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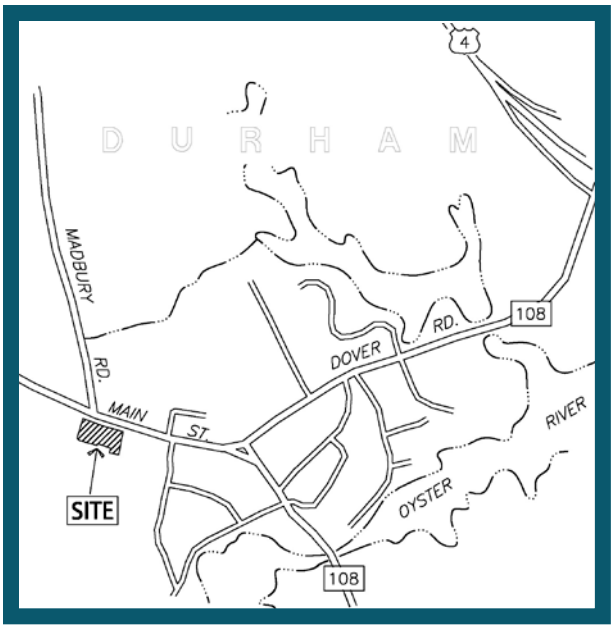

ORION STUDENT HOUSING PROJECT

#25-35 MAIN STREET
DURHAM, NEW HAMPSHIRE

STORMWATER MANAGEMENT PLAN

DATE PREPARED
January 9, 2014

APPLICANT:
Orion UNH, LLC
225 Franklin Street, 26th floor
Boston, MA 02110

PREPARED BY:
Allen & Major Associates, Inc.
250 Commercial Street, Suite 1001
Manchester, New Hampshire 03101

A&M PROJECT NO.: 1925-01

STORMWATER MANAGEMENT PLAN

ORION STUDENT HOUSING
25-35 MAIN STREET – DURHAM, NH

APPLICANT:

ORION UNH, LLC
225 FRANKLIN STREET, 26TH FLOOR
BOSTON, MA 02110

PREPARED BY:

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A&M PROJECT #1925-01

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SECTION 1.0

PROJECT OVERVIEW

1.0 OVERVIEW

1.1 INTRODUCTION

The purpose of this drainage report is to provide a detailed review of the stormwater runoff, both quality and quantity, as it pertains to the existing and proposed developed conditions. The report will show by means of narrative, calculations and exhibits that appropriate best management practices have been used to mitigate the impacts from the proposed development. The report will demonstrate that there is no increase in total peak rate of runoff from the site for all design storm events. The following table illustrates that an overall peak reduction of the site as a whole is achieved.

Design Storm	Peak Discharge (Entire Project)		
	Pre-Development (cfs)	Post-Development (cfs)	Change (cfs)
SP1			
2-year	0.3	0.3	0.0
10-year	0.5	0.5	0.0
25-year	0.7	0.6	-0.1
100-year	1.1	0.9	-0.2
SP2			
2-year	2.0	1.4	-0.6
10-year	4.7	2.3	-2.4
25-year	4.7	2.9	-1.8
100-year	7.1	4.3	-2.8

Design Storm	Peak Volume (Entire Project)		
	Pre-Development (cf)	Post-Development (cf)	Change (cf)
SP1			
2-year	977	945	-32
10-year	1,687	1,610	-77
25-year	2,261	2,145	-116
100-year	3,447	3,249	-198
SP2			
2-year	7,471	4,689	-2,782
10-year	13,246	7,887	-5,359
25-year	17,952	10,451	-7,501
100-year	27,731	15,726	-12,005

1.2 SITE LOCATION AND DESCRIPTION

The proposed parcel that is the focus of this study is three parcels identified on the Town of Durham Tax Map 5 as Lots 1-6, 1-7, and 1-8. The total land area for the redevelopment is 1.09 acres or 47,676± square feet. The proposed site redevelopment would restore 25 and 35 Main Street to their original architectural significance, demolish 27 and 29 Main Street and a barn, and construct four new residential buildings. The redeveloped 25 – 35 Main Street will function as multi-family housing primarily targeted to collegiate students.

The existing terrain scheduled for disturbance is moderately sloping with a combination of pavement and minimal landscaping. The majority of the site is paved, with some areas of grass and woodland. There are several buildings located on site, with associated parking and landscaping areas. Currently, stormwater exits the site via sheet flow at two locations. The first, being a small portion of the site along the northeastern boundary which drains toward Main Street. The remainder of the site exits the site via sheet flow toward the southwest corner of the project through a wooded buffer along the abutting parcels.

The disturbance area is approximately 52,000+/- for the improvements to the site and associated drainage systems. This disturbance includes operations associated with the construction of the site. According to The Soil Survey of Strafford County, New Hampshire, the predominate soil of the site is identified by the US Department of Agricultural (USDA) Natural Resources Conservation Service (NRCS) as SfC – Suffield silt loam and a small portion being HcB - Hollis-Charlton fine sandy loams,. For the purposes of the drainage analysis the Hydrological Soil Group were based upon the Web Soil Survey data.

The methodology is NRCS; TR-20, Type III rainfalls (2, 10, 25 & 100 year events). This is consistent with the requirements of the Town of Durham. All pertinent calculations represented in the following pages were developed utilizing HydroCAD Stormwater modeling software.

A storm water analysis has been performed for two project site situations. The first analysis consists of the existing site conditions and the second consists of the proposed site conditions. There are three study points developed along the limits of the project boundaries where storm water runoff leaves the site via the wetlands, overland flow and the existing municipal storm system. The study points and contributing watersheds are further outlined in the accompanying text and calculations.

1.3 EXISTING SITE CONDITIONS

The existing terrain scheduled for disturbance is moderately sloping with a combination of pavement and minimal landscaping. The majority of the site is paved, with some areas of grass and woodland. There are several buildings located on site, with associated parking and landscaping areas. Storm water runoff exits the site at two points along the property. In order to exhibit no increase in runoff to these points, storm water runoff flows were analyzed at two specific “Study Points.” The included Existing Watershed Plan (EWP) outlines the boundaries and contributing watershed for the Study Points.

1. Study Point 1: This study point is located at the northwest corner of the site at the existing municipal storm system in Main Street at the intersection of Madbury Road. This is the collection point for Existing Watershed Ex-1. Ex-1 collects surface runoff from the northern portion of the site. Ex-1 is primarily impervious with some landscaped areas.

2. Study Point 2: This study point collects the remainder of the site and exits via sheet flow toward the southwest corner of the project through a wooded buffer along the abutting parcels. This is the collection point for Existing Watershed Ex-2. Ex-2 collects surface runoff from the majority of the site. Ex-2 is mostly impervious with a mix of landscaped areas and scrub brush.

Analysis Point	Pre Development								
	Inflow area (sf)	2yr Storm		10yr Storm		25yr Storm		100yr Storm	
		Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)
SP1	5,599	0.3	977	0.5	1,687	0.7	2,261	1.1	3,447
SP2	46,570	2.0	7,471	3.5	13,246	4.7	17,952	7.1	27,731
	TOTAL =	**2.3**	**8,448**	**4.0**	**14,933**	**5.4**	**20,213**	**8.2**	**31,178**

1.4 PROPOSED SITE CONDITIONS

The proposed site redevelopment would restore 25 and 35 Main Street to their original architectural significance, demolish 27 and 29 Main Street and a barn, and construct four new residential buildings. The redeveloped 25 – 35 Main Street will function as multi-family housing primarily targeted to collegiate students. Although, there is an increase in impervious cover for the site, the peak rate of runoff from the site will mitigated through the installation of pervious pavers throughout designed to collect and infiltrate the added stormwater runoff.

The disturbance area is approximately 52,000+/- for the improvements to the site and associated drainage systems. This disturbance includes operations associated with the construction of the site.
The reduction in runoff rate and volume is due to the replacement of impervious pavement with permeable pavers. As an accepted BMP listed in the NHDES Stormwater Handbook, the permeable paver will also improve water quality. According the Handbook, permeable paver provides 80% TSS removal. The proposed porous pavement design is based on the University of New Hampshire Stormwater Center (UNHSC) design criteria and includes a layer of sand for treatment of the stormwater prior to recharge. UNHSC has performed testing of the porous pavement BMP, which has been shown to remove greater than 80% TSS – See UNHSC 2009 Biannual report for performance of the porous pavement.

(http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/2009_unhsc_report.pdf)

Site Data for Stormwater Modeling

The proposed site is comprised of approximately 531,928 square feet of impervious (a decrease of 15,364 sf from the pre-development conditions), including parking, roofs and walkways. Rainfall data used for modeling the stormwater runoff was derived from the Natural Resources Conservation Service "New Hampshire County Rainfall Frequency Data". The storm events were broken down for the 2, 10, 25, and 100 year storms.

Analysis Point	Post Development								
	Inflow area (sf)	2yr Storm		10yr Storm		25yr Storm		100yr Storm	
		Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)	Flow (cfs)	Volume (cf)
SP1	27,430	0.3	945	0.5	1,610	0.6	2,145	0.9	3,249
SP2	24,739	1.4	4,689	2.3	7,887	2.9	10,451	4.3	15,726
	TOTAL =	**1.7**	**5,634**	**2.8**	**9,497**	**3.5**	**12,596**	**5.2**	**18,975**

Hydraulic Study

A hydrologic study of the site was conducted in order to determine the impact of the proposed development on the existing storm water runoff. The study determined the rates of runoff at the three study points discussed in the existing condition analysis. The included Proposed Watershed Plan (PWP) outlines the boundaries and contributing watershed for the Study Points.

1. Study Point 1: This study point is located at the northwest corner of the site at the existing municipal storm system in Main Street at the intersection of Madbury Road. This is the collection point for Existing Watershed Ex-1. Ex-1 collects surface runoff from the northern portion of the site. Ex-1 is primarily impervious with some landscaped areas.

2. Study Point 2: This study point collects the remainder of the site and exits via sheet flow toward the southwest corner of the project through a wooded buffer along the abutting parcels. This is the collection point for Existing Watershed Ex-2. Ex-2 collects surface runoff from the majority of the site. Ex-2 is mostly impervious with a mix of landscaped areas and scrub brush.

SECTION 2.0

DISCUSSION

2.0 DISCUSSION

2.1 METHODOLOGY

The peak discharge rates were determined using techniques and data found in the following:

1. Urban Hydrology for Small Watersheds – Technical Release 55 by the United States Department of Agriculture Soils Conservation Service, June 1986. Runoff curve numbers and 24-hour precipitation values were obtained from this reference.

2. HydroCAD© Storm water Modeling System by HydroCAD Software Solutions LLC, version 9.10, 2009. The HydroCAD program was used to generate the runoff hydrographs for the watershed areas, to determine discharge/stage/storage characteristics for the infiltration basin, to perform drainage routing and to combine the results of the runoff hydrographs.

3. UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds, by University of New Hampshire Stormwater Center, October 2009.

4. Soil Survey of Rockingham County, New Hampshire by the United States Department of Agriculture, Natural Resources Conservation Services (NRCS). Soil types and boundaries were obtained from this reference.

2.2 PEAK DISCHARGE RATES

The storm water runoff analysis of the existing and proposed conditions includes an estimation of the peak discharge rate from various rainfall events. Peak discharge rates were developed using TR-55 Urban Hydrology for Small Watersheds, developed by the U.S. Department of Commerce, Engineering Division and the HydroCAD 9.10 computer program. Further, the analysis has been prepared in accordance with the NH Stormwater Management Manual and standard engineering practices. The peak discharge rate has been estimated for each watershed during the 2, 10, 25, and 100-year storm events.

The storm water runoff model shows that the proposed site design results in no increase to the total rate of runoff during all storm events. This is accomplished by the conversion of some of the parking area to grass or landscaping for an overall reduction in impervious area. The following table provides a summary of the estimated peak discharge rates for each study point during each of the design storm events. The HydroCAD worksheets and hydrographs are included in the Existing and Proposed Drainage Calculations section of this report.

All Study points have shown a decrease in flow in Post Development verses Pre-Development. There is no proposed development within this watershed area, therefore the flows remain unchanged and no treatment is necessary.

Design Storm	Peak Discharge		
	Pre-Development (cfs)	Post-Development (cfs)	Change (cfs)
SP1			
2-year	0.3	0.3	0.0
10-year	0.5	0.5	0.0
25-year	0.7	0.6	-0.1
100-year	1.1	0.9	-0.2
SP2			
2-year	2.0	1.4	-0.6
10-year	4.7	2.3	-2.4
25-year	4.7	2.9	-1.8
100-year	7.1	4.3	-2.8
TOTAL			
2-year	2.3	1.7	-0.6
10-year	4.0	2.8	-1.2
25-year	5.4	3.5	-1.9
100-year	8.2	5.2	-3.0

2.3 CLOSED DRAINAGE SYSTEM

No new closed drainage systems area being proposed. Permeable pavers are being proposed for the attenuation of the stormwater

2.4 PERFORMANCE STANDARDS

Stormwater performance standards have been implemented as part of the overall stormwater management plan for the proposed development. The goal of these standards is to improve water quality and protect the waters of New Hampshire from adverse impacts due to development. The performance standards are met by implementing appropriate Best Management Practices (BMPs). BMPs were designed in accordance with the NH Stormwater Management Manual and Env.Wq. 1500. See section 6.2 for design calculations.

BMPs implemented in the design include:

- Permeable Pavers
- Specific maintenance schedule

Reservoir Course Sizing*

25-yr storm event = 6.0" of rainfall depth
Reservoir Void Space = 35%
Reservoir Depth = 6.0" / 0.35 = 17.1" required

** UNHSC Design Specification for Porous Asphalt and Infiltration Beds by the University of New Hampshire Stormwater Center, October 2009.*

Water Quality Volume (WQV)

0.60 ac	A= Area draining to the practice
0.49 ac	A_1 = Impervious area draining to the practice
0.82 decimal	I = percent impervious area draining to the practice, in decimal fonn
0.79 unitless	Rv =Runoff coefficient = 0.05 + (0.9 xI)
0.47 ac-in	WQV= 1" x Rv x A
1,709 cf	WQV conversion (ac-in x 43,560 sf/ac x 1 ft/12")

Groundwater Recharge Volume (GRv)

There will be no loss of annual recharge to the groundwater. This is accomplished by a reduction in the total impervious area and the replacement of the impervious pavement with permeable pavers.

According to The Soil Survey of Strafford County, New Hampshire, the predominate soil of the site is identified by the US Department of Agricultural (USDA) Natural Resources Conservation Service (NRCS) as SfC - Suffield silt loam and a small portion being HcB -Hollis-Charlton fine sandy loams,. For the purposes of the drainage analysis the Hydrological Soil Group were based upon the Web Soil Survey data. The recharge volume calculation assumes the site is a Hydrologic Soil Group "C" (HSG-C).

