460	0.80		**Lag/CN Method,**

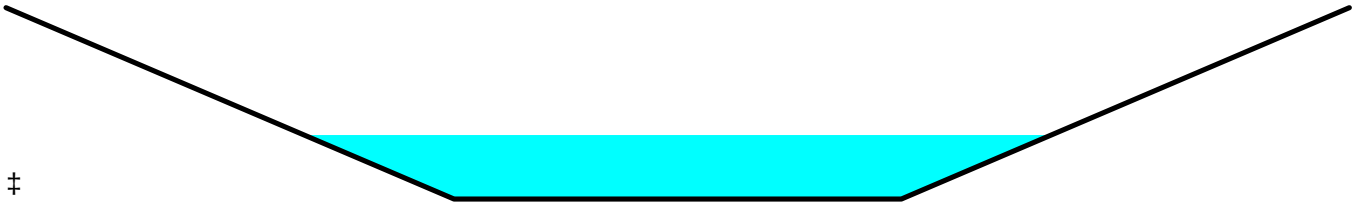
Summary for Reach 7R:

Inflow Area = 19.833 ac, 3.92% Impervious, Inflow Depth = 0.17" for 50-yr event
Inflow = 2.56 cfs @ 12.08 hrs, Volume= 0.280 af
Outflow = 2.29 cfs @ 12.13 hrs, Volume= 0.280 af, Atten= 11%, Lag= 3.2 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.70 fps, Min. Travel Time= 3.9 min
Avg. Velocity = 0.56 fps, Avg. Travel Time= 12.0 min

Peak Storage= 539 cf @ 12.13 hrs
Average Depth at Peak Storage= 0.34'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.50 cfs

Custom cross-section, Length= 400.0' Slope= 0.0037 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 244.00', Outlet Invert= 242.50'



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Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,400	18.50

Summary for Pond 5P: Drywell

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 6.44" for 50-yr event
Inflow = 0.71 cfs @ 12.04 hrs, Volume= 0.062 af
Outflow = 0.68 cfs @ 12.05 hrs, Volume= 0.057 af, Atten= 3%, Lag= 1.0 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.68 cfs @ 12.05 hrs, Volume= 0.057 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.27' @ 12.05 hrs Surf.Area= 120 sf Storage= 258 cf

Plug-Flow detention time= 94.1 min calculated for 0.057 af (92% of inflow)
Center-of-Mass det. time= 46.3 min (790.5 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	290 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 724 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
245.00	156	0	0
248.00	156	468	468
250.00	100	256	724

Device	Routing	Invert	Outlet Devices
#1	Primary	248.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	245.00'	**20.000 in/hr Exfiltration over Horizontal area above 245.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 156 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=245.00' (Free Discharge)
2=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.68 cfs @ 12.05 hrs HW=249.27' TW=244.09' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.68 cfs @ 3.48 fps)

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.349 ac, 5.83% Impervious, Inflow Depth = 0.39" for 50-yr event
Inflow = 8.50 cfs @ 12.32 hrs, Volume= 1.075 af
Outflow = 4.75 cfs @ 12.83 hrs, Volume= 1.021 af, Atten= 44%, Lag= 31.0 min
Primary = 4.75 cfs @ 12.83 hrs, Volume= 1.021 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 237.82' @ 12.83 hrs Surf.Area= 5,273 sf Storage= 10,942 cf

Plug-Flow detention time= 64.1 min calculated for 1.021 af (95% of inflow)
Center-of-Mass det. time= 38.7 min (913.0 - 874.3)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=4.75 cfs @ 12.83 hrs HW=237.82' (Free Discharge)
1=Culvert (Inlet Controls 4.75 cfs @ 6.04 fps)

Summary for Pond 7P: Drywell

Inflow Area = 0.069 ac,100.00% Impervious, Inflow Depth = 6.44" for 50-yr event
Inflow = 0.42 cfs @ 12.04 hrs, Volume= 0.037 af
Outflow = 0.42 cfs @ 12.05 hrs, Volume= 0.033 af, Atten= 1%, Lag= 0.6 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.42 cfs @ 12.05 hrs, Volume= 0.033 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.45' @ 12.05 hrs Surf.Area= 105 sf Storage= 203 cf

Plug-Flow detention time= 122.5 min calculated for 0.033 af (89% of inflow)

Center-of-Mass det. time= 60.0 min (804.2 - 744.2)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 600 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
246.00	150	0	0
249.00	150	450	450
250.00	50	100	550
251.00	50	50	600

Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	246.00'	**20.000 in/hr Exfiltration over Horizontal area above 246.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 150 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=246.00' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.42 cfs @ 12.05 hrs HW=249.44' TW=244.27' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.42 cfs @ 2.27 fps)

Summary for Pond 8P:

Inflow Area = 17.662 ac, 2.69% Impervious, Inflow Depth = 1.49" for 50-yr event
Inflow = 12.90 cfs @ 12.38 hrs, Volume= 2.196 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 248.96' @ 25.47 hrs Surf.Area= 101,134 sf Storage= 95,656 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' TW=244.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 9P: Infiltration Basin

Inflow Area = 30.265 ac, 5.75% Impervious, Inflow Depth = 0.58" for 50-yr event
Inflow = 7.78 cfs @ 12.33 hrs, Volume= 1.458 af
Outflow = 7.73 cfs @ 12.38 hrs, Volume= 1.458 af, Atten= 1%, Lag= 2.6 min
Discarded = 1.02 cfs @ 12.38 hrs, Volume= 0.703 af
Primary = 6.42 cfs @ 12.38 hrs, Volume= 0.749 af
Secondary = 0.28 cfs @ 12.38 hrs, Volume= 0.006 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.07' @ 12.38 hrs Surf.Area= 2,233 sf Storage= 3,086 cf