Existing Impervious Area = 32,224± square feet
Proposed "Impervious" Area (includes porous pavement) = 39,559± square feet

Groundwater Recharge Volume *(GRv) = (R_d) x (A_I)*

Where:

GRv = Required Recharge Volume, expressed in cubic feet
R_d = Target Depth Factor associated with each Hydrologic Soil Group
A_I = proposed pavement, sidewalk, rooftop in square feet

Groundwater Recharge Volume *(GRv)* = *(R_d) x (A_I)*
= *(0.1 inches)*(l/12 inches/ft)* (39,559 square feet)*
= *(0.008 feet)*(39,559 square feet)*
= *329.7 ft^3*

Recharge Provided = (Porous Pavement Area)*(Porous Pavement Voids/effective depth)

Porous pavement area= 7,055 square feet

Porous pavement voids / effective depth:

(2" Bedding Course)* (30% VR)	= 0.6"
(4" Choker Course)* (35% VR)	= 1.4"
(8" Filter Course)* (30% VR)	=2.4"
(3" Filter Blanket)* (35% VR)	= 1.0"
(18" Reservoir Course) * (35% VR)	= 6.3"
Total effective depth	= 11.7"

Recharge Provided = (7,055 square feet)* (11.7"112) = 6 879 ft^3

Required Volume = *WQV + GRv*
= 1,709 ft^3 + 329.7 ft^3
= 2,039 ft^3

6,879 ft3 > 2,039 ft^3 Required

2.5 OPERATION AND MAINTENANCE PLAN

General Information
Allen & Major Associates, Inc. has prepared the following Operation and Maintenance Plan for Orion Student Housing located at 25 and 35 Main Street, Durham, NH. The plan is broken down into the following major sections. The first section gives general information about ownership and responsibility (General Information). The next section describes the erosion and sediment control measures used during construction (Construction Period). The third section describes the long term pollution prevention measures (Long Term Pollution Prevention Plan). The fourth section describes the proposed pervious pavement (Facilities Description). The last section describes the maintenance requirements for the pervious pavement and Bio-retention area (Maintenance Plan).

Contact Information

Stormwater Management System Owner: Orion UNH, LLC
225 Franklin Street, 26th floor
Boston, MA 02110
Attention: William Fideli

Notification Procedures for Change of Responsibility for O&M
The Stormwater Management System (SMS) for this project is owned by Orion UNH, LLC. The owner shall be legally responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner shall notify the Town that the succeeding owner has assumed such responsibility. Upon subsequent transfers, the responsibility shall continue to be that of transferring owner until the transferee owner notifies the Town of Durham of its assumption of responsibility.

In the event the SMS will serve multiple lots/owners, such as the subdivision of the existing parcel, the owner(s) shall establish an association or other legally enforceable arrangements under which the association or a single party shall have legal responsibility for the operation and maintenance of the entire SMS.

Construction Period

1. Contact the Town of Durham Engineering Department at least three (3) days prior to start of construction.

2. Install the coir logs, silt fence and construction fencing as shown on the enclosed Erosion and Sediment Control Plan.

3. Site access shall be achieved only from the designated construction entrance.

4. All erosion control measures shall be inspected weekly and after all rainfall events, and shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, or the Town's Engineer.

5. Sediment accumulation up-gradient of the hay bales and silt fence greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.

6. If it appears that sediment is exiting the site, silt sacks shall be installed in all catch basins adjacent to the site. Sediment accumulation on all adjacent catch basin inlets shall be removed and the silt sack replaced if torn or damaged.

7. The contractor shall comply with the General and Erosion Notes as shown on the Site Development Plans.

Post-Development Activities

1. Upon completion of all terrain alteration activities that direct stormwater to a particular practice, the responsible party (ies) shall initiate the O&M activities.

2. Paved Areas – Paved areas should be swept as part of the routine site maintenance. Pavement sweeping is an excellent source control for sedimentation to the existing drainage system and is typically performed in the spring of each year following the snow melt.

3. Salt for de-icing on the paved areas during the winter months shall be limited to the minimum amount practicable. Sand containing the minimum amount of calcium chloride (or approved equivalent) needed for handling may be applied as part of the routine winter maintenance activities.

4. All sediments removed from site drainage facilities shall be disposed of properly, and in accordance with applicable local and state regulations.

5. All vegetated areas on the site shall be stabilized and maintained to control erosion. Any disturbed areas shall be re-seeded as soon as practicable.

6. Work within any drainage structures shall performed in accordance with the latest OSHA regulations, and only by individuals with appropriate OSHA certification.

7. Maintenance Responsibilities - All post-construction maintenance activities shall be documented and kept on file and made available to the proper Town and State authorities upon request.

8. If ownership of the property is transferred, the new owner(s) shall become the responsible party (ies).

Long Term Pollution Prevention Plan

The Town of Durham requires that a Long Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

Housekeeping

The proposed site development has been designed to maintain a high level of water quality treatment for all stormwater discharge and groundwater. An Operation and Maintenance (O&M) plan has been prepared and is included in this section of the report. The Owner (or its designee) is responsible for adherence to the O&M plan in a strict and complete manner.

Storing of Materials and Waste Products

There are no proposed exterior (un-covered) storage areas. The trash and waste program for the site includes a dedicated space within the building for waste & recyclables.

Vehicle Washing

Outdoor vehicle washing has the potential to result in high loads of nutrients, metals, and hydrocarbons during dry weather conditions, as the detergent-rich water used to wash the grime off the vehicle enters the stormwater drainage system. The proposed project does not include any designated vehicle washing areas, nor is it expected that any vehicle washing will take place on-site. Resident car washing or charity car wash fundraisers are not anticipated at this site and would not be allowed.

Maintenance of Lawns, Gardens and other Landscaped Areas

It should be recognized that this is a general guideline towards achieving high quality and well groomed landscaped areas. The grounds staff / landscape contractor must recognize the shortcomings of a general maintenance plan such as this, and modify and/or augment it based on weekly, monthly, and yearly observations. In order to assure the highest quality conditions, the staff must also recognize and appreciate the need to be aware of the constantly changing conditions of the landscaping and be able to respond to them on a proactive basis. No trash or landscape debris (including lawn clippings) shall be stored or dumped within the landscaped or naturalized areas.

Fertilizer

Maintenance practices should be aimed at reducing environmental, mechanical and pest stresses to promote healthy and vigorous growth. When necessary, pest outbreaks should be treated with the most sensitive control measures available. Synthetic chemical controls should be used only as a last resort to organic and biological control methods. Fertilizer, synthetic chemical controls and pest management applications (when necessary) shall be performed only by licensed applicators in accordance with the manufacturer's label instructions when environmental conditions are conducive to controlled product application.

Only slow-release organic fertilizers should be used in the landscaped areas to limit the amount of nutrients that could enter downstream resource areas. Fertilization of developed areas on site will be performed within manufacturers labeling instructions and shall not exceed an NPK ratio of 1:1:1 (i.e. Triple 10 fertilizer mix), considered a low nitrogen mixture. Additionally, the fertilizer will include a slow release element.

Suggested Aeration Program

In-season aeration of lawn areas is good cultural practice, and is recommended whenever feasible. It should be accomplished with a solid thin tine aeration method to reduce disruption to the use of the area. The depth of solid tine aeration is similar to core type, but should be performed when the soil is somewhat drier for a greater overall effect.

Depending on the intensity of use, it can be expected that all landscaped lawn areas will need aeration to reduce compaction at least once per year. The first operation should occur in late May following the spring season. Methods of reducing compaction will vary based on the nature of the compaction. Compaction on newly established landscaped areas is generally limited to the top 2-3" and can be alleviated using hollow core or thin tine aeration methods.

Landscape Maintenance Program Practices:

Lawn	▪ Mow a minimum of once a week in spring, to a height of 2” to 2 1/2” high. Mowing should be frequent enough so that no more than 1/3 of grass blade is removed at each mowing. The top growth supports the roots; the shorter the grass is cut, the less the roots will grow. Short cutting also dries out the soil and encourages weeds to germinate. ▪ Mow approximately once every two weeks from July 1st to August 15th depending on lawn growth. ▪ Mow on a ten-day cycle in fall, when growth is stimulated by cooler nights and increased moisture. ▪ Do not remove grass clippings after mowing. ▪ Keep mower blades sharp to prevent ragged cuts on grass leaves, which cause a brownish appearance and increase the chance for disease to enter a leaf.
Shrubs	▪ Mulch not more than 3” depth with shredded pine or fir bark. ▪ Hand prune annually, immediately after blooming, to remove 1/3 of the above-ground biomass (older stems). Stem removals to occur within 6” of the ground to open up shrub and maintain two-year wood (the blooming wood). ▪ Fertilize with ½ lb. slow-release fertilizer (see above section on Fertilizer) every second year. ▪ Hand prune evergreen shrubs only as needed to remove dead and damaged wood and to maintain the naturalistic form of the shrub. Never mechanically shear evergreen shrubs.
Trees	▪ Provide aftercare for new tree plantings for the first three years. ▪ Do not fertilize trees, it artificially stimulates them (unless tree health warrants). ▪ Water once a week for the first year; twice a month the second, once a month the third year. ▪ Prune trees on a four-year cycle.

Management of Deicing Chemicals and Snow
Snow shall only be stockpiled on site within the snow storage areas depicted on the layout plan associated with the installation of permeable pavers. If the stockpiles of snow do not fit within the designated areas, then snow will be disposed off-site. It will be the responsibility of the snow removal contractor to properly dispose of transported snow according to the Town of Durham and NHDES. It will be the responsibility of the snow removal contractor to follow these guidelines and all applicable laws and regulations.

The owner (or its designee) will be responsible for the clearing of the sidewalk and building entrances. The Owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface; however, these are to be used at the minimum amount practicable. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the buildings. De-icing agents will not be stored outside.

No traction sand shall be allowed on-site. The permeable pavers areas are highly susceptible to plugging/failure should traction sand be applied. Also, studies have shown that significantly less de-icing chemicals are required for the pervious pavement. The University of New Hampshire has maintained their permeable pavers with a 75% reduction in de-icing agents.

FACILITIES DESCRIPTION

Pervious Pavement Areas
The majority of the pavement within the site is permeable pavers. The pervious pavement is designed for dual duty: it provides for parking and site access and also serves as stormwater storage and infiltration. From the bottom up, the pervious pavement structure consists of:

- An un-compacted level subgrade.
- A stone recharge bed consisting of clean, ¾" crushed stone. This course is considered the "reservoir course" and is a structural layer that also temporarily stores stormwater as it infiltrates in the soil below.
- A filter blanket comprised of pea-stone. The filter blanket prevents the filter course from migrating into the reservoir course.
- A filter course comprised of sand and gravel. The purpose of the filter course is to provide water quality treatment prior to recharge.
- A choker course comprised of ¾" crushed stone. The purpose of the choker course is to stabilize the surface for the paving equipment.
- Permeable Concrete Pavers – interlocking pavers with interconnected voids that allow stormwater to flow through the pavement into the reservoir course.

Sand must not be used for the control of snow and ice. For additional maintenance requirements, refer to the Long Term Maintenance Plan section.

MAINTENANCE PLAN

Documentation
Maintenance documents shall include a completed maintenance checklist (attached) that will include any applicable notes or other documents as described in this section. These will be submitted to the Winchester Building Department yearly.

Pervious Pavement Maintenance
Sand must not be used for the control of snow and ice. All pervious pavements should be inspected several times in the first few months after construction and at least quarterly thereafter. Pavement inspections should include, but not be limited to, unevenness, heaving, and settlement (particularly at boundaries. Inspections should be conducted during and after large storms (2" of rainfall in a 24-hour period) to check for surface ponding that might indicate possible clogging. To prevent clogging of pervious pavements, the areas shall be vacuum swept at least twice per year. Minimize the use of de-icing agents. Initial application rates should be 25% of a normal application rate. The results should be monitored and the application rates modified if necessary.

The Owner or its designee shall maintain records of the vacuum sweeping of the pervious pavement. Maintenance documents shall include a completed maintenance checklist (attached) upon which personnel should note any abnormalities, degradations, or corrective actions (or on an extra sheet attached to it).

Bio-Retention Area (Rain Garden) Maintenance
Remove any trash and debris within the bio-retention area on a quarterly basis. Inspect the rip-rap for signs of erosion or displaced stone. Replace the stone if needed. Annually inspect the side slopes of the bio-retention area for erosion and repair as needed using erosion control fabric and seeding. Note any abnormalities, degradations, sediment removal activities, or corrective actions on the Maintenance Checklist (or on an extra sheet attached to it).

Operation and Maintenance Schedule Summary
The following is a summary of the maintenance schedule for each of the stormwater BMPs. Note all anomalies, signs of degradation, or corrective actions on the annual Maintenance Checklist.

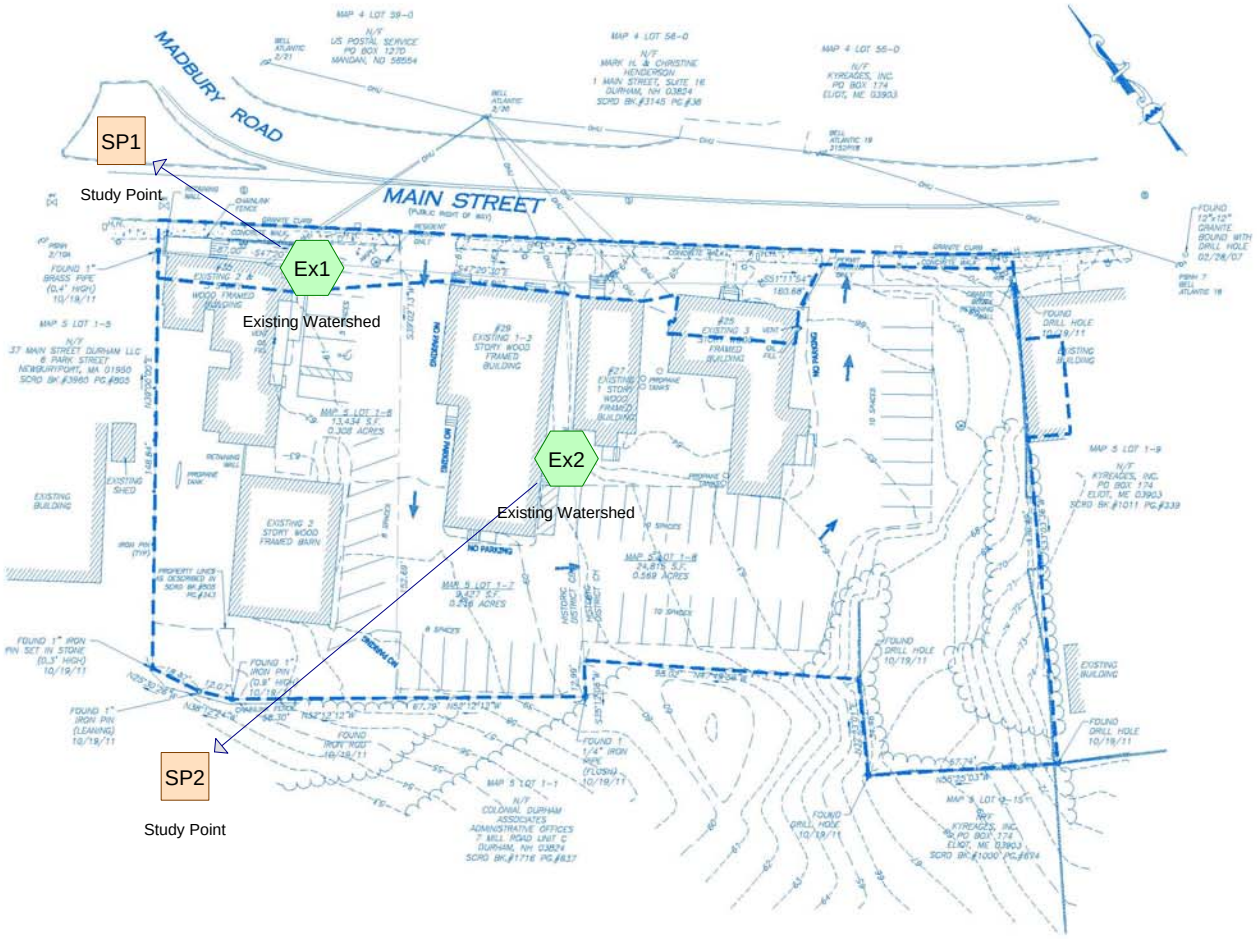
BMP	MAINTENANCE ITEM	FREQUENCY
Impervious Pavement	Perform vacuum sweeping. No Sand. Distribute de-icing agents and inspect according to narrative.	Inspect /sweep twice per year (Early spring & late fall)
Pervious Pavement	See narrative regarding inspections for settling, heaving, cracking, unraveling, etc. Inspect at the sloped area for signs of break-out. Use no sand. Distribute de-icing agents according to narrative. Perform vacuum sweeping according to narrative.	Inspect quarterly and after and during rainfall events (see narrative on page 6) Sweep twice per year (Early spring & late fall)
Bio-Retention Area	See narrative. Remove trash and debris & inspect rip rap. Inspect side slopes for erosion.	Remove trash quarterly. Other activities are annual

The Owner or its designee shall keep records of the maintenance of the Stormwater BMPs on a yearly basis. Maintenance documents shall include a completed maintenance checklist.