Plug-Flow detention time= 29.9 min calculated for 1.458 af (100% of inflow)
Center-of-Mass det. time= 29.9 min (970.2 - 940.3)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	8,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	400	0	0
242.50	943	1,007	1,007
244.00	1,647	1,943	2,950
245.00	10,000	5,824	8,773

Device	Routing	Invert	Outlet Devices
#1	Secondary	244.00'	**6.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	243.50'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	241.00'	**20.000 in/hr Exfiltration over Horizontal area above 241.00'** Conductivity to Groundwater Elevation = 237.00' Excluded Horizontal area = 400 sf

Discarded OutFlow Max=1.02 cfs @ 12.38 hrs HW=244.07' (Free Discharge)
3=Exfiltration (Controls 1.02 cfs)

Primary OutFlow Max=6.42 cfs @ 12.38 hrs HW=244.07' TW=236.88' (Dynamic Tailwater)
2=Orifice/Grate (Orifice Controls 6.42 cfs @ 3.64 fps)

Secondary OutFlow Max=0.28 cfs @ 12.38 hrs HW=244.07' TW=236.88' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Weir Controls 0.28 cfs @ 0.67 fps)

Summary for Pond 10P: Sediment Forebay

Inflow Area = 24.340 ac, 5.39% Impervious, Inflow Depth = 0.41" for 50-yr event
Inflow = 5.35 cfs @ 12.23 hrs, Volume= 0.840 af
Outflow = 4.49 cfs @ 12.41 hrs, Volume= 0.840 af, Atten= 16%, Lag= 10.6 min
Primary = 4.49 cfs @ 12.41 hrs, Volume= 0.840 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 245.00' @ 12.40 hrs Surf.Area= 1,543 sf Storage= 1,829 cf

Plug-Flow detention time= 9.9 min calculated for 0.840 af (100% of inflow)
Center-of-Mass det. time= 9.5 min (940.0 - 930.5)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	9,406 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	25	0	0
243.00	160	185	185
244.00	796	478	663
245.00	1,545	1,171	1,834
246.00	1,800	1,673	3,506
247.00	10,000	5,900	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	241.50'	**15.0" Round Culvert** L= 98.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.50' / 241.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=4.49 cfs @ 12.41 hrs HW=245.00' TW=244.07' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 4.49 cfs @ 3.66 fps)

Summary for Pond 11P: Sediment Forebay

Inflow Area = 5.925 ac, 7.23% Impervious, Inflow Depth = 1.26" for 50-yr event
Inflow = 3.55 cfs @ 12.27 hrs, Volume= 0.623 af
Outflow = 3.48 cfs @ 12.28 hrs, Volume= 0.618 af, Atten= 2%, Lag= 1.0 min
Primary = 3.48 cfs @ 12.28 hrs, Volume= 0.618 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.16' @ 12.32 hrs Surf.Area= 1,834 sf Storage= 351 cf

Plug-Flow detention time= 7.5 min calculated for 0.618 af (99% of inflow)
Center-of-Mass det. time= 3.9 min (940.6 - 936.7)

Volume	Invert	Avail.Storage	Storage Description
#1	243.00'	5,318 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
243.00	90	0	0
244.00	273	182	182
245.00	10,000	5,137	5,318

Device	Routing	Invert	Outlet Devices
#1	Primary	244.00'	**25.0' long x 4.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.36 2.52 2.70 2.68 2.67 2.67 2.65 2.66 2.66 2.67 2.70 2.70 2.72 2.75 2.81 2.93 3.10

Primary OutFlow Max=3.44 cfs @ 12.28 hrs HW=244.16' TW=244.05' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 3.44 cfs @ 0.87 fps)

Summary for Subcatchment 1S:

Runoff = 5.76 cfs @ 12.27 hrs, Volume= 0.829 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	172,995	43	Woods/grass comb., Fair, HSG A
*	23,330	98	Pavement
	196,325	50	Weighted Average
	172,995		88.12% Pervious Area
	23,330		11.88% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.2	825	0.0820	0.65		**Lag/CN Method,**

Summary for Subcatchment 2.0:

Runoff = 3.58 cfs @ 12.08 hrs, Volume= 0.368 af, Depth= 2.10"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	81,434	43	Woods/grass comb., Fair, HSG A
*	10,113	98	Pavement
	91,547	49	Weighted Average
	81,434		88.95% Pervious Area
	10,113		11.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.7	445	0.1930	0.86		**Lag/CN Method,**

Summary for Subcatchment 2.1: Roof Runoff

Runoff = 0.49 cfs @ 12.04 hrs, Volume= 0.044 af, Depth= 7.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
*	3,020	98	
	3,020		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 3S:

Runoff = 20.56 cfs @ 12.35 hrs, Volume= 3.249 af, Depth= 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	633,376	43	Woods/grass comb., Fair, HSG A
	115,267	77	Brush, Fair, HSG D
*	20,712	98	Pavement
	769,355	50	Weighted Average
	748,643		97.31% Pervious Area
	20,712		2.69% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.1	1,144	0.0910	0.73		**Lag/CN Method,**

Summary for Subcatchment 4.0:

Runoff = 5.85 cfs @ 12.26 hrs, Volume= 0.871 af, Depth= 1.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	239,438	43	Woods/grass comb., Fair, HSG A
*	13,625	98	Pavement
	253,063	46	Weighted Average
	239,438		94.62% Pervious Area
	13,625		5.38% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.0	858	0.1330	0.75		**Lag/CN Method,**

Summary for Subcatchment 4.1: Roof Runoff

Runoff = 0.83 cfs @ 12.04 hrs, Volume= 0.074 af, Depth= 7.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
*	5,048	98	
	5,048		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	42	0.5000	4.15		**Lag/CN Method,**
5.8					**Direct Entry,**
6.0	42	Total			

Summary for Subcatchment 5S:

Runoff = 3.54 cfs @ 12.21 hrs, Volume= 0.488 af, Depth= 1.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Devens Rainfall 24-hr S1 100-yr Rainfall=7.93"

	Area (sf)	CN	Description
	125,508	43	Woods/grass comb., Fair, HSG A
*	8,801	98	
	134,309	47	Weighted Average
	125,508		93.45% Pervious Area
	8,801		6.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.7	795	0.1460	0.80		**Lag/CN Method,**

Summary for Reach 7R:

Inflow Area = 19.833 ac, 3.92% Impervious, Inflow Depth = 0.25" for 100-yr event
Inflow = 4.03 cfs @ 12.07 hrs, Volume= 0.409 af
Outflow = 3.67 cfs @ 12.12 hrs, Volume= 0.409 af, Atten= 9%, Lag= 2.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.96 fps, Min. Travel Time= 3.4 min
Avg. Velocity = 0.61 fps, Avg. Travel Time= 10.9 min

Peak Storage= 749 cf @ 12.12 hrs
Average Depth at Peak Storage= 0.43'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 18.50 cfs

Custom cross-section, Length= 400.0' Slope= 0.0037 '/'
Constant n= 0.022 Earth, clean & straight
Inlet Invert= 244.00', Outlet Invert= 242.50'

‡

Offset (feet)	Elevation (feet)	Chan.Depth (feet)
0.00	1.00	0.00
3.00	0.00	1.00
6.00	0.00	1.00
9.00	1.00	0.00

Depth (feet)	End Area (sq-ft)	Perim. (feet)	Storage (cubic-feet)	Discharge (cfs)
0.00	0.0	3.0	0	0.00
1.00	6.0	9.3	2,400	18.50

Summary for Pond 5P: Drywell

Inflow Area = 0.116 ac,100.00% Impervious, Inflow Depth = 7.69" for 100-yr event
Inflow = 0.83 cfs @ 12.04 hrs, Volume= 0.074 af
Outflow = 0.79 cfs @ 12.05 hrs, Volume= 0.069 af, Atten= 4%, Lag= 1.1 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.79 cfs @ 12.05 hrs, Volume= 0.069 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.45' @ 12.05 hrs Surf.Area= 115 sf Storage= 266 cf

Plug-Flow detention time= 82.0 min calculated for 0.069 af (93% of inflow)
Center-of-Mass det. time= 40.7 min (782.3 - 741.7)

Volume	Invert	Avail.Storage	Storage Description
#1	245.00'	290 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 724 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
245.00	156	0	0
248.00	156	468	468
250.00	100	256	724

Device	Routing	Invert	Outlet Devices
#1	Primary	248.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	245.00'	**20.000 in/hr Exfiltration over Horizontal area above 245.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 156 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=245.00' (Free Discharge)
2=Exfiltration (Controls 0.00 cfs)

Primary OutFlow Max=0.79 cfs @ 12.05 hrs HW=249.45' TW=244.14' (Dynamic Tailwater)
1=Orifice/Grate (Orifice Controls 0.79 cfs @ 4.03 fps)

Summary for Pond 6P: Roadside Wetland

Inflow Area = 33.349 ac, 5.83% Impervious, Inflow Depth = 0.68" for 100-yr event
Inflow = 12.71 cfs @ 12.32 hrs, Volume= 1.876 af
Outflow = 6.57 cfs @ 12.95 hrs, Volume= 1.822 af, Atten= 48%, Lag= 37.7 min
Primary = 6.57 cfs @ 12.95 hrs, Volume= 1.822 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 239.26' @ 12.95 hrs Surf.Area= 6,837 sf Storage= 19,693 cf

Plug-Flow detention time= 53.8 min calculated for 1.822 af (97% of inflow)
Center-of-Mass det. time= 38.2 min (924.0 - 885.8)

Volume	Invert	Avail.Storage	Storage Description
#1	235.00'	51,183 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
235.00	3,000	0	0
236.00	3,308	3,154	3,154
240.00	7,638	21,892	25,046
242.00	18,499	26,137	51,183

Device	Routing	Invert	Outlet Devices
#1	Primary	235.74'	**12.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 235.74' / 235.24' S= 0.0100 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 0.79 sf

Primary OutFlow Max=6.57 cfs @ 12.95 hrs HW=239.26' (Free Discharge)
1=Culvert (Inlet Controls 6.57 cfs @ 8.37 fps)

Summary for Pond 7P: Drywell

Inflow Area = 0.069 ac,100.00% Impervious, Inflow Depth = 7.69" for 100-yr event
Inflow = 0.49 cfs @ 12.04 hrs, Volume= 0.044 af
Outflow = 0.49 cfs @ 12.05 hrs, Volume= 0.040 af, Atten= 2%, Lag= 0.7 min
Discarded = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Primary = 0.49 cfs @ 12.05 hrs, Volume= 0.040 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.51' @ 12.05 hrs Surf.Area= 99 sf Storage= 206 cf