SECTION 3.0

PRE-DEVELOPMENT DRAINAGE CALCULATIONS

TYPE III, 2, 10, 25 & 100YR STORM EVENT



Subcat Reach Pond Link

Drainage Diagram for Pre

Prepared by Allen & Major Associates, Printed 1/13/2014

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
2,920	70	Woods, Good, HSG C (Ex2)
17,025	74	>75% Grass cover, Good, HSG C (Ex1, Ex2)
21,543	98	Paved parking, HSG C (Ex1, Ex2)
10,681	98	Roofs, HSG C (Ex1, Ex2)
52,169	89	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
52,169	HSG C	Ex1, Ex2
0	HSG D	
0	Other	
52,169		**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment Ex1: Existing Watershed Runoff Area=5,599 sf 68.21% Impervious Runoff Depth=2.09"
Flow Length=371' Tc=1.1 min CN=90 Runoff=0.3 cfs 977 cf

Subcatchment Ex2: Existing Watershed Runoff Area=46,570 sf 60.99% Impervious Runoff Depth=1.93"
Flow Length=305' Tc=9.4 min CN=88 Runoff=2.0 cfs 7,471 cf

Reach SP1: Study Point Inflow=0.3 cfs 977 cf
Outflow=0.3 cfs 977 cf

Reach SP2: Study Point Inflow=2.0 cfs 7,471 cf
Outflow=2.0 cfs 7,471 cf

Total Runoff Area = 52,169 sf Runoff Volume = 8,449 cf Average Runoff Depth = 1.94"
38.23% Pervious = 19,945 sf 61.77% Impervious = 32,224 sf

Summary for Subcatchment Ex1: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.3 cfs @ 12.01 hrs, Volume= 977 cf, Depth= 2.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
1,780	74	>75% Grass cover, Good, HSG C
0	70	Woods, Good, HSG C
2,830	98	Paved parking, HSG C
989	98	Roofs, HSG C
5,599	90	Weighted Average
1,780		31.79% Pervious Area
3,819		68.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0500	1.69		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.12"
0.6	323	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013 Asphalt, smooth
1.1	371	Total			

Summary for Subcatchment Ex2: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.0 cfs @ 12.13 hrs, Volume= 7,471 cf, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
15,245	74	>75% Grass cover, Good, HSG C
2,920	70	Woods, Good, HSG C
18,713	98	Paved parking, HSG C
9,692	98	Roofs, HSG C
46,570	88	Weighted Average
18,165		39.01% Pervious Area
28,405		60.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	35	0.1300	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.12"
1.7	270	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.4	305	Total			

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 5,599 sf, 68.21% Impervious, Inflow Depth = 2.09" for 2yr event
Inflow = 0.3 cfs @ 12.01 hrs, Volume= 977 cf
Outflow = 0.3 cfs @ 12.01 hrs, Volume= 977 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 46,570 sf, 60.99% Impervious, Inflow Depth = 1.93" for 2yr event
Inflow = 2.0 cfs @ 12.13 hrs, Volume= 7,471 cf
Outflow = 2.0 cfs @ 12.13 hrs, Volume= 7,471 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment Ex1: Existing Watershed Runoff Area=5,599 sf 68.21% Impervious Runoff Depth=3.62"
Flow Length=371' Tc=1.1 min CN=90 Runoff=0.5 cfs 1,687 cf

Subcatchment Ex2: Existing Watershed Runoff Area=46,570 sf 60.99% Impervious Runoff Depth=3.41"
Flow Length=305' Tc=9.4 min CN=88 Runoff=3.5 cfs 13,246 cf

Reach SP1: Study Point Inflow=0.5 cfs 1,687 cf
Outflow=0.5 cfs 1,687 cf

Reach SP2: Study Point Inflow=3.5 cfs 13,246 cf
Outflow=3.5 cfs 13,246 cf

Total Runoff Area = 52,169 sf Runoff Volume = 14,933 cf Average Runoff Depth = 3.43"
38.23% Pervious = 19,945 sf 61.77% Impervious = 32,224 sf

Summary for Subcatchment Ex1: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.5 cfs @ 12.01 hrs, Volume= 1,687 cf, Depth= 3.62"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

Area (sf)	CN	Description
1,780	74	>75% Grass cover, Good, HSG C
0	70	Woods, Good, HSG C
2,830	98	Paved parking, HSG C
989	98	Roofs, HSG C
5,599	90	Weighted Average
1,780		31.79% Pervious Area
3,819		68.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0500	1.69		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.12"
0.6	323	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013 Asphalt, smooth
1.1	371	Total			

Summary for Subcatchment Ex2: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 3.5 cfs @ 12.13 hrs, Volume= 13,246 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

Area (sf)	CN	Description
15,245	74	>75% Grass cover, Good, HSG C
2,920	70	Woods, Good, HSG C
18,713	98	Paved parking, HSG C
9,692	98	Roofs, HSG C
46,570	88	Weighted Average
18,165		39.01% Pervious Area
28,405		60.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	35	0.1300	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.12"
1.7	270	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.4	305	Total			

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 5,599 sf, 68.21% Impervious, Inflow Depth = 3.62" for 10yr event
Inflow = 0.5 cfs @ 12.01 hrs, Volume= 1,687 cf
Outflow = 0.5 cfs @ 12.01 hrs, Volume= 1,687 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 46,570 sf, 60.99% Impervious, Inflow Depth = 3.41" for 10yr event
Inflow = 3.5 cfs @ 12.13 hrs, Volume= 13,246 cf
Outflow = 3.5 cfs @ 12.13 hrs, Volume= 13,246 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment Ex1: Existing Watershed Runoff Area=5,599 sf 68.21% Impervious Runoff Depth=4.85"
Flow Length=371' Tc=1.1 min CN=90 Runoff=0.7 cfs 2,261 cf

Subcatchment Ex2: Existing Watershed Runoff Area=46,570 sf 60.99% Impervious Runoff Depth=4.63"
Flow Length=305' Tc=9.4 min CN=88 Runoff=4.7 cfs 17,952 cf

Reach SP1: Study Point Inflow=0.7 cfs 2,261 cf
Outflow=0.7 cfs 2,261 cf

Reach SP2: Study Point Inflow=4.7 cfs 17,952 cf
Outflow=4.7 cfs 17,952 cf

Total Runoff Area = 52,169 sf Runoff Volume = 20,213 cf Average Runoff Depth = 4.65"
38.23% Pervious = 19,945 sf 61.77% Impervious = 32,224 sf

Summary for Subcatchment Ex1: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.7 cfs @ 12.01 hrs, Volume= 2,261 cf, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

Area (sf)	CN	Description
1,780	74	>75% Grass cover, Good, HSG C
0	70	Woods, Good, HSG C
2,830	98	Paved parking, HSG C
989	98	Roofs, HSG C
5,599	90	Weighted Average
1,780		31.79% Pervious Area
3,819		68.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0500	1.69		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.12"
0.6	323	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013 Asphalt, smooth
1.1	371	Total			

Summary for Subcatchment Ex2: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.7 cfs @ 12.13 hrs, Volume= 17,952 cf, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

Area (sf)	CN	Description
15,245	74	>75% Grass cover, Good, HSG C
2,920	70	Woods, Good, HSG C
18,713	98	Paved parking, HSG C
9,692	98	Roofs, HSG C
46,570	88	Weighted Average
18,165		39.01% Pervious Area
28,405		60.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	35	0.1300	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.12"
1.7	270	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.4	305	Total			

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 5,599 sf, 68.21% Impervious, Inflow Depth = 4.85" for 25yr event
Inflow = 0.7 cfs @ 12.01 hrs, Volume= 2,261 cf
Outflow = 0.7 cfs @ 12.01 hrs, Volume= 2,261 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 46,570 sf, 60.99% Impervious, Inflow Depth = 4.63" for 25yr event
Inflow = 4.7 cfs @ 12.13 hrs, Volume= 17,952 cf
Outflow = 4.7 cfs @ 12.13 hrs, Volume= 17,952 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment Ex1: Existing Watershed Runoff Area=5,599 sf 68.21% Impervious Runoff Depth=7.39"
Flow Length=371' Tc=1.1 min CN=90 Runoff=1.1 cfs 3,447 cf

Subcatchment Ex2: Existing Watershed Runoff Area=46,570 sf 60.99% Impervious Runoff Depth=7.15"
Flow Length=305' Tc=9.4 min CN=88 Runoff=7.1 cfs 27,731 cf

Reach SP1: Study Point Inflow=1.1 cfs 3,447 cf
Outflow=1.1 cfs 3,447 cf

Reach SP2: Study Point Inflow=7.1 cfs 27,731 cf
Outflow=7.1 cfs 27,731 cf

Total Runoff Area = 52,169 sf Runoff Volume = 31,178 cf Average Runoff Depth = 7.17"
38.23% Pervious = 19,945 sf 61.77% Impervious = 32,224 sf

Summary for Subcatchment Ex1: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.1 cfs @ 12.01 hrs, Volume= 3,447 cf, Depth= 7.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

Area (sf)	CN	Description
1,780	74	>75% Grass cover, Good, HSG C
0	70	Woods, Good, HSG C
2,830	98	Paved parking, HSG C
989	98	Roofs, HSG C
5,599	90	Weighted Average
1,780		31.79% Pervious Area
3,819		68.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.5	48	0.0500	1.69		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.12"
0.6	323	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013 Asphalt, smooth
1.1	371	Total			

Summary for Subcatchment Ex2: Existing Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 7.1 cfs @ 12.13 hrs, Volume= 27,731 cf, Depth= 7.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

Area (sf)	CN	Description
15,245	74	>75% Grass cover, Good, HSG C
2,920	70	Woods, Good, HSG C
18,713	98	Paved parking, HSG C
9,692	98	Roofs, HSG C
46,570	88	Weighted Average
18,165		39.01% Pervious Area
28,405		60.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.7	35	0.1300	0.08		**Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.12"
1.7	270	0.0300	2.60		**Shallow Concentrated Flow,** Grassed Waterway Kv= 15.0 fps
9.4	305	Total			

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 5,599 sf, 68.21% Impervious, Inflow Depth = 7.39" for 100yr event
Inflow = 1.1 cfs @ 12.01 hrs, Volume= 3,447 cf
Outflow = 1.1 cfs @ 12.01 hrs, Volume= 3,447 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

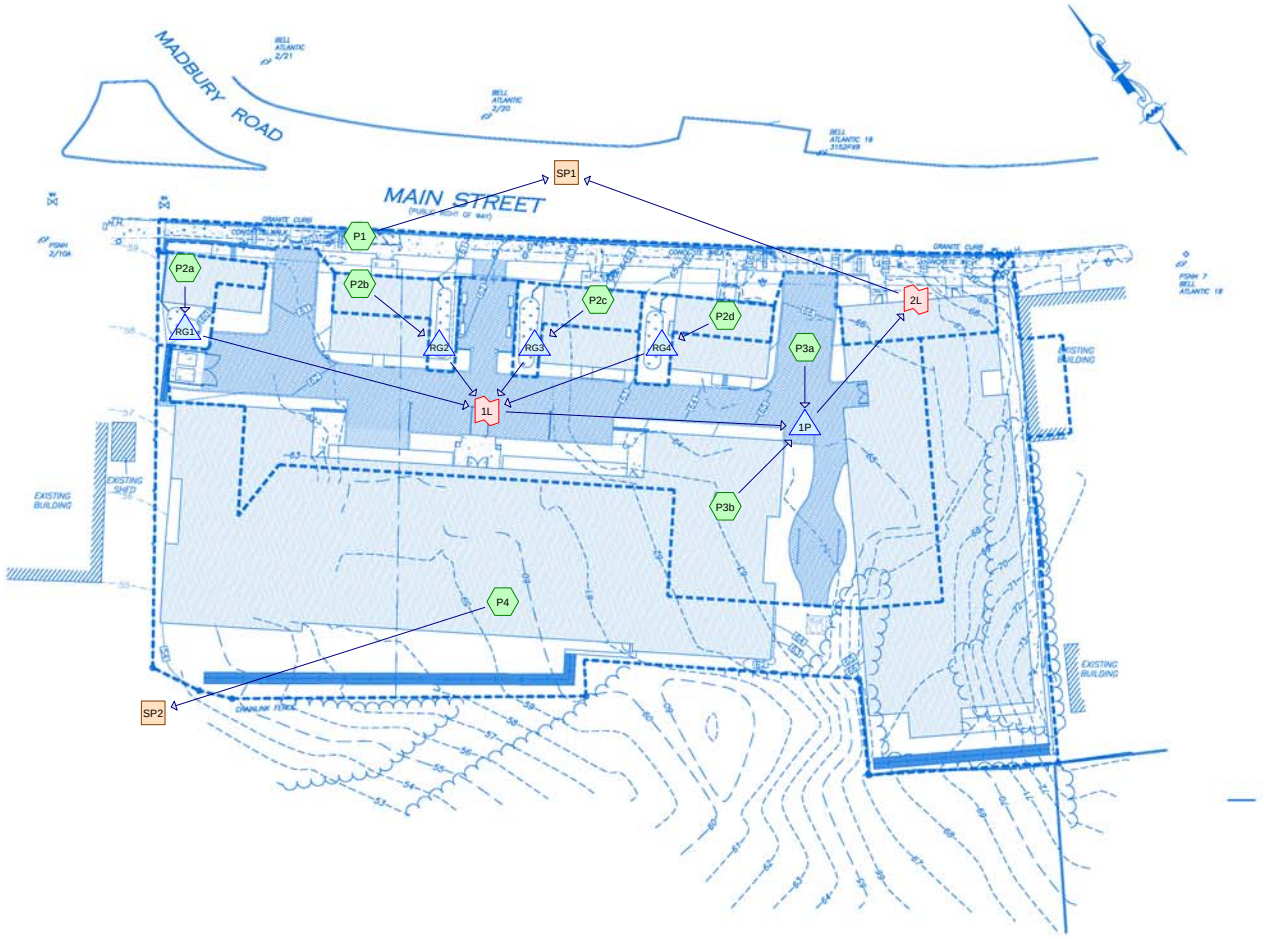
Inflow Area = 46,570 sf, 60.99% Impervious, Inflow Depth = 7.15" for 100yr event
Inflow = 7.1 cfs @ 12.13 hrs, Volume= 27,731 cf
Outflow = 7.1 cfs @ 12.13 hrs, Volume= 27,731 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

SECTION 4.0

POST-DEVELOPMENT DRAINAGE CALCULATIONS

TYPE III, 2, 10, 25 & 100YR STORM EVENT



Subcat Reach Pond Link

Drainage Diagram for Post_rev1

Prepared by Allen & Major Associates, Printed 1/13/2014

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
12,610	74	>75% Grass cover, Good, HSG C (P1, P2a, P2b, P2c, P2d, P3b, P4)
4,378	98	Paved parking, HSG C (P1, P3b, P4)
7,055	98	Permeable Pavers (P3a)
28,126	98	Roofs, HSG C (P1, P2a, P2b, P2c, P2d, P3b, P4)
52,169	92	**TOTAL AREA**

Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
45,114	HSG C	P1, P2a, P2b, P2c, P2d, P3b, P4
0	HSG D	
7,055	Other	P3a
52,169		**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Proposed Watershed Runoff Area=5,193 sf 70.09% Impervious Runoff Depth=2.18"
Flow Length=341' Tc=5.0 min CN=91 Runoff=0.3 cfs 945 cf

Subcatchment P2a: Proposed Watershed Runoff Area=817 sf 58.63% Impervious Runoff Depth=1.93"
Tc=5.0 min CN=88 Runoff=0.0 cfs 131 cf

Subcatchment P2b: Proposed Watershed Runoff Area=817 sf 59.98% Impervious Runoff Depth=1.93"
Tc=5.0 min CN=88 Runoff=0.0 cfs 131 cf

Subcatchment P2c: Proposed Watershed Runoff Area=799 sf 61.20% Impervious Runoff Depth=2.01"
Tc=5.0 min CN=89 Runoff=0.0 cfs 134 cf

Subcatchment P2d: Proposed Watershed Runoff Area=844 sf 55.21% Impervious Runoff Depth=1.84"
Tc=5.0 min CN=87 Runoff=0.0 cfs 130 cf

Subcatchment P3a: Pavers Runoff Area=7,055 sf 100.00% Impervious Runoff Depth=2.89"
Tc=463.0 min CN=98 Runoff=0.0 cfs 1,698 cf

Subcatchment P3b: Proposed Watershed Runoff Area=11,905 sf 74.35% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=92 Runoff=0.7 cfs 2,257 cf

Subcatchment P4: Proposed Watershed Runoff Area=24,739 sf 73.12% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=92 Runoff=1.4 cfs 4,689 cf

Reach SP1: Study Point Inflow=0.3 cfs 945 cf
Outflow=0.3 cfs 945 cf

Reach SP2: Study Point Inflow=1.4 cfs 4,689 cf
Outflow=1.4 cfs 4,689 cf

Pond 1P: Storage under pavers Peak Elev=59.01' Storage=875 cf Inflow=0.7 cfs 3,954 cf
Discarded=0.1 cfs 3,961 cf Primary=0.0 cfs 0 cf Outflow=0.1 cfs 3,961 cf

Pond RG1: Rain Garden Peak Elev=61.53' Storage=69 cf Inflow=0.0 cfs 131 cf
Discarded=0.0 cfs 131 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 131 cf

Pond RG2: Rain Garden Peak Elev=61.53' Storage=69 cf Inflow=0.0 cfs 131 cf
Discarded=0.0 cfs 131 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 131 cf

Pond RG3: Rain Garden Peak Elev=61.54' Storage=70 cf Inflow=0.0 cfs 134 cf
Discarded=0.0 cfs 134 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 134 cf

Pond RG4: Rain Garden Peak Elev=61.52' Storage=68 cf Inflow=0.0 cfs 130 cf
Discarded=0.0 cfs 130 cf Primary=0.0 cfs 0 cf Outflow=0.0 cfs 130 cf

Link 1L: (new Link) Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

Link 2L: Link Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

Total Runoff Area = 52,169 sf Runoff Volume = 10,114 cf Average Runoff Depth = 2.33"
24.17% Pervious = 12,610 sf 75.83% Impervious = 39,559 sf

Summary for Subcatchment P1: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.3 cfs @ 12.09 hrs, Volume= 945 cf, Depth= 2.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

	Area (sf)	CN	Description
	749	98	Roofs, HSG C
	1,553	74	>75% Grass cover, Good, HSG C
	2,891	98	Paved parking, HSG C
*	0	98	Permeable Pavers
	5,193	91	Weighted Average
	1,553		29.91% Pervious Area
	3,640		70.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	48	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.12"
0.5	293	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
4.3	341	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment P2a: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.0 cfs @ 12.09 hrs, Volume= 131 cf, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
479	98	Roofs, HSG C
338	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
817	88	Weighted Average
338		41.37% Pervious Area
479		58.63% Impervious Area

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

Summary for Subcatchment P2b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.0 cfs @ 12.09 hrs, Volume= 131 cf, Depth= 1.93"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
490	98	Roofs, HSG C
327	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
817	88	Weighted Average
327		40.02% Pervious Area
490		59.98% Impervious Area

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

Summary for Subcatchment P2c: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.0 cfs @ 12.09 hrs, Volume= 134 cf, Depth= 2.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
489	98	Roofs, HSG C
310	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
799	89	Weighted Average
310		38.80% Pervious Area
489		61.20% Impervious Area

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

Summary for Subcatchment P2d: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.0 cfs @ 12.09 hrs, Volume= 130 cf, Depth= 1.84"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
466	98	Roofs, HSG C
378	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
844	87	Weighted Average
378		44.79% Pervious Area
466		55.21% Impervious Area

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

Summary for Subcatchment P3a: Pavers

Runoff = 0.0 cfs @ 17.97 hrs, Volume= 1,698 cf, Depth= 2.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

	Area (sf)	CN	Description
*	7,055	98	Permeable Pavers
	7,055		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
463.0					**Direct Entry, Volume to Pavers**

Summary for Subcatchment P3b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.7 cfs @ 12.09 hrs, Volume= 2,257 cf, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
8,220	98	Roofs, HSG C
3,054	74	>75% Grass cover, Good, HSG C
631	98	Paved parking, HSG C
11,905	92	Weighted Average
3,054		25.65% Pervious Area
8,851		74.35% Impervious Area

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

Summary for Subcatchment P4: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.4 cfs @ 12.09 hrs, Volume= 4,689 cf, Depth= 2.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 2yr Rainfall=3.12"

Area (sf)	CN	Description
17,233	98	Roofs, HSG C
6,650	74	>75% Grass cover, Good, HSG C
856	98	Paved parking, HSG C
24,739	92	Weighted Average
6,650		26.88% Pervious Area
18,089		73.12% Impervious Area

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

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 27,430 sf, 78.27% Impervious, Inflow Depth = 0.41" for 2yr event
Inflow = 0.3 cfs @ 12.09 hrs, Volume= 945 cf
Outflow = 0.3 cfs @ 12.09 hrs, Volume= 945 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 24,739 sf, 73.12% Impervious, Inflow Depth = 2.27" for 2yr event
Inflow = 1.4 cfs @ 12.09 hrs, Volume= 4,689 cf
Outflow = 1.4 cfs @ 12.09 hrs, Volume= 4,689 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Pond 1P: Storage under pavers

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 2.13" for 2yr event
Inflow = 0.7 cfs @ 12.09 hrs, Volume= 3,954 cf
Outflow = 0.1 cfs @ 13.26 hrs, Volume= 3,961 cf, Atten= 90%, Lag= 70.2 min
Discarded = 0.1 cfs @ 13.26 hrs, Volume= 3,961 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 59.01' @ 13.26 hrs Surf.Area= 7,055 sf Storage= 875 cf
Flood Elev= 62.00' Surf.Area= 35,275 sf Storage= 7,334 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=138.4 min (1,099.6 - 961.2)

Volume	Invert	Avail.Storage	Storage Description
#1	61.58'	360 cf	**Bedding Course (2") (Conic)** Listed below (Recalc) 1,199 cf Overall x 30.0% Voids
#2	61.08'	1,235 cf	**Choker Course (4") (Conic)** Listed below (Recalc) 3,528 cf Overall x 35.0% Voids
#3	60.41'	1,418 cf	**Filter Course (8") (Conic)** Listed below (Recalc) 4,727 cf Overall x 30.0% Voids
#4	60.16'	617 cf	**Filter Blanket (3") (Conic)** Listed below (Recalc) 1,764 cf Overall x 35.0% Voids
#5	58.66'	3,704 cf	**Reservoir Course (18") (Conic)** Listed below (Recalc) 10,583 cf Overall x 35.0% Voids
		7,334 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.58	7,055	0	0	7,055
61.75	7,055	1,199	1,199	7,106

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.08	7,055	0	0	7,055
61.58	7,055	3,528	3,528	7,204

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.41	7,055	0	0	7,055
61.08	7,055	4,727	4,727	7,254

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.16	7,055	0	0	7,055
60.41	7,055	1,764	1,764	7,129

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
58.66	7,055	0	0	7,055
60.16	7,055	10,583	10,583	7,502

Device	Routing	Invert	Outlet Devices
#1	Discarded	58.66'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**25.0' long x 25.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.1 cfs @ 13.26 hrs HW=59.01' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=58.66' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond RG1: Rain Garden

Inflow Area = 817 sf, 58.63% Impervious, Inflow Depth = 1.93" for 2yr event
Inflow = 0.0 cfs @ 12.09 hrs, Volume= 131 cf
Outflow = 0.0 cfs @ 14.01 hrs, Volume= 131 cf, Atten= 94%, Lag= 115.1 min
Discarded = 0.0 cfs @ 14.01 hrs, Volume= 131 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 61.53' @ 14.01 hrs Surf.Area= 221 sf Storage= 69 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=434.8 min calculated for 131 cf (100% of inflow)
Center-of-Mass det. time=435.5 min (1,250.6 - 815.2)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 14.01 hrs HW=61.53' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=60.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond RG2: Rain Garden

Inflow Area = 817 sf, 59.98% Impervious, Inflow Depth = 1.93" for 2yr event
Inflow = 0.0 cfs @ 12.09 hrs, Volume= 131 cf
Outflow = 0.0 cfs @ 14.01 hrs, Volume= 131 cf, Atten= 94%, Lag= 115.1 min
Discarded = 0.0 cfs @ 14.01 hrs, Volume= 131 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 61.53' @ 14.01 hrs Surf.Area= 221 sf Storage= 69 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=434.8 min calculated for 131 cf (100% of inflow)
Center-of-Mass det. time=435.5 min (1,250.6 - 815.2)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 14.01 hrs HW=61.53' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=60.00' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond RG3: Rain Garden

Inflow Area = 799 sf, 61.20% Impervious, Inflow Depth = 2.01" for 2yr event
Inflow = 0.0 cfs @ 12.09 hrs, Volume= 134 cf
Outflow = 0.0 cfs @ 14.00 hrs, Volume= 134 cf, Atten= 94%, Lag= 114.5 min
Discarded = 0.0 cfs @ 14.00 hrs, Volume= 134 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 61.54' @ 14.00 hrs Surf.Area= 222 sf Storage= 70 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=430.1 min (1,241.2 - 811.2)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 14.00 hrs HW=61.54' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=60.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond RG4: Rain Garden

Inflow Area = 844 sf, 55.21% Impervious, Inflow Depth = 1.84" for 2yr event
Inflow = 0.0 cfs @ 12.09 hrs, Volume= 130 cf
Outflow = 0.0 cfs @ 14.03 hrs, Volume= 130 cf, Atten= 93%, Lag= 116.6 min
Discarded = 0.0 cfs @ 14.03 hrs, Volume= 130 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 61.52' @ 14.03 hrs Surf.Area= 221 sf Storage= 68 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=441.6 min (1,260.6 - 819.0)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 14.03 hrs HW=61.52' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=60.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Link 1L: (new Link)

Inflow Area = 3,277 sf, 58.71% Impervious, Inflow Depth = 0.00" for 2yr event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Summary for Link 2L: Link

Linked used for internal modeling only as emergency overflow.