Plug-Flow detention time= 107.5 min calculated for 0.040 af (91% of inflow)

Center-of-Mass det. time= 53.2 min (794.8 - 741.7)

Volume	Invert	Avail.Storage	Storage Description
#1	246.00'	240 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc) 600 cf Overall x 40.0% Voids

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
246.00	150	0	0
249.00	150	450	450
250.00	50	100	550
251.00	50	50	600

Device	Routing	Invert	Outlet Devices
#1	Primary	249.00'	**6.0" Vert. Orifice/Grate** C= 0.600
#2	Discarded	246.00'	**20.000 in/hr Exfiltration over Horizontal area above 246.00'** Conductivity to Groundwater Elevation = 235.00' Excluded Horizontal area = 150 sf

Discarded OutFlow Max=0.00 cfs @ 0.00 hrs HW=246.00' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.00 cfs)

Primary OutFlow Max=0.49 cfs @ 12.05 hrs HW=249.51' TW=244.37' (Dynamic Tailwater)
↑—**1=Orifice/Grate** (Orifice Controls 0.49 cfs @ 2.47 fps)

Summary for Pond 8P:

Inflow Area = 17.662 ac, 2.69% Impervious, Inflow Depth = 2.21" for 100-yr event
Inflow = 20.56 cfs @ 12.35 hrs, Volume= 3.249 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 249.41' @ 25.47 hrs Surf.Area= 102,332 sf Storage= 141,527 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	993,677 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	98,588	0	0
256.00	119,850	873,752	873,752
257.00	120,000	119,925	993,677

Device	Routing	Invert	Outlet Devices
#1	Primary	256.00'	**51.0' long x 13.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.60 2.64 2.70 2.66 2.65 2.66 2.65 2.63

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=248.00' TW=244.00' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Summary for Pond 9P: Infiltration Basin

Inflow Area = 30.265 ac, 5.75% Impervious, Inflow Depth = 0.86" for 100-yr event
Inflow = 11.82 cfs @ 12.32 hrs, Volume= 2.173 af
Outflow = 11.67 cfs @ 12.38 hrs, Volume= 2.173 af, Atten= 1%, Lag= 4.0 min
Discarded = 1.87 cfs @ 12.38 hrs, Volume= 0.785 af
Primary = 7.51 cfs @ 12.38 hrs, Volume= 1.293 af
Secondary = 2.28 cfs @ 12.38 hrs, Volume= 0.095 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.28' @ 12.38 hrs Surf.Area= 3,986 sf Storage= 3,738 cf

Plug-Flow detention time= 21.4 min calculated for 2.173 af (100% of inflow)
Center-of-Mass det. time= 21.4 min (945.4 - 924.0)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	8,773 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	400	0	0
242.50	943	1,007	1,007
244.00	1,647	1,943	2,950
245.00	10,000	5,824	8,773

Device	Routing	Invert	Outlet Devices
#1	Secondary	244.00'	**6.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	243.50'	**18.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	241.00'	**20.000 in/hr Exfiltration over Horizontal area above 241.00'** Conductivity to Groundwater Elevation = 237.00' Excluded Horizontal area = 400 sf

Discarded OutFlow Max=1.87 cfs @ 12.38 hrs HW=244.28' (Free Discharge)
3=Exfiltration (Controls 1.87 cfs)

Primary OutFlow Max=7.51 cfs @ 12.38 hrs HW=244.28' TW=237.94' (Dynamic Tailwater)
2=Orifice/Grate (Orifice Controls 7.51 cfs @ 4.25 fps)

Secondary OutFlow Max=2.28 cfs @ 12.38 hrs HW=244.28' TW=237.94' (Dynamic Tailwater)
1=Broad-Crested Rectangular Weir (Weir Controls 2.28 cfs @ 1.36 fps)

Summary for Pond 10P: Sediment Forebay

Inflow Area = 24.340 ac, 5.39% Impervious, Inflow Depth = 0.61" for 100-yr event
Inflow = 8.49 cfs @ 12.22 hrs, Volume= 1.238 af
Outflow = 6.44 cfs @ 12.46 hrs, Volume= 1.237 af, Atten= 24%, Lag= 14.3 min
Primary = 6.44 cfs @ 12.46 hrs, Volume= 1.237 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 246.18' @ 12.44 hrs Surf.Area= 3,260 sf Storage= 3,957 cf

Plug-Flow detention time= 9.0 min calculated for 1.237 af (100% of inflow)
Center-of-Mass det. time= 8.8 min (923.7 - 914.9)

Volume	Invert	Avail.Storage	Storage Description
#1	241.00'	9,406 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
241.00	25	0	0
243.00	160	185	185
244.00	796	478	663
245.00	1,545	1,171	1,834
246.00	1,800	1,673	3,506
247.00	10,000	5,900	9,406

Device	Routing	Invert	Outlet Devices
#1	Primary	241.50'	**15.0" Round Culvert** L= 98.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 241.50' / 241.00' S= 0.0051 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf

Primary OutFlow Max=6.44 cfs @ 12.46 hrs HW=246.18' TW=244.27' (Dynamic Tailwater)
↑—**1=Culvert** (Inlet Controls 6.44 cfs @ 5.25 fps)