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 0.00" for 2yr event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Proposed Watershed Runoff Area=5,193 sf 70.09% Impervious Runoff Depth=3.72"
Flow Length=341' Tc=5.0 min CN=91 Runoff=0.5 cfs 1,610 cf

Subcatchment P2a: Proposed Watershed Runoff Area=817 sf 58.63% Impervious Runoff Depth=3.41"
Tc=5.0 min CN=88 Runoff=0.1 cfs 232 cf

Subcatchment P2b: Proposed Watershed Runoff Area=817 sf 59.98% Impervious Runoff Depth=3.41"
Tc=5.0 min CN=88 Runoff=0.1 cfs 232 cf

Subcatchment P2c: Proposed Watershed Runoff Area=799 sf 61.20% Impervious Runoff Depth=3.51"
Tc=5.0 min CN=89 Runoff=0.1 cfs 234 cf

Subcatchment P2d: Proposed Watershed Runoff Area=844 sf 55.21% Impervious Runoff Depth=3.31"
Tc=5.0 min CN=87 Runoff=0.1 cfs 233 cf

Subcatchment P3a: Pavers Runoff Area=7,055 sf 100.00% Impervious Runoff Depth=4.49"
Tc=463.0 min CN=98 Runoff=0.1 cfs 2,642 cf

Subcatchment P3b: Proposed Watershed Runoff Area=11,905 sf 74.35% Impervious Runoff Depth=3.83"
Tc=5.0 min CN=92 Runoff=1.1 cfs 3,796 cf

Subcatchment P4: Proposed Watershed Runoff Area=24,739 sf 73.12% Impervious Runoff Depth=3.83"
Tc=5.0 min CN=92 Runoff=2.3 cfs 7,887 cf

Reach SP1: Study Point Inflow=0.5 cfs 1,610 cf
Outflow=0.5 cfs 1,610 cf

Reach SP2: Study Point Inflow=2.3 cfs 7,887 cf
Outflow=2.3 cfs 7,887 cf

Pond 1P: Storage under pavers Peak Elev=59.67' Storage=2,496 cf Inflow=1.1 cfs 6,484 cf
Discarded=0.1 cfs 6,488 cf Primary=0.0 cfs 0 cf Outflow=0.1 cfs 6,488 cf

Pond RG1: Rain Garden Peak Elev=62.00' Storage=129 cf Inflow=0.1 cfs 232 cf
Discarded=0.0 cfs 221 cf Primary=0.0 cfs 11 cf Outflow=0.0 cfs 232 cf

Pond RG2: Rain Garden Peak Elev=62.00' Storage=129 cf Inflow=0.1 cfs 232 cf
Discarded=0.0 cfs 221 cf Primary=0.0 cfs 11 cf Outflow=0.0 cfs 232 cf

Pond RG3: Rain Garden Peak Elev=62.00' Storage=129 cf Inflow=0.1 cfs 234 cf
Discarded=0.0 cfs 222 cf Primary=0.0 cfs 12 cf Outflow=0.0 cfs 234 cf

Pond RG4: Rain Garden Peak Elev=62.00' Storage=129 cf Inflow=0.1 cfs 233 cf
Discarded=0.0 cfs 221 cf Primary=0.0 cfs 12 cf Outflow=0.0 cfs 233 cf

Link 1L: (new Link) Inflow=0.0 cfs 46 cf
Primary=0.0 cfs 46 cf

Link 2L: Link Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

Total Runoff Area = 52,169 sf Runoff Volume = 16,867 cf Average Runoff Depth = 3.88"
24.17% Pervious = 12,610 sf 75.83% Impervious = 39,559 sf

Summary for Subcatchment P1: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.5 cfs @ 12.09 hrs, Volume= 1,610 cf, Depth= 3.72"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

	Area (sf)	CN	Description
	749	98	Roofs, HSG C
	1,553	74	>75% Grass cover, Good, HSG C
	2,891	98	Paved parking, HSG C
*	0	98	Permeable Pavers
	5,193	91	Weighted Average
	1,553		29.91% Pervious Area
	3,640		70.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	48	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.12"
0.5	293	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
4.3	341	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment P2a: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 232 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

	Area (sf)	CN	Description
	479	98	Roofs, HSG C
	338	74	>75% Grass cover, Good, HSG C
	0	98	Paved parking, HSG C
	817	88	Weighted Average
	338		41.37% Pervious Area
	479		58.63% Impervious Area

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

Summary for Subcatchment P2b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 232 cf, Depth= 3.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

	Area (sf)	CN	Description
	490	98	Roofs, HSG C
	327	74	>75% Grass cover, Good, HSG C
	0	98	Paved parking, HSG C
	817	88	Weighted Average
	327		40.02% Pervious Area
	490		59.98% Impervious Area

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

Summary for Subcatchment P2c: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 234 cf, Depth= 3.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

Area (sf)	CN	Description
489	98	Roofs, HSG C
310	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
799	89	Weighted Average
310		38.80% Pervious Area
489		61.20% Impervious Area

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

Summary for Subcatchment P2d: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 233 cf, Depth= 3.31"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

Area (sf)	CN	Description
466	98	Roofs, HSG C
378	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
844	87	Weighted Average
378		44.79% Pervious Area
466		55.21% Impervious Area

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

Summary for Subcatchment P3a: Pavers

Runoff = 0.1 cfs @ 17.96 hrs, Volume= 2,642 cf, Depth= 4.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

	Area (sf)	CN	Description
*	7,055	98	Permeable Pavers
	7,055		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
463.0					**Direct Entry, Volume to Pavers**

Summary for Subcatchment P3b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.1 cfs @ 12.09 hrs, Volume= 3,796 cf, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

Area (sf)	CN	Description
8,220	98	Roofs, HSG C
3,054	74	>75% Grass cover, Good, HSG C
631	98	Paved parking, HSG C
11,905	92	Weighted Average
3,054		25.65% Pervious Area
8,851		74.35% Impervious Area

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

Summary for Subcatchment P4: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.3 cfs @ 12.09 hrs, Volume= 7,887 cf, Depth= 3.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 10yr Rainfall=4.73"

Area (sf)	CN	Description
17,233	98	Roofs, HSG C
6,650	74	>75% Grass cover, Good, HSG C
856	98	Paved parking, HSG C
24,739	92	Weighted Average
6,650		26.88% Pervious Area
18,089		73.12% Impervious Area

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

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 27,430 sf, 78.27% Impervious, Inflow Depth = 0.70" for 10yr event
Inflow = 0.5 cfs @ 12.09 hrs, Volume= 1,610 cf
Outflow = 0.5 cfs @ 12.09 hrs, Volume= 1,610 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 24,739 sf, 73.12% Impervious, Inflow Depth = 3.83" for 10yr event
Inflow = 2.3 cfs @ 12.09 hrs, Volume= 7,887 cf
Outflow = 2.3 cfs @ 12.09 hrs, Volume= 7,887 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Pond 1P: Storage under pavers

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 3.50" for 10yr event
Inflow = 1.1 cfs @ 12.09 hrs, Volume= 6,484 cf
Outflow = 0.1 cfs @ 20.80 hrs, Volume= 6,488 cf, Atten= 94%, Lag= 523.1 min
Discarded = 0.1 cfs @ 20.80 hrs, Volume= 6,488 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 59.67' @ 20.80 hrs Surf.Area= 7,055 sf Storage= 2,496 cf
Flood Elev= 62.00' Surf.Area= 35,275 sf Storage= 7,334 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=374.7 min (1,316.2 - 941.5)

Volume	Invert	Avail.Storage	Storage Description
#1	61.58'	360 cf	**Bedding Course (2") (Conic)** Listed below (Recalc) 1,199 cf Overall x 30.0% Voids
#2	61.08'	1,235 cf	**Choker Course (4") (Conic)** Listed below (Recalc) 3,528 cf Overall x 35.0% Voids
#3	60.41'	1,418 cf	**Filter Course (8") (Conic)** Listed below (Recalc) 4,727 cf Overall x 30.0% Voids
#4	60.16'	617 cf	**Filter Blanket (3") (Conic)** Listed below (Recalc) 1,764 cf Overall x 35.0% Voids
#5	58.66'	3,704 cf	**Reservoir Course (18") (Conic)** Listed below (Recalc) 10,583 cf Overall x 35.0% Voids
		7,334 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.58	7,055	0	0	7,055
61.75	7,055	1,199	1,199	7,106

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.08	7,055	0	0	7,055
61.58	7,055	3,528	3,528	7,204

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.41	7,055	0	0	7,055
61.08	7,055	4,727	4,727	7,254

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.16	7,055	0	0	7,055
60.41	7,055	1,764	1,764	7,129

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
58.66	7,055	0	0	7,055
60.16	7,055	10,583	10,583	7,502

Device	Routing	Invert	Outlet Devices
#1	Discarded	58.66'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**25.0' long x 25.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.1 cfs @ 20.80 hrs HW=59.67' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=58.66' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond RG1: Rain Garden

Inflow Area = 817 sf, 58.63% Impervious, Inflow Depth = 3.41" for 10yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 232 cf
Outflow = 0.0 cfs @ 13.14 hrs, Volume= 232 cf, Atten= 91%, Lag= 63.0 min
Discarded = 0.0 cfs @ 13.10 hrs, Volume= 221 cf
Primary = 0.0 cfs @ 13.14 hrs, Volume= 11 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.00' @ 13.10 hrs Surf.Area= 249 sf Storage= 129 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=505.8 min calculated for 232 cf (100% of inflow)
Center-of-Mass det. time=506.5 min (1,305.5 - 799.0)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 13.10 hrs HW=62.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 13.14 hrs HW=62.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.16 fps)

Summary for Pond RG2: Rain Garden

Inflow Area = 817 sf, 59.98% Impervious, Inflow Depth = 3.41" for 10yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 232 cf
Outflow = 0.0 cfs @ 13.14 hrs, Volume= 232 cf, Atten= 91%, Lag= 63.0 min
Discarded = 0.0 cfs @ 13.10 hrs, Volume= 221 cf
Primary = 0.0 cfs @ 13.14 hrs, Volume= 11 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.00' @ 13.10 hrs Surf.Area= 249 sf Storage= 129 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=505.8 min calculated for 232 cf (100% of inflow)
Center-of-Mass det. time=506.5 min (1,305.5 - 799.0)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 13.10 hrs HW=62.00' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 13.14 hrs HW=62.00' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.16 fps)

Summary for Pond RG3: Rain Garden

Inflow Area = 799 sf, 61.20% Impervious, Inflow Depth = 3.51" for 10yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 234 cf
Outflow = 0.0 cfs @ 13.03 hrs, Volume= 234 cf, Atten= 89%, Lag= 56.4 min
Discarded = 0.0 cfs @ 13.03 hrs, Volume= 222 cf
Primary = 0.0 cfs @ 13.03 hrs, Volume= 12 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.00' @ 13.03 hrs Surf.Area= 249 sf Storage= 129 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=501.3 min calculated for 234 cf (100% of inflow)
Center-of-Mass det. time=502.2 min (1,297.6 - 795.4)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 13.03 hrs HW=62.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 13.03 hrs HW=62.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.17 fps)

Summary for Pond RG4: Rain Garden

Inflow Area = 844 sf, 55.21% Impervious, Inflow Depth = 3.31" for 10yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 233 cf
Outflow = 0.0 cfs @ 13.15 hrs, Volume= 233 cf, Atten= 91%, Lag= 63.4 min
Discarded = 0.0 cfs @ 13.10 hrs, Volume= 221 cf
Primary = 0.0 cfs @ 13.15 hrs, Volume= 12 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.00' @ 13.10 hrs Surf.Area= 249 sf Storage= 129 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=506.6 min calculated for 233 cf (100% of inflow)
Center-of-Mass det. time=507.5 min (1,309.8 - 802.4)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 13.10 hrs HW=62.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.0 cfs @ 13.15 hrs HW=62.00' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.0 cfs @ 0.16 fps)

Summary for Link 1L: (new Link)

Inflow Area = 3,277 sf, 58.71% Impervious, Inflow Depth = 0.17" for 10yr event
Inflow = 0.0 cfs @ 13.14 hrs, Volume= 46 cf
Primary = 0.0 cfs @ 13.14 hrs, Volume= 46 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Summary for Link 2L: Link

Linked used for internal modeling only as emergency overflow.

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 0.00" for 10yr event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Proposed Watershed Runoff Area=5,193 sf 70.09% Impervious Runoff Depth=4.96"
Flow Length=341' Tc=5.0 min CN=91 Runoff=0.6 cfs 2,145 cf

Subcatchment P2a: Proposed Watershed Runoff Area=817 sf 58.63% Impervious Runoff Depth=4.63"
Tc=5.0 min CN=88 Runoff=0.1 cfs 315 cf

Subcatchment P2b: Proposed Watershed Runoff Area=817 sf 59.98% Impervious Runoff Depth=4.63"
Tc=5.0 min CN=88 Runoff=0.1 cfs 315 cf

Subcatchment P2c: Proposed Watershed Runoff Area=799 sf 61.20% Impervious Runoff Depth=4.74"
Tc=5.0 min CN=89 Runoff=0.1 cfs 315 cf

Subcatchment P2d: Proposed Watershed Runoff Area=844 sf 55.21% Impervious Runoff Depth=4.52"
Tc=5.0 min CN=87 Runoff=0.1 cfs 318 cf

Subcatchment P3a: Pavers Runoff Area=7,055 sf 100.00% Impervious Runoff Depth=5.76"
Tc=463.0 min CN=98 Runoff=0.1 cfs 3,387 cf

Subcatchment P3b: Proposed Watershed Runoff Area=11,905 sf 74.35% Impervious Runoff Depth=5.07"
Tc=5.0 min CN=92 Runoff=1.4 cfs 5,029 cf

Subcatchment P4: Proposed Watershed Runoff Area=24,739 sf 73.12% Impervious Runoff Depth=5.07"
Tc=5.0 min CN=92 Runoff=2.9 cfs 10,451 cf

Reach SP1: Study Point Inflow=0.6 cfs 2,145 cf
Outflow=0.6 cfs 2,145 cf

Reach SP2: Study Point Inflow=2.9 cfs 10,451 cf
Outflow=2.9 cfs 10,451 cf

Pond 1P: Storage under pavers Peak Elev=60.16' Storage=3,704 cf Inflow=1.4 cfs 8,729 cf
Discarded=0.1 cfs 8,738 cf Primary=0.0 cfs 0 cf Outflow=0.1 cfs 8,738 cf

Pond RG1: Rain Garden Peak Elev=62.02' Storage=131 cf Inflow=0.1 cfs 315 cf
Discarded=0.0 cfs 238 cf Primary=0.1 cfs 77 cf Outflow=0.1 cfs 315 cf

Pond RG2: Rain Garden Peak Elev=62.02' Storage=131 cf Inflow=0.1 cfs 315 cf
Discarded=0.0 cfs 238 cf Primary=0.1 cfs 77 cf Outflow=0.1 cfs 315 cf

Pond RG3: Rain Garden Peak Elev=62.02' Storage=131 cf Inflow=0.1 cfs 315 cf
Discarded=0.0 cfs 238 cf Primary=0.1 cfs 77 cf Outflow=0.1 cfs 315 cf

Pond RG4: Rain Garden Peak Elev=62.02' Storage=131 cf Inflow=0.1 cfs 318 cf
Discarded=0.0 cfs 238 cf Primary=0.1 cfs 80 cf Outflow=0.1 cfs 318 cf

Link 1L: (new Link) Inflow=0.2 cfs 312 cf
Primary=0.2 cfs 312 cf

Link 2L: Link Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

Total Runoff Area = 52,169 sf Runoff Volume = 22,276 cf Average Runoff Depth = 5.12"
24.17% Pervious = 12,610 sf 75.83% Impervious = 39,559 sf

Summary for Subcatchment P1: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.6 cfs @ 12.09 hrs, Volume= 2,145 cf, Depth= 4.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

	Area (sf)	CN	Description
	749	98	Roofs, HSG C
	1,553	74	>75% Grass cover, Good, HSG C
	2,891	98	Paved parking, HSG C
*	0	98	Permeable Pavers
	5,193	91	Weighted Average
	1,553		29.91% Pervious Area
	3,640		70.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	48	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.12"
0.5	293	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
4.3	341	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment P2a: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 315 cf, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

	Area (sf)	CN	Description
	479	98	Roofs, HSG C
	338	74	>75% Grass cover, Good, HSG C
	0	98	Paved parking, HSG C
	817	88	Weighted Average
	338		41.37% Pervious Area
	479		58.63% Impervious Area