Summary for Pond 11P: Sediment Forebay

Inflow Area = 5.925 ac, 7.23% Impervious, Inflow Depth = 1.90" for 100-yr event
Inflow = 6.15 cfs @ 12.25 hrs, Volume= 0.940 af
Outflow = 5.70 cfs @ 12.27 hrs, Volume= 0.936 af, Atten= 7%, Lag= 1.4 min
Primary = 5.70 cfs @ 12.27 hrs, Volume= 0.936 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 244.31' @ 12.37 hrs Surf.Area= 3,326 sf Storage= 746 cf

Plug-Flow detention time= 5.7 min calculated for 0.936 af (100% of inflow)
Center-of-Mass det. time= 3.2 min (924.3 - 921.1)

Volume	Invert	Avail.Storage	Storage Description
#1	243.00'	5,318 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
243.00	90	0	0
244.00	273	182	182
245.00	10,000	5,137	5,318

Device	Routing	Invert	Outlet Devices
#1	Primary	244.00'	**25.0' long x 4.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.36 2.52 2.70 2.68 2.67 2.67 2.65 2.66 2.66 2.67 2.70 2.70 2.72 2.75 2.81 2.93 3.10

Primary OutFlow Max=5.40 cfs @ 12.27 hrs HW=244.29' TW=244.25' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 5.40 cfs @ 0.74 fps)

Appendix D – TSS Worksheet

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: Shabokin WTP

TSS Removal Calculation Worksheet

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Sediment Forebay	**0.25**	**1.00**	**0.25**	**0.75**
Infiltration Basin	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

Project: **Shabokin WTP**

Prepared By: **CAD**

Date: **8/12/2020**

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

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

Appendix E – O&M Forms

INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 14 DAYS AND/OR WITHIN 24 HOURS OF
A RAINFALL EVENT OF 0.5 INCHES OR MORE

SITE STABILIZATION

Inspector:_____ Date:_____

Days Since Last Rainfall:_____ Amount of Last Rainfall:____ Inches

Area	Date since last disturbed	Stabilized? (yes/no)	Stabilized with	Condition

Contractor's Superintendent: _____ Date:_____

Stabilization Action Required:

_____
_____
_____
_____
_____
_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

SILT FENCE

Inspector: _____ Date: _____

Depth of material behind silt fence	Condition of landfill side slopes	Any evidence of overtopping of the silt fence?	Condition of drainage swales

Contractor's Superintendent: _____ Date: _____

Maintenance action required for silt fence:

_____
_____
_____
_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

STORMWATER STRUCTURES

Inspector: _____ Date: _____

Any evidence of erosion or sedimentation at culvert inlet or outlet?	Condition of riprap inlet and outlet aprons at culvert	Accumulation of silt or debris in stormwater storage area?

Contractor's Superintendent: _____ Date: _____

Maintenance action required for stormwater structures:

_____
_____
_____
_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

ACCESS ROAD

Inspector: _____ Date: _____

Does much sediment get tracked on to road?	Is the gravel clean or is it filled with sediment?	Does all traffic use the stabilized entrance to leave the site?

Contractor's Superintendent: _____ Date: _____

Maintenance action required to stabilize access road:

_____

_____

_____

_____

Performed by: _____ On or Before: _____

INSPECTION AND MAINTENANCE REPORT FORM

Inspector: _____ Date: _____

Contractor's Superintendent: _____

Changes required to the Construction Pollution Prevention Plan:

_____
_____
_____
_____

Reasons for changes:

_____
_____
_____
_____

I certify that the foregoing statements are, to the best of my knowledge, true and accurate.

Inspector
Signature: _____ Date: _____

Contractor's Superintendent
Signature: _____ Date: _____

Inspection and Maintenance Checklist

Category: **Stormwater BMP** Type:

Location: _____

Date: _____ Time: _____Inspector: _____Weather:_____

Recent Large Rainfall Event □ Yes □ No Rainfall Depth: _____ Event Date:_____

□ **UNIT AREA**

Area Accessible: □ Yes □ No Comment: _____
Sink Holes: □ Yes □ No Comment: _____
Corrective Action Needed: _____
Corrective Action Taken: _____Date:_____

□ **FLOATABLE DEBRIS/ORGANIC MATTER**

Floatables present? □Yes □No If yes, to what extent? _____
Corrective Action Needed: _____
Corrective Action Taken: _____Date:_____

□ **SEDIMENT MEASUREMENT**

Sediment Depth: _____ Note: if the sediment depth is 2 feet or more, removal is necessary.
Corrective Action Needed: _____
Corrective Action Taken: _____Date:_____

NOTES:

Describe any incidents of non-compliance not listed above:

Note: Any maintenance performed as a result of this inspection should be recorded on the maintenance log.

Inspector Signature: _____ Date: _____

Stormwater BMP Maintenance Log

Date	Initials	BMP	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

Appendix F – Stabilization Specifications

SECTION 31 25 00

EROSION AND SEDIMENTATION CONTROLS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included:
   1. The work under this section shall include provision of all labor, equipment, materials and maintenance of temporary erosion control devices, as specified herein, as shown on the Drawings and as directed by the Engineer.
   2. Erosion control measures shall be provided as necessary to correct conditions that develop prior to the completion of permanent erosion control devices, or as required to control erosion that occurs during normal construction operations.
   3. Construction operations shall comply with all federal, state and local regulations pertaining to erosion control.
   4. After awarding of or after being awarded the Contract, prior to commencement of construction activities, the Contractor will meet with the Engineer to discuss erosion control requirements and develop a mutual understanding relative to details of erosion control.

B. Related Work Specified Elsewhere:
   1. Site work is specified in appropriate sections of this Division.

C. Design Criteria:
   1. Conduct all construction in a manner and sequence that causes the least practical disturbance of the physical environment.
   2. Stabilize disturbed earth surfaces in the shortest time and employ such temporary erosion control devices, as may be necessary, until such time as adequate soil stabilization has been achieved.

1.2 SUBMITTALS

A. The Contractor shall furnish the Engineer, in writing, his work plan giving proposed locations for storage of topsoil and excavated material, before beginning construction. A schedule of work shall accompany the work plan. Acceptance of this plan will not relieve the Contractor of his responsibility for completion of the work as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Baled Hay:
   1. At least 14" by 18" by 30" securely tied to form a firm bale, staked as necessary to hold the bale in place.

B. Sand Bags:
   1. Heavy cloth bags of approximately one cubic foot capacity filled with sand or gravel.

C. Mulches:

1. Loose hay, straw, peat moss, wood chips, bark mulch, crushed stone, wood excelsior, or wood fiber cellulose.
2. Type and use shall be as specified by the "Maine Erosion and Sedimentation Control Best Management Practices" prepared by the Maine DEP, herein after referred to as the BMP.

D. Mats and Nettings:
1. Twisted Craft paper, yarn, jute, excelsior wood fiber mats, glass fiber and plastic film.
2. Type and use shall be as specified in the BMP.

E. Permanent Seed:
1. Conservation mix appropriate to the predominant soil conditions as specified in the BMP and subject to approval by the Engineer.

F. Temporary Seeding:
1. Use species appropriate for soil conditions and season as specified in the BMP and subject to approval by the Engineer.

G. Water:
1. The Contractor shall provide water and equipment to control dust, as directed by the Engineer.

H. Silt Fence:
1. Silt Fence shall be one of the commercially available brands, meeting the following requirements:

Geotextile Mechanical Property	Test Method	Minimum Permissible Value
Grab Tensile Strength (both directions)	ASTM D-4632	124 pounds
Puncture Strength	ASTM D-4833	60 pounds
Apparent Opening Size	ASTM D-4751	#30
Flow Rate	ASTM D-4491	8 gal/min/ft^2

2.2 CONSTRUCTION REQUIREMENTS

A. Temporary Erosion Checks:
1. Temporary erosion checks shall be constructed in ditches and other locations as necessary.
2. Baled hay, sand bags or siltation fence may be used in an arrangement to fit local conditions.

B. Temporary Berms:
1. Temporary barriers shall be constructed along the toe of embankments when necessary to prevent erosion and sedimentation.

C. Temporary Seeding:
1. Areas to remain exposed for a time exceeding 3 weeks shall receive temporary seeding as indicated below:

Season	Seed	Rate
Summer (5/15 - 8/15)	Sudangrass	40 lbs/acre
Late Summer/Early Fall	Oats	80 lbs/acre
(8/15 - 9/15)	Annual Ryegrass	40 lbs/acre
Fall (9/15 - 10/1)	Winter Rye	112 lbs/acre
Winter (10/1 - 4/1	Mulch w/Dormant Seed	80 lbs/acre*
Spring (4/1 - 7/1)	Oats	80 lbs/acre
	Annual Ryegrass	40 lbs/acre

* seed rate only

D. Silt Fence shall be supported by posts and installed per the manufacturer's recommendations.

E. Mulch All Areas Receiving Seeding:
   1. Use either wood cellulose fiber mulch (750 lbs/acre); or straw mulch with chemical tack (as per manufacturer's specifications). Wetting for small areas may be permitted. Biodegradable netting is recommended in areas to be exposed to drainage flow.

F. Erosion control matting for slopes and ditches shall be anchored with pegs and/or staples per manufacturer's recommendations. Contractor shall provide matting along the flowline of all ditches and swales having a longitudinal slope in excess of 0.01 ft/ft, and on all slopes in excess of 3(H) to 1(V).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Temporary Erosion Checks:
   1. Temporary erosion checks shall be constructed in ditches and at other locations designated by the Engineer. The Engineer may modify the Contractor's arrangement of silt fences, bales and bags to fit local conditions.
   2. Baled hay, silt fences, or sandbags, or some combination, may be used in other areas, as necessary, to inhibit soil erosion.
   3. Siltation fence shall be located and installed as shown on plans or as required to comply with all Federal, State and Local Regulations.
   4. Sedimentation ponds shall be sited and constructed to the grades and dimensions as shown on the Drawings and will include drainage pipe and an emergency spillway.

B. Erosion control matting for slopes and ditches shall be installed where indicated on the Drawings and as required to stabilize the soil until permanent vegetative stabilization is established.

C. Maintenance:
   1. Erosion control features shall be installed prior to excavation wherever appropriate. Temporary erosion control features shall remain in place and shall be maintained until a satisfactory growth of grass is established. The Contractor shall be responsible for maintaining erosion control features throughout the life of the construction contract. Maintenance will include periodic inspections by the Owner or Engineer for effectiveness of location, installation and condition with corrective action taken by the Contractor, as appropriate.

D. Removing and Disposing of Materials:
   1. When no longer needed, material and devices for temporary erosion control shall be removed and disposed of upon approval by Engineer.
   2. When removed, such devices may be reused in other locations, provided they are in good condition and suitable to perform the erosion control for which they are intended.
   3. When dispersed over adjacent areas, the material shall be scattered to the extent that it causes no unsightly conditions nor creates future maintenance problems.
   4. Sedimentation basins, if no longer required, will be filled in, the pipe removed, the surface loamed and grass cover shall be established.