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

Summary for Subcatchment P2b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 315 cf, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

	Area (sf)	CN	Description
	490	98	Roofs, HSG C
	327	74	>75% Grass cover, Good, HSG C
	0	98	Paved parking, HSG C
	817	88	Weighted Average
	327		40.02% Pervious Area
	490		59.98% Impervious Area

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

Summary for Subcatchment P2c: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 315 cf, Depth= 4.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

Area (sf)	CN	Description
489	98	Roofs, HSG C
310	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
799	89	Weighted Average
310		38.80% Pervious Area
489		61.20% Impervious Area

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

Summary for Subcatchment P2d: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 318 cf, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

Area (sf)	CN	Description
466	98	Roofs, HSG C
378	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
844	87	Weighted Average
378		44.79% Pervious Area
466		55.21% Impervious Area

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

Summary for Subcatchment P3a: Pavers

Runoff = 0.1 cfs @ 17.96 hrs, Volume= 3,387 cf, Depth= 5.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

	Area (sf)	CN	Description
*	7,055	98	Permeable Pavers
	7,055		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
463.0					**Direct Entry, Volume to Pavers**

Summary for Subcatchment P3b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 1.4 cfs @ 12.09 hrs, Volume= 5,029 cf, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

Area (sf)	CN	Description
8,220	98	Roofs, HSG C
3,054	74	>75% Grass cover, Good, HSG C
631	98	Paved parking, HSG C
11,905	92	Weighted Average
3,054		25.65% Pervious Area
8,851		74.35% Impervious Area

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

Summary for Subcatchment P4: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.9 cfs @ 12.09 hrs, Volume= 10,451 cf, Depth= 5.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 25yr Rainfall=6.00"

Area (sf)	CN	Description
17,233	98	Roofs, HSG C
6,650	74	>75% Grass cover, Good, HSG C
856	98	Paved parking, HSG C
24,739	92	Weighted Average
6,650		26.88% Pervious Area
18,089		73.12% Impervious Area

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

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 27,430 sf, 78.27% Impervious, Inflow Depth = 0.94" for 25yr event
Inflow = 0.6 cfs @ 12.09 hrs, Volume= 2,145 cf
Outflow = 0.6 cfs @ 12.09 hrs, Volume= 2,145 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 24,739 sf, 73.12% Impervious, Inflow Depth = 5.07" for 25yr event
Inflow = 2.9 cfs @ 12.09 hrs, Volume= 10,451 cf
Outflow = 2.9 cfs @ 12.09 hrs, Volume= 10,451 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Pond 1P: Storage under pavers

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 4.71" for 25yr event
Inflow = 1.4 cfs @ 12.09 hrs, Volume= 8,729 cf
Outflow = 0.1 cfs @ 17.50 hrs, Volume= 8,738 cf, Atten= 91%, Lag= 324.7 min
Discarded = 0.1 cfs @ 17.50 hrs, Volume= 8,738 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 60.16' @ 17.50 hrs Surf.Area= 14,110 sf Storage= 3,704 cf
Flood Elev= 62.00' Surf.Area= 35,275 sf Storage= 7,334 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=514.2 min (1,442.0 - 927.7)

Volume	Invert	Avail.Storage	Storage Description
#1	61.58'	360 cf	**Bedding Course (2") (Conic)** Listed below (Recalc) 1,199 cf Overall x 30.0% Voids
#2	61.08'	1,235 cf	**Choker Course (4") (Conic)** Listed below (Recalc) 3,528 cf Overall x 35.0% Voids
#3	60.41'	1,418 cf	**Filter Course (8") (Conic)** Listed below (Recalc) 4,727 cf Overall x 30.0% Voids
#4	60.16'	617 cf	**Filter Blanket (3") (Conic)** Listed below (Recalc) 1,764 cf Overall x 35.0% Voids
#5	58.66'	3,704 cf	**Reservoir Course (18") (Conic)** Listed below (Recalc) 10,583 cf Overall x 35.0% Voids
		7,334 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.58	7,055	0	0	7,055
61.75	7,055	1,199	1,199	7,106

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.08	7,055	0	0	7,055
61.58	7,055	3,528	3,528	7,204

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.41	7,055	0	0	7,055
61.08	7,055	4,727	4,727	7,254

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.16	7,055	0	0	7,055
60.41	7,055	1,764	1,764	7,129

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
58.66	7,055	0	0	7,055
60.16	7,055	10,583	10,583	7,502

Device	Routing	Invert	Outlet Devices
#1	Discarded	58.66'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**25.0' long x 25.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.1 cfs @ 17.50 hrs HW=60.16' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.1 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=58.66' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)

Summary for Pond RG1: Rain Garden

Inflow Area = 817 sf, 58.63% Impervious, Inflow Depth = 4.63" for 25yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 315 cf
Outflow = 0.1 cfs @ 12.30 hrs, Volume= 315 cf, Atten= 33%, Lag= 12.7 min
Discarded = 0.0 cfs @ 12.30 hrs, Volume= 238 cf
Primary = 0.1 cfs @ 12.30 hrs, Volume= 77 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.02' @ 12.30 hrs Surf.Area= 250 sf Storage= 131 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=409.8 min (1,200.3 - 790.6)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.30 hrs HW=62.02' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.30 hrs HW=62.02' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.41 fps)

Summary for Pond RG2: Rain Garden

Inflow Area = 817 sf, 59.98% Impervious, Inflow Depth = 4.63" for 25yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 315 cf
Outflow = 0.1 cfs @ 12.30 hrs, Volume= 315 cf, Atten= 33%, Lag= 12.7 min
Discarded = 0.0 cfs @ 12.30 hrs, Volume= 238 cf
Primary = 0.1 cfs @ 12.30 hrs, Volume= 77 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.02' @ 12.30 hrs Surf.Area= 250 sf Storage= 131 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=409.8 min (1,200.3 - 790.6)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.30 hrs HW=62.02' (Free Discharge)
↑**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.30 hrs HW=62.02' TW=0.00' (Dynamic Tailwater)
↑**2=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.41 fps)

Summary for Pond RG3: Rain Garden

Inflow Area = 799 sf, 61.20% Impervious, Inflow Depth = 4.74" for 25yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 315 cf
Outflow = 0.1 cfs @ 12.30 hrs, Volume= 315 cf, Atten= 37%, Lag= 12.6 min
Discarded = 0.0 cfs @ 12.29 hrs, Volume= 238 cf
Primary = 0.1 cfs @ 12.30 hrs, Volume= 77 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.02' @ 12.29 hrs Surf.Area= 250 sf Storage= 131 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=408.3 min (1,195.6 - 787.3)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.29 hrs HW=62.02' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.30 hrs HW=62.02' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.40 fps)

Summary for Pond RG4: Rain Garden

Inflow Area = 844 sf, 55.21% Impervious, Inflow Depth = 4.52" for 25yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 318 cf
Outflow = 0.1 cfs @ 12.30 hrs, Volume= 318 cf, Atten= 33%, Lag= 12.7 min
Discarded = 0.0 cfs @ 12.30 hrs, Volume= 238 cf
Primary = 0.1 cfs @ 12.30 hrs, Volume= 80 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.02' @ 12.30 hrs Surf.Area= 250 sf Storage= 131 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=407.6 min calculated for 317 cf (100% of inflow)
Center-of-Mass det. time=408.8 min (1,202.6 - 793.7)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.30 hrs HW=62.02' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.1 cfs @ 12.30 hrs HW=62.02' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 0.1 cfs @ 0.42 fps)

Summary for Link 1L: (new Link)

Inflow Area = 3,277 sf, 58.71% Impervious, Inflow Depth = 1.14" for 25yr event
Inflow = 0.2 cfs @ 12.30 hrs, Volume= 312 cf
Primary = 0.2 cfs @ 12.30 hrs, Volume= 312 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Summary for Link 2L: Link

Linked used for internal modeling only as emergency overflow.

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 0.00" for 25yr event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Time span=0.00-72.00 hrs, dt=0.10 hrs, 721 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Proposed Watershed Runoff Area=5,193 sf 70.09% Impervious Runoff Depth=7.51"
Flow Length=341' Tc=5.0 min CN=91 Runoff=0.9 cfs 3,249 cf

Subcatchment P2a: Proposed Watershed Runoff Area=817 sf 58.63% Impervious Runoff Depth=7.15"
Tc=5.0 min CN=88 Runoff=0.1 cfs 487 cf

Subcatchment P2b: Proposed Watershed Runoff Area=817 sf 59.98% Impervious Runoff Depth=7.15"
Tc=5.0 min CN=88 Runoff=0.1 cfs 487 cf

Subcatchment P2c: Proposed Watershed Runoff Area=799 sf 61.20% Impervious Runoff Depth=7.27"
Tc=5.0 min CN=89 Runoff=0.1 cfs 484 cf

Subcatchment P2d: Proposed Watershed Runoff Area=844 sf 55.21% Impervious Runoff Depth=7.03"
Tc=5.0 min CN=87 Runoff=0.1 cfs 494 cf

Subcatchment P3a: Pavers Runoff Area=7,055 sf 100.00% Impervious Runoff Depth=8.35"
Tc=463.0 min CN=98 Runoff=0.1 cfs 4,909 cf

Subcatchment P3b: Proposed Watershed Runoff Area=11,905 sf 74.35% Impervious Runoff Depth=7.63"
Tc=5.0 min CN=92 Runoff=2.1 cfs 7,568 cf

Subcatchment P4: Proposed Watershed Runoff Area=24,739 sf 73.12% Impervious Runoff Depth=7.63"
Tc=5.0 min CN=92 Runoff=4.3 cfs 15,726 cf

Reach SP1: Study Point Inflow=0.9 cfs 3,249 cf
Outflow=0.9 cfs 3,249 cf

Reach SP2: Study Point Inflow=4.3 cfs 15,726 cf
Outflow=4.3 cfs 15,726 cf

Pond 1P: Storage under pavers Peak Elev=60.55' Storage=4,616 cf Inflow=2.8 cfs 13,371 cf
Discarded=0.2 cfs 13,382 cf Primary=0.0 cfs 0 cf Outflow=0.2 cfs 13,382 cf

Pond RG1: Rain Garden Peak Elev=62.05' Storage=135 cf Inflow=0.1 cfs 487 cf
Discarded=0.0 cfs 264 cf Primary=0.2 cfs 222 cf Outflow=0.2 cfs 487 cf

Pond RG2: Rain Garden Peak Elev=62.05' Storage=135 cf Inflow=0.1 cfs 487 cf
Discarded=0.0 cfs 264 cf Primary=0.2 cfs 222 cf Outflow=0.2 cfs 487 cf

Pond RG3: Rain Garden Peak Elev=62.05' Storage=135 cf Inflow=0.1 cfs 484 cf
Discarded=0.0 cfs 265 cf Primary=0.2 cfs 219 cf Outflow=0.2 cfs 484 cf

Pond RG4: Rain Garden Peak Elev=62.05' Storage=135 cf Inflow=0.1 cfs 494 cf
Discarded=0.0 cfs 264 cf Primary=0.2 cfs 230 cf Outflow=0.2 cfs 494 cf

Link 1L: (new Link) Inflow=0.7 cfs 894 cf
Primary=0.7 cfs 894 cf

Link 2L: Link Inflow=0.0 cfs 0 cf
Primary=0.0 cfs 0 cf

Total Runoff Area = 52,169 sf Runoff Volume = 33,402 cf Average Runoff Depth = 7.68"
24.17% Pervious = 12,610 sf 75.83% Impervious = 39,559 sf

Summary for Subcatchment P1: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.9 cfs @ 12.09 hrs, Volume= 3,249 cf, Depth= 7.51"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

	Area (sf)	CN	Description
	749	98	Roofs, HSG C
	1,553	74	>75% Grass cover, Good, HSG C
	2,891	98	Paved parking, HSG C
*	0	98	Permeable Pavers
	5,193	91	Weighted Average
	1,553		29.91% Pervious Area
	3,640		70.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	48	0.0500	0.21		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.12"
0.5	293	0.0400	8.95	55.95	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
4.3	341	Total, Increased to minimum Tc = 5.0 min			

Summary for Subcatchment P2a: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 487 cf, Depth= 7.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

	Area (sf)	CN	Description
	479	98	Roofs, HSG C
	338	74	>75% Grass cover, Good, HSG C
	0	98	Paved parking, HSG C
	817	88	Weighted Average
	338		41.37% Pervious Area
	479		58.63% Impervious Area

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

Summary for Subcatchment P2b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 487 cf, Depth= 7.15"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

	Area (sf)	CN	Description
	490	98	Roofs, HSG C
	327	74	>75% Grass cover, Good, HSG C
	0	98	Paved parking, HSG C
	817	88	Weighted Average
	327		40.02% Pervious Area
	490		59.98% Impervious Area

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

Summary for Subcatchment P2c: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 484 cf, Depth= 7.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

Area (sf)	CN	Description
489	98	Roofs, HSG C
310	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
799	89	Weighted Average
310		38.80% Pervious Area
489		61.20% Impervious Area

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

Summary for Subcatchment P2d: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 0.1 cfs @ 12.09 hrs, Volume= 494 cf, Depth= 7.03"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

Area (sf)	CN	Description
466	98	Roofs, HSG C
378	74	>75% Grass cover, Good, HSG C
0	98	Paved parking, HSG C
844	87	Weighted Average
378		44.79% Pervious Area
466		55.21% Impervious Area

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

Summary for Subcatchment P3a: Pavers

Runoff = 0.1 cfs @ 17.96 hrs, Volume= 4,909 cf, Depth= 8.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

	Area (sf)	CN	Description
*	7,055	98	Permeable Pavers
	7,055		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
463.0					**Direct Entry, Volume to Pavers**

Summary for Subcatchment P3b: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 2.1 cfs @ 12.08 hrs, Volume= 7,568 cf, Depth= 7.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

Area (sf)	CN	Description
8,220	98	Roofs, HSG C
3,054	74	>75% Grass cover, Good, HSG C
631	98	Paved parking, HSG C
11,905	92	Weighted Average
3,054		25.65% Pervious Area
8,851		74.35% Impervious Area

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

Summary for Subcatchment P4: Proposed Watershed

[49] Hint: Tc<2dt may require smaller dt

Runoff = 4.3 cfs @ 12.08 hrs, Volume= 15,726 cf, Depth= 7.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs
Type III 24-hr 100yr Rainfall=8.59"

Area (sf)	CN	Description
17,233	98	Roofs, HSG C
6,650	74	>75% Grass cover, Good, HSG C
856	98	Paved parking, HSG C
24,739	92	Weighted Average
6,650		26.88% Pervious Area
18,089		73.12% Impervious Area

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

Summary for Reach SP1: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 27,430 sf, 78.27% Impervious, Inflow Depth = 1.42" for 100yr event
Inflow = 0.9 cfs @ 12.09 hrs, Volume= 3,249 cf
Outflow = 0.9 cfs @ 12.09 hrs, Volume= 3,249 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Reach SP2: Study Point

This reach used for design purposes only to total offsite flows to abutting properties