END OF SECTION

SECTION 32 92 19

LOAMING & SEEDING

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish, place, and test topsoil, seed, lime, and fertilizer where shown on the drawings and protect and maintain seeded areas disturbed by construction work, as directed by the Engineer.

B. Related Work Specified Elsewhere (When Applicable): Earthwork, excavation, backfill, compaction, site grading and temporary erosion control are specified in the appropriate Sections of this Division.

1.2 SUBMITTALS AND TESTING

A. Seed:

1. Furnish the Engineer with duplicate signed copies of a statement from the vendor, certifying that each container of seed delivered to the project site is fully labeled in accordance with the Federal Seed Act and is at least equal to the specification requirements.
2. This certification shall appear in, or with, all copies of invoices for the seed.
3. The certification shall include the guaranteed percentages of purity, weed content and germination of the seed, and also the net weight and date of shipment. No seed may be sown until the Contractor has submitted the certificates and certificates have been approved.
4. Each lot of seed shall be subject to sampling and testing, at the discretion of the Engineer, in accordance with the latest rules and regulations under the Federal Seed Act.

B. Topsoil:

1. Inform the Engineer, within 30 days after the award of the Contract, of the sources from which the topsoil is to be furnished.
2. Obtain representative soil samples, taken from several locations in the area under consideration for topsoil removal, to the full stripping depth.
3. Have soil samples tested by an independent soils testing laboratory, approved by the Engineer, at the Contractor's expense.
4. Have soil samples tested for physical properties and pH (or lime requirement), for organic matter, available phosphoric acid, and available potash, in accordance with standard practices of soil testing.
5. Approval, by the Engineer, to use topsoil for the work will be dependent upon the results of the soils tests.

C. Lime & Fertilizer:

1. Furnish the Engineer with duplicate copies of invoices for all lime and fertilizer used on the project showing the total minimum carbonates and minimum percentages of the material furnished that pass the 90 and 20 mesh sieves and the grade furnished.

2. Each lot of lime and fertilizer shall be subject to sampling and testing at the discretion of the Engineer.
3. Sampling and testing shall be in accordance with the official methods of the Association of Official Agricultural Chemists.
4. Upon completion of the project, a final check may be made comparing the total quantities of fertilizer and lime used to the total area seeded. If the minimum rates of application have not been met, the Engineer may require the Contractor to distribute additional quantities of these materials to meet the minimum rates.

1.3 DELIVERY, STORAGE & HANDLING

A. Seed:
   1. Furnish all seed in sealed standard containers, unless exception is granted in writing by the Engineer.
   2. Containers shall be labeled in accordance with the United States Department of Agriculture's rules and regulations under the Federal Seed Act in effect at the time of purchase.

B. Fertilizer:
   1. Furnish all fertilizer in unopened original containers.
   2. Containers shall be labeled with the manufacturer's statement of analysis.

1.4 JOB CONDITIONS

A. Topsoil: Do not place or spread topsoil when the subgrade is frozen, excessively wet or dry, or in any condition otherwise detrimental, in the opinion of the Engineer, to the proposed planting or to proper grading.

B. Seeding:
   1. Planting Seasons: The recommended seeding time is from April 1 to September 15. The Contractor may seed at other times. Regardless of the time of seeding, the Contractor shall be responsible for each seeded area until it is accepted.
   2. Weather Conditions:
      a. Do not perform seeding work when weather conditions are such that beneficial results are not likely to be obtained, such as drought, excessive moisture, or high winds.
      b. Stop the seeding work when, in the opinion of the Engineer, weather conditions are not favorable.
      c. Resume the work only when, in the opinion of the Engineer, conditions become favorable, or when approved alternate or corrective measures and procedures are placed into effect.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Seed:
   1. Provide the grass seed mixture approved by the Engineer, having the following composition:
      a. Park Mixture:
         50 percent Creeping Red Fesque
         30 percent Kentucky Bluegrass

20 percent Annual Ryegrass

b. Roadside Mixture:

50 percent Creeping Red Fescue
15 percent Kentucky Bluegrass
5 percent White Clover
2 percent Red Top
3 percent Birdsfoot Trefoil
25 percent Annual Ryegrass

2. Do not use seed which has become wet, moldy, or otherwise damaged in transit or during storage.

B. Topsoil:
1. Fertile, friable, natural topsoil typical of the locality, without admixture of subsoil, refuse or other foreign materials and obtained from a well-drained site. Mixture of sand, silt, and clay particles in equal proportions.
2. Free of stumps, roots, heavy of stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, weeds, sticks, brush or other deleterious matter.
3. Not less than 4 percent nor more than 20 percent organic matter.
4. Topsoil depth shall be 4-inches, unless otherwise indicated.

C. Lime:
1. Provide lime which is ground limestone containing not less than 85% of total carbonate and of such fineness that 90% will pass a No. 20 sieve and 50% will pass a No. l00 sieve.
2. Coarser materials will be acceptable provided the specified rates of application are increased proportionately on the basis of quantities passing a No. l00 sieve. No additional payment will be made to the Contractor for the increased quantity.

D. Fertilizer:
1. Provide a commercial fertilizer approved by the Engineer.
2. Provide fertilizer containing the following minimum percentage of nutrients by weight:
l0% Available phosphoric acid
l0% Available potash
l0% Available nitrogen (75% of the nitrogen shall be organic)

PART 3 - EXECUTION

3.1 PREPARATION

A. Equipment:
1. Provide all equipment necessary for the proper preparation of the ground surface and for the handling and placing of all required materials.
2. Demonstrate to the Engineer that the equipment will apply materials at the specified rates.

B. Soil: Perform the following work prior to the application of lime, fertilizer or seed.
1. Scarify the subgrade to a depth of 2 inches to allow the bonding of the topsoil with the subsoil.
2. Apply topsoil to a depth of 4 inches or as directed on areas to be seeded.

3. Trim and rake the topsoil to true grades free from unsightly variations, humps, ridges or depressions.
4. Remove all objectionable material and form a finely pulverized seed bed.

3.2 PERFORMANCE

A. Grading:
   1. Grade the areas to be seeded as shown on the Drawings or as directed by the Engineer.
   2. Leave all surfaces in even and properly compacted condition.
   3. Maintain grades on the areas to be seeded in true and even conditions, including any necessary repairs to previously graded areas.

B. Placing Topsoil:
   1. Uniformly distribute and evenly spread topsoil on the designated areas.
   2. Spread the topsoil in such a manner that planting work can be performed with little additional soil preparation or tillage.
   3. Correct any irregularities in the surface resulting from topsoiling or other operations to prevent the formation of depressions where water may stand.
   4. Thoroughly till the topsoil to a depth of at least 3 inches by plowing, harrowing, or other approved method until the condition of the soil is acceptable to the Engineer. The surface shall be cleared of all debris and or stones one inch or more in diameter.

C. Placing Fertilizer:
   1. Distribute fertilizer uniformly at a rate determined by the soils test over the areas to be seeded.
   2. Incorporate fertilizer into the soil to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.
   3. The incorporation of fertilizer may be a part of the tillage operation specified above.
   4. Distribution by means of an approved seed drill equipped to sow seed and distribute fertilizer at the same time will be acceptable.

D. Placing Lime:
   1. Uniformly distribute lime immediately following or simultaneously with the incorporation of fertilizer.
   2. Distribute lime at a rate determined from the pH test, to a depth of at least 3 inches by discing, harrowing, or other methods acceptable to the Engineer.

E. Seeding:
   1. Fine rake and level out any undulations or irregularities in the surface resulting from tillage, fertilizing, liming or other operations before starting seeding operations.
   2. Hydroseeding:
      a. Hydroseeding may be performed where approved and with equipment approved by the Engineer.
      b. Sow the seed over designated areas at a minimum rate of 5 pounds per 1000 square feet.
      c. Seed and fertilizing materials shall be kept thoroughly agitated in order to maintain a uniform suspension within the tank of the hydroseeder.

d. The spraying equipment must be designed and operated to distribute seed and fertilizing materials evenly and uniformly on the designated areas at the required rates.

3. Drill Seeding:
   a. Drill seeding may be performed with approved equipment having drills not more than 2 inches apart.
   b. Sow the seed uniformly over the designated areas to a depth of l/2 inch and at a rate of 5 pounds per l,000 square feet.
4. Broadcast Seeding:
   a. Broadcast seeding may be performed by equipment approved by the Engineer.
   b. Sow the seed uniformly over the designated areas at a rate of 5 pounds per l,000 square feet.
   c. Sow half the seed with the equipment moving in one direction and the remainder of the seed with the equipment moving at right angles to the first sowing.
   d. Cover the seed to an average depth of l/2 inch by means of a brush harrow, spike-tooth harrow, chain harrow, cultipacker, or other approved devices.
   e. Do not perform broadcast seeding work during windy weather.

F. Compacting:
1. Seeded areas must be raked lightly after sowing unless seeding is to be directly followed by application of an approved mulch.
2. Compact the entire area immediately after the seeding operations have been completed.
3. Compact by means of a cultipacker, roller, or other equipment approved by the Engineer weighing 60 to 90 pounds per linear foot of roller.
4. If the soil is of such type that a smooth or corrugated roller cannot be operated satisfactorily, use a pneumatic roller (not wobbly wheel) that has tires of sufficient size to obtain complete coverage of the soil.
5. When using a cultipacker or similar equipment, perform the final rolling at right angles to the prevailing slopes to prevent water erosion, or at right angles to the prevailing wind to prevent dust.

3.3 PROTECTION & MAINTENANCE

A. Protection:
1. Protect the seeded area against traffic or other use.
2. Erect barricades and place warning signs as needed.

B. Maintenance:
1. At the time of the first cutting, set mower blades two inches high. All lawns shall receive at least two mowings before acceptance. Coordinate schedule for mowing with Engineer.
2. Maintenance shall also include all temporary protection fences, barriers and signs and all other work incidental to proper maintenance.
3. Maintain grass areas until a full stand of grass is indicated, which will be a minimum of 45 days after all seeding work is completed, and shall not necessarily related to Substantial Completion of the General Contract.

4. Protection and maintenance of grass areas shall consist of watering, weeding, cutting, repair of any erosion and reseeding as necessary to establish a uniform stand for the specified grasses, and shall continue until Acceptance by the Engineer of the work of this section. It shall also include the furnishing and applying of such pesticides as are necessary to keep grass areas free of insects and disease. All pesticides shall be approved by Engineer prior to use.

3.4 ACCEPTANCE

A. At final acceptance of the project all areas shall have a close stand of grass with no weeds present and no bare spots greater than three inches (3") in diameter over greater than five percent (5%) of the overall seeded area.

END OF SECTION

WRIGHT-PIERCE
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