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

Inflow Area = 24,739 sf, 73.12% Impervious, Inflow Depth = 7.63" for 100yr event
Inflow = 4.3 cfs @ 12.08 hrs, Volume= 15,726 cf
Outflow = 4.3 cfs @ 12.08 hrs, Volume= 15,726 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3

Summary for Pond 1P: Storage under pavers

[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 7.22" for 100yr event
Inflow = 2.8 cfs @ 12.09 hrs, Volume= 13,371 cf
Outflow = 0.2 cfs @ 13.83 hrs, Volume= 13,382 cf, Atten= 93%, Lag= 104.6 min
Discarded = 0.2 cfs @ 13.83 hrs, Volume= 13,382 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 60.55' @ 13.83 hrs Surf.Area= 21,165 sf Storage= 4,616 cf
Flood Elev= 62.00' Surf.Area= 35,275 sf Storage= 7,334 cf

Plug-Flow detention time=(not calculated: outflow precedes inflow)
Center-of-Mass det. time=413.1 min (1,324.6 - 911.5)

Volume	Invert	Avail.Storage	Storage Description
#1	61.58'	360 cf	**Bedding Course (2") (Conic)** Listed below (Recalc) 1,199 cf Overall x 30.0% Voids
#2	61.08'	1,235 cf	**Choker Course (4") (Conic)** Listed below (Recalc) 3,528 cf Overall x 35.0% Voids
#3	60.41'	1,418 cf	**Filter Course (8") (Conic)** Listed below (Recalc) 4,727 cf Overall x 30.0% Voids
#4	60.16'	617 cf	**Filter Blanket (3") (Conic)** Listed below (Recalc) 1,764 cf Overall x 35.0% Voids
#5	58.66'	3,704 cf	**Reservoir Course (18") (Conic)** Listed below (Recalc) 10,583 cf Overall x 35.0% Voids
		7,334 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.58	7,055	0	0	7,055
61.75	7,055	1,199	1,199	7,106

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.08	7,055	0	0	7,055
61.58	7,055	3,528	3,528	7,204

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.41	7,055	0	0	7,055
61.08	7,055	4,727	4,727	7,254

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.16	7,055	0	0	7,055
60.41	7,055	1,764	1,764	7,129

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
58.66	7,055	0	0	7,055
60.16	7,055	10,583	10,583	7,502

Device	Routing	Invert	Outlet Devices
#1	Discarded	58.66'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**25.0' long x 25.0' 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) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Discarded OutFlow Max=0.2 cfs @ 13.83 hrs HW=60.55' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.2 cfs)

Primary OutFlow Max=0.0 cfs @ 0.00 hrs HW=58.66' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Controls 0.0 cfs)

Summary for Pond RG1: Rain Garden

[90] Warning: Qout>Qin may require Finer Routing or smaller dt

Inflow Area = 817 sf, 58.63% Impervious, Inflow Depth = 7.15" for 100yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 487 cf
Outflow = 0.2 cfs @ 12.10 hrs, Volume= 487 cf, Atten= 0%, Lag= 1.0 min
Discarded = 0.0 cfs @ 12.10 hrs, Volume= 264 cf
Primary = 0.2 cfs @ 12.10 hrs, Volume= 222 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.05' @ 12.10 hrs Surf.Area= 252 sf Storage= 135 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=302.5 min calculated for 486 cf (100% of inflow)
Center-of-Mass det. time=303.9 min (1,082.8 - 779.0)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc) 165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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 Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.10 hrs HW=62.05' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.10 hrs HW=62.05' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 0.2 cfs @ 0.58 fps)

Summary for Pond RG2: Rain Garden

[90] Warning: Qout>Qin may require Finer Routing or smaller dt

Inflow Area = 817 sf, 59.98% Impervious, Inflow Depth = 7.15" for 100yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 487 cf
Outflow = 0.2 cfs @ 12.10 hrs, Volume= 487 cf, Atten= 0%, Lag= 1.0 min
Discarded = 0.0 cfs @ 12.10 hrs, Volume= 264 cf
Primary = 0.2 cfs @ 12.10 hrs, Volume= 222 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.05' @ 12.10 hrs Surf.Area= 252 sf Storage= 135 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=302.5 min calculated for 486 cf (100% of inflow)
Center-of-Mass det. time=303.9 min (1,082.8 - 779.0)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.10 hrs HW=62.05' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.10 hrs HW=62.05' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 0.2 cfs @ 0.58 fps)

Summary for Pond RG3: Rain Garden

[90] Warning: Qout>Qin may require Finer Routing or smaller dt

Inflow Area = 799 sf, 61.20% Impervious, Inflow Depth = 7.27" for 100yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 484 cf
Outflow = 0.2 cfs @ 12.10 hrs, Volume= 484 cf, Atten= 0%, Lag= 1.0 min
Discarded = 0.0 cfs @ 12.10 hrs, Volume= 265 cf
Primary = 0.2 cfs @ 12.10 hrs, Volume= 219 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.05' @ 12.10 hrs Surf.Area= 252 sf Storage= 135 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=303.6 min calculated for 483 cf (100% of inflow)
Center-of-Mass det. time=304.9 min (1,080.9 - 776.0)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.10 hrs HW=62.05' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.10 hrs HW=62.05' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 0.2 cfs @ 0.58 fps)

Summary for Pond RG4: Rain Garden

[90] Warning: Qout>Qin may require Finer Routing or smaller dt

Inflow Area = 844 sf, 55.21% Impervious, Inflow Depth = 7.03" for 100yr event
Inflow = 0.1 cfs @ 12.09 hrs, Volume= 494 cf
Outflow = 0.2 cfs @ 12.10 hrs, Volume= 494 cf, Atten= 0%, Lag= 1.0 min
Discarded = 0.0 cfs @ 12.10 hrs, Volume= 264 cf
Primary = 0.2 cfs @ 12.10 hrs, Volume= 230 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs / 3
Peak Elev= 62.05' @ 12.10 hrs Surf.Area= 252 sf Storage= 135 cf
Flood Elev= 62.30' Surf.Area= 268 sf Storage= 173 cf

Plug-Flow detention time=299.6 min calculated for 493 cf (100% of inflow)
Center-of-Mass det. time=300.9 min (1,082.7 - 781.8)

Volume	Invert	Avail.Storage	Storage Description
#1	61.50'	107 cf	**Rain garden area (Conic)** Listed below (Recalc)
#2	60.00'	66 cf	**Filter Media (Conic)** Listed below (Recalc)
			165 cf Overall x 40.0% Voids
		173 cf	Total Available Storage

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
61.50	110	0	0	110
62.30	158	107	107	168

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
60.00	110	0	0	110
61.50	110	165	165	166

Device	Routing	Invert	Outlet Devices
#1	Discarded	60.00'	**0.400 in/hr Exfiltration over Wetted area**
#2	Primary	62.00'	**6.0' long x 1.0' 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
			Coef. (English) 2.69 2.72 2.75 2.85 2.98 3.08 3.20 3.28 3.31 3.30 3.31 3.32

Discarded OutFlow Max=0.0 cfs @ 12.10 hrs HW=62.05' (Free Discharge)
1=Exfiltration (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.10 hrs HW=62.05' TW=0.00' (Dynamic Tailwater)
2=Broad-Crested Rectangular Weir (Weir Controls 0.2 cfs @ 0.59 fps)

Summary for Link 1L: (new Link)

Inflow Area = 3,277 sf, 58.71% Impervious, Inflow Depth = 3.27" for 100yr event
Inflow = 0.7 cfs @ 12.10 hrs, Volume= 894 cf
Primary = 0.7 cfs @ 12.10 hrs, Volume= 894 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

Summary for Link 2L: Link

Linked used for internal modeling only as emergency overflow.

Inflow Area = 22,237 sf, 80.18% Impervious, Inflow Depth = 0.00" for 100yr event
Inflow = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.0 cfs @ 0.00 hrs, Volume= 0 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.10 hrs

APPENDIX 5.0

FIGURES AND SUPPORT DOCUMENTATION

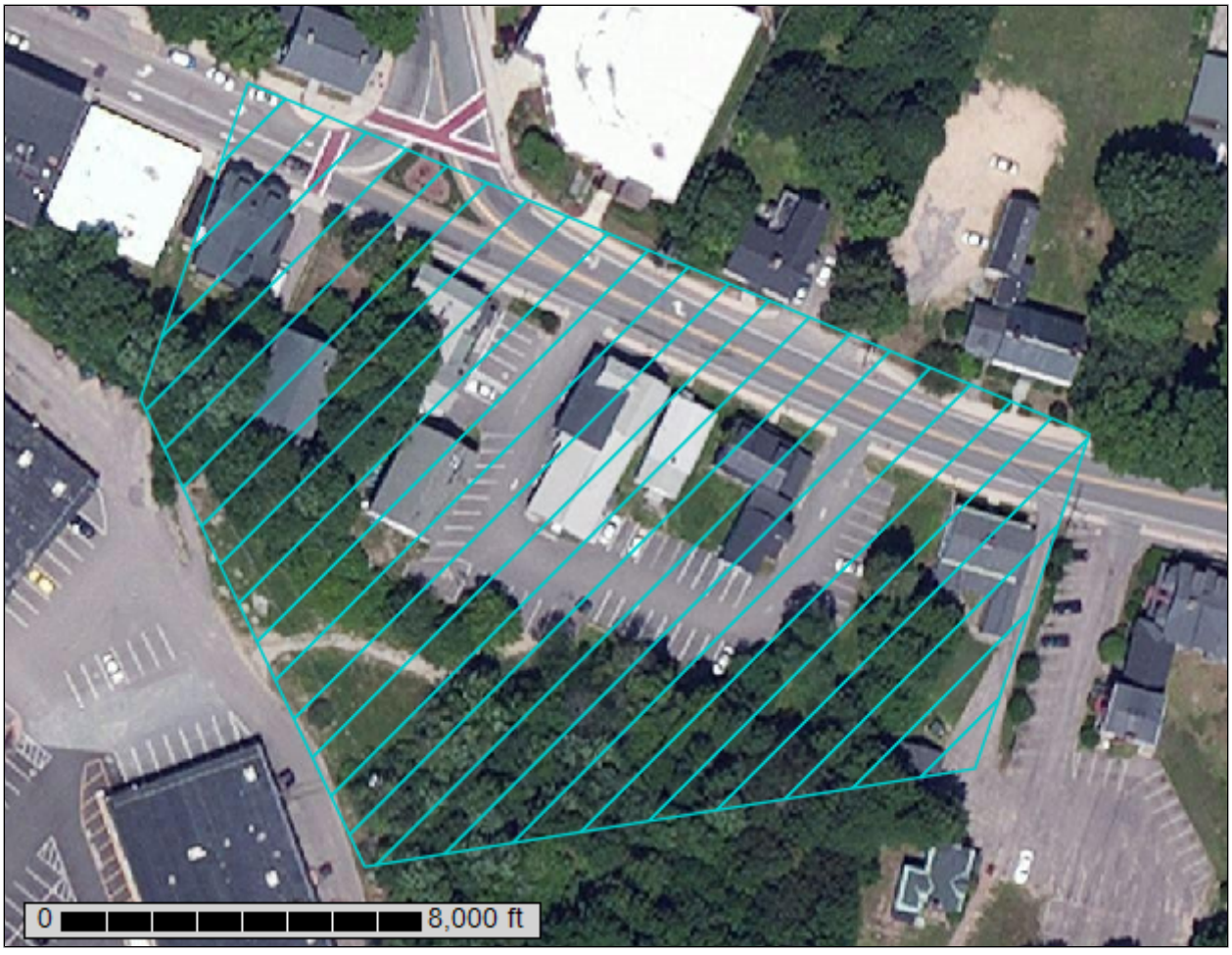
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

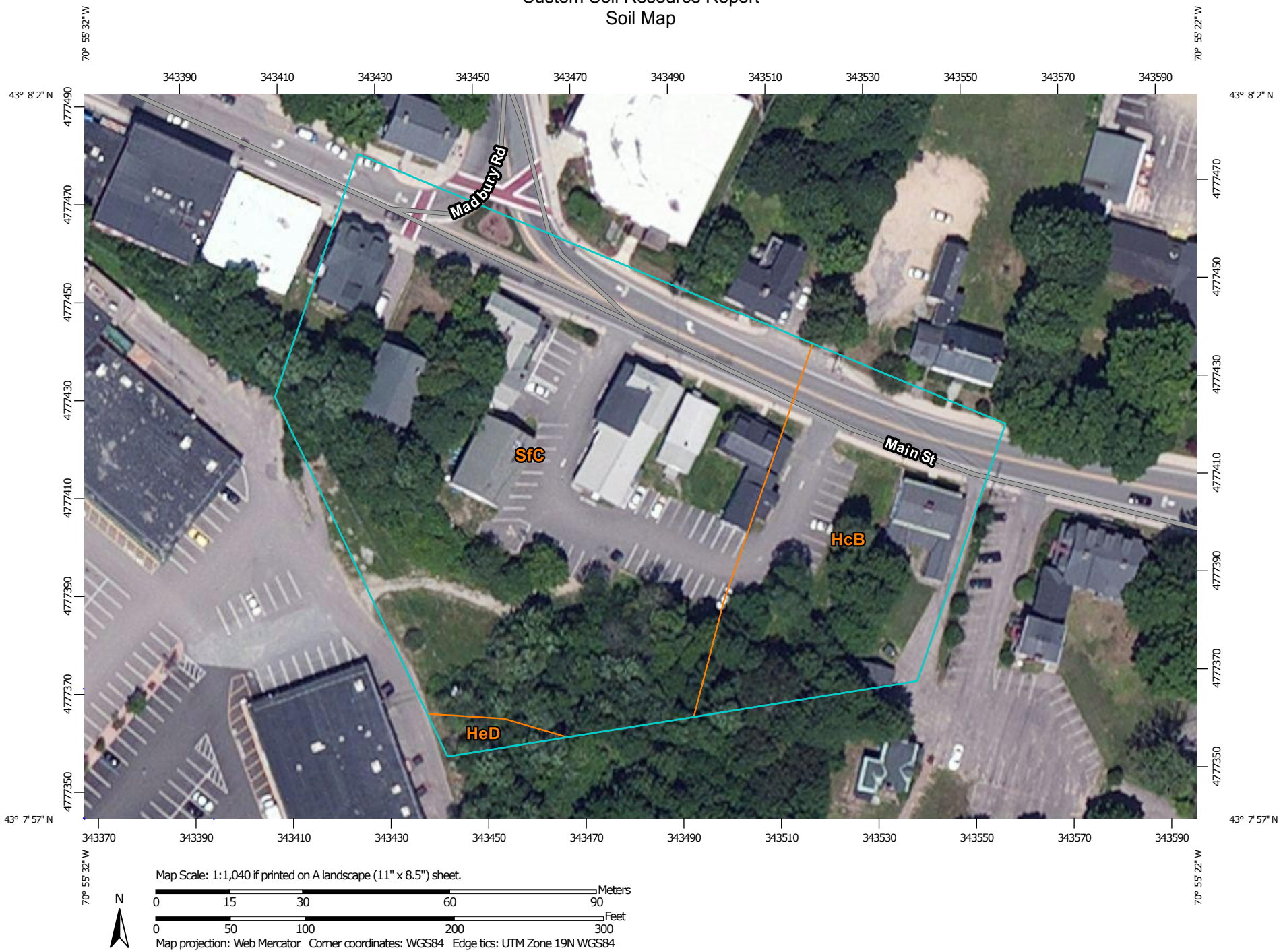
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Strafford County, New Hampshire



August 20, 2013

Custom Soil Resource Report
Soil Map



MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Strafford County, New Hampshire
Survey Area Data: Version 10, Oct 27, 2009

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

Date(s) aerial images were photographed: Jun 20, 2010—May 1, 2011

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

Map Unit Legend

Strafford County, New Hampshire (NH017)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
HcB	Hollis-Charlton fine sandy loams, 3 to 8 percent slopes	0.7	25.1%
HeD	Hollis-Charlton extremely rocky fine sandy loams, 8 to 25 percent slopes	0.0	1.2%
SfC	Suffield silt loam, 8 to 15 percent slopes	2.1	73.7%
Totals for Area of Interest		**2.9**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that

Custom Soil Resource Report
Map—Saturated Hydraulic Conductivity (Ksat)

Map Scale: 1:1,040 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- <= 6.0329
- > 6.0329 and <= 23.2833
- Not rated or not available

Soil Rating Lines

- <= 6.0329
- > 6.0329 and <= 23.2833
- Not rated or not available

Soil Rating Points

- <= 6.0329
- > 6.0329 and <= 23.2833
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Strafford County, New Hampshire
Survey Area Data: Version 10, Oct 27, 2009

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

Date(s) aerial images were photographed: Jun 20, 2010—May 1, 2011

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

Table—Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — Strafford County, New Hampshire (NH017)				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
HcB	Hollis-Charlton fine sandy loams, 3 to 8 percent slopes	23.2833	0.7	25.1%
HeD	Hollis-Charlton extremely rocky fine sandy loams, 8 to 25 percent slopes	23.2833	0.0	1.2%
SfC	Suffield silt loam, 8 to 15 percent slopes	6.0329	2.1	73.7%
Totals for Area of Interest			**2.9**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 6

Bottom Depth: 72

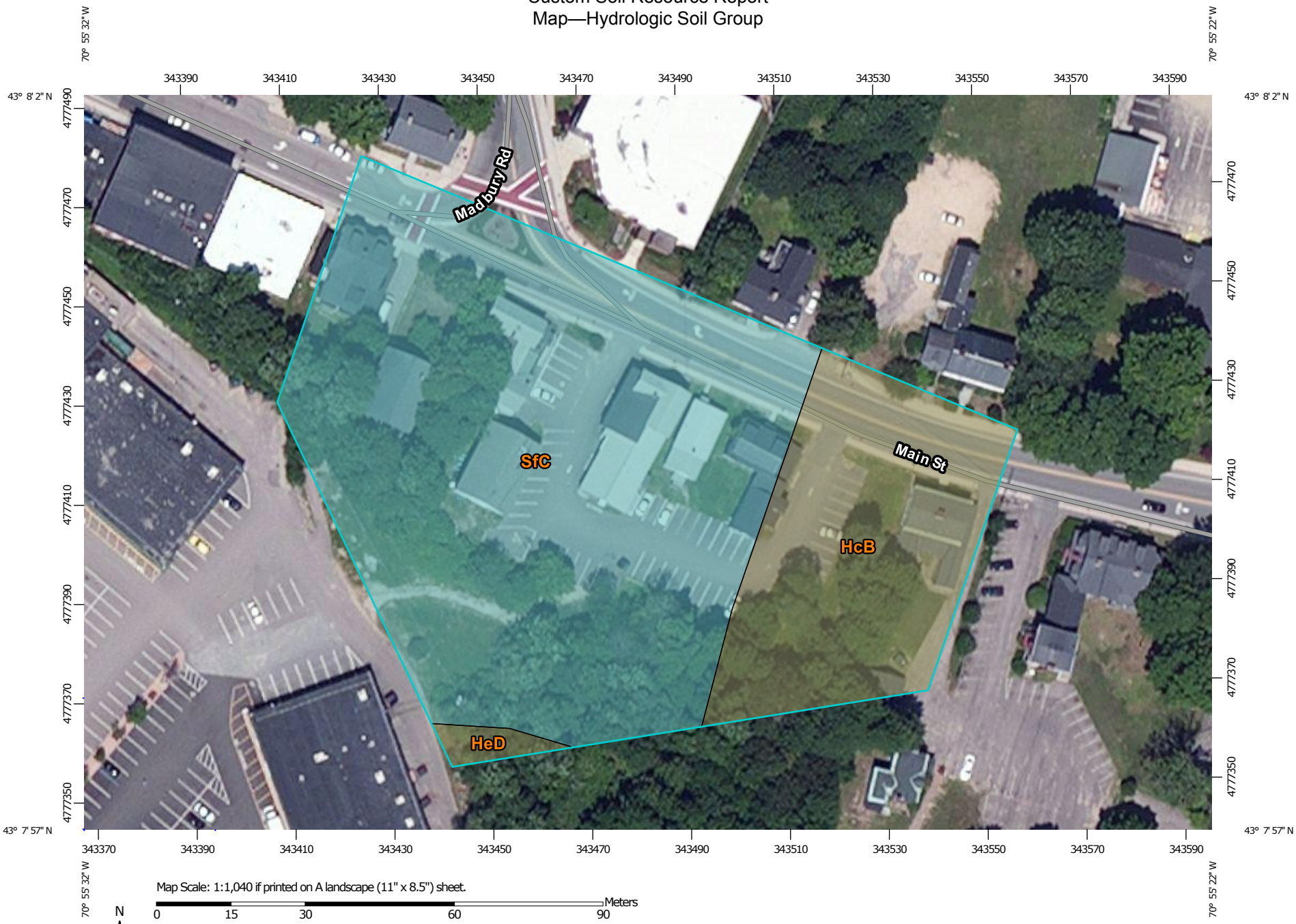
Units of Measure: Inches

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.


70° 55' 32" W
70° 55' 22" W
343390
343410
343430
343450
343470
343490
343510
343530
343550
343570
343590
43° 8' 2" N
43° 7' 57" N
4777490
4777470
4777450
4777430
4777410
4777390
4777370
4777350
Madbury Rd
Main St
SfC
HcB
HeD
343370
Map Scale: 1:1,040 if printed on A landscape (11" x 8.5") sheet.
N
Meters
0
15
30
60
90
Feet
0
50
100
200
300
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

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Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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Survey Area Data: Version 10, Oct 27, 2009

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Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Strafford County, New Hampshire (NH017)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
HcB	Hollis-Charlton fine sandy loams, 3 to 8 percent slopes	C/D	0.7	25.1%
HeD	Hollis-Charlton extremely rocky fine sandy loams, 8 to 25 percent slopes	C/D	0.0	1.2%
SfC	Suffield silt loam, 8 to 15 percent slopes	C	2.1	73.7%
Totals for Area of Interest			**2.9**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Extreme Precipitation Tables

Northeast Regional Climate Center

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

Smoothing	Yes
State	New Hampshire
Location	near 129 Main Street, University of New Hampshire, Durham, NH 03824, USA
Longitude	70.942 degrees West
Latitude	43.141 degrees North
Elevation	69 feet
Date/Time	Mon, 25 Mar 2013 14:41:30 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.26	0.40	0.50	0.65	0.81	1.03	**1yr**	0.70	0.98	1.20	1.55	2.00	2.60	2.83	**1yr**	2.30	2.72	3.13	3.85	4.43	**1yr**
2yr	0.32	0.49	0.61	0.81	1.01	1.28	**2yr**	0.87	1.17	1.49	1.90	2.43	3.12	3.46	**2yr**	2.77	3.33	3.83	4.56	5.19	**2yr**
5yr	0.37	0.57	0.72	0.96	1.23	1.58	**5yr**	1.06	1.44	1.85	2.38	3.06	3.96	4.44	**5yr**	3.50	4.27	4.88	5.76	6.52	**5yr**
10yr	0.40	0.63	0.80	1.09	1.42	1.84	**10yr**	1.22	1.69	2.18	2.82	3.65	4.73	5.36	**10yr**	4.19	5.15	5.87	6.89	7.76	**10yr**
25yr	0.46	0.74	0.94	1.29	1.72	2.26	**25yr**	1.48	2.09	2.69	3.52	4.60	6.00	6.88	**25yr**	5.31	6.61	7.49	8.73	9.78	**25yr**
50yr	0.51	0.83	1.06	1.48	1.99	2.66	**50yr**	1.72	2.46	3.17	4.18	5.49	7.18	8.31	**50yr**	6.35	7.99	9.01	10.45	11.65	**50yr**
100yr	0.58	0.93	1.20	1.70	2.31	3.12	**100yr**	2.00	2.89	3.74	4.95	6.53	8.59	10.05	**100yr**	7.61	9.66	10.84	12.51	13.89	**100yr**
200yr	0.64	1.04	1.35	1.95	2.69	3.66	**200yr**	2.32	3.40	4.42	5.89	7.80	10.29	12.15	**200yr**	9.11	11.68	13.05	14.98	16.56	**200yr**
500yr	0.75	1.24	1.61	2.34	3.29	4.52	**500yr**	2.84	4.21	5.48	7.37	9.84	13.08	15.62	**500yr**	11.57	15.02	16.68	19.03	20.92	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.37	0.45	0.60	0.74	0.90	**1yr**	0.64	0.88	0.91	1.25	1.54	1.96	2.52	**1yr**	1.74	2.42	2.95	3.30	4.04	**1yr**
2yr	0.31	0.49	0.60	0.81	1.00	1.18	**2yr**	0.86	1.16	1.37	1.83	2.36	3.04	3.38	**2yr**	2.69	3.25	3.73	4.45	5.05	**2yr**
5yr	0.35	0.54	0.67	0.92	1.17	1.40	**5yr**	1.01	1.37	1.62	2.15	2.78	3.71	4.13	**5yr**	3.28	3.97	4.57	5.42	6.13	**5yr**
10yr	0.38	0.59	0.73	1.02	1.32	1.60	**10yr**	1.14	1.57	1.82	2.45	3.14	4.28	4.81	**10yr**	3.79	4.62	5.33	6.28	7.06	**10yr**
25yr	0.44	0.67	0.83	1.19	1.56	1.92	**25yr**	1.35	1.88	2.12	2.85	3.68	5.10	5.86	**25yr**	4.51	5.63	6.52	7.65	8.52	**25yr**
50yr	0.49	0.74	0.92	1.32	1.78	2.20	**50yr**	1.54	2.15	2.36	3.21	4.14	5.86	6.79	**50yr**	5.19	6.53	7.61	8.87	9.81	**50yr**
100yr	0.54	0.82	1.03	1.49	2.04	2.52	**100yr**	1.76	2.47	2.64	3.60	4.63	6.73	7.87	**100yr**	5.95	7.57	8.89	10.29	11.27	**100yr**
200yr	0.61	0.91	1.16	1.67	2.33	2.89	**200yr**	2.01	2.82	2.94	4.03	5.20	7.72	9.13	**200yr**	6.83	8.78	10.40	11.94	12.97	**200yr**
500yr	0.71	1.06	1.36	1.98	2.81	3.48	**500yr**	2.42	3.40	3.42	4.68	6.07	9.22	11.10	**500yr**	8.16	10.67	12.79	14.54	15.55	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.28	0.43	0.53	0.71	0.87	1.08	**1yr**	0.75	1.05	1.24	1.74	2.21	2.80	3.01	**1yr**	2.47	2.89	3.33	4.14	4.74	**1yr**
2yr	0.33	0.50	0.62	0.84	1.04	1.24	**2yr**	0.90	1.22	1.48	1.95	2.50	3.23	3.56	**2yr**	2.86	3.42	3.93	4.69	5.35	**2yr**
5yr	0.39	0.60	0.75	1.03	1.31	1.58	**5yr**	1.13	1.54	1.85	2.49	3.18	4.21	4.74	**5yr**	3.72	4.56	5.20	6.12	6.90	**5yr**
10yr	0.46	0.70	0.87	1.21	1.57	1.92	**10yr**	1.35	1.87	2.22	3.03	3.82	5.18	5.90	**10yr**	4.59	5.67	6.44	7.51	8.40	**10yr**
25yr	0.55	0.84	1.05	1.49	1.96	2.47	**25yr**	1.69	2.41	2.86	3.94	4.89	6.91	7.89	**25yr**	6.12	7.58	8.52	9.88	10.94	**25yr**
50yr	0.64	0.97	1.21	1.73	2.34	2.98	**50yr**	2.02	2.91	3.47	4.79	5.93	8.54	9.84	**50yr**	7.56	9.46	10.55	12.14	13.38	**50yr**
100yr	0.74	1.12	1.40	2.02	2.77	3.59	**100yr**	2.39	3.51	4.20	5.86	7.19	10.55	12.29	**100yr**	9.33	11.82	13.05	14.93	16.37	**100yr**
200yr	0.85	1.29	1.63	2.36	3.29	4.35	**200yr**	2.84	4.26	5.11	7.16	8.69	13.08	15.36	**200yr**	11.57	14.77	16.14	18.35	20.06	**200yr**
500yr	1.04	1.55	1.99	2.89	4.12	5.58	**500yr**	3.55	5.46	6.59	9.36	11.21	17.42	20.62	**500yr**	15.41	19.82	21.39	24.16	26.27	**500yr**

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UNIVERSITY OF NEW HAMPSHIRE
STORMWATER CENTER

UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds

Rev. October 2009

University of New Hampshire Stormwater Center (UNHSC)
Gregg Hall ● 35 Colovos Road ● Durham, New Hampshire 03824-3534 ● http://www.unh.edu/erg/cstev

UNHSC DESIGN SPECIFICATIONS FOR POROUS ASPHALT PAVEMENT AND INFILTRATION BEDS

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UNHSC DESIGN SPECIFICATIONS FOR POROUS ASPHALT PAVEMENT AND INFILTRATION BEDS

NOTICE

The specifications listed herein were developed by the UNHSC for UNHSC related projects and represent the author's best professional judgment. No assurances are given for projects other than the intended application. These design specifications are not a substitute for licensed, qualified engineering oversight and should be reviewed, and adapted as necessary.

ACKNOWLEDGEMENTS

The original 2007 specifications were completed by collaboration between the University of New Hampshire, of Durham, New Hampshire, and Pike Industries Inc., of Belmont, New Hampshire. The principal UNH authors were Joshua F. Briggs, Robert M. Roseen, PE, PhD, and Thomas P. Ballestero, PE, PhD, PH, CGWP, PG. The principal author from Pike Industries was the Corporate Quality Control Manager, Jeff Pochily. Other contributions to the project were made by Grant Swenson, also of Pike Industries. The revised specifications (2009) were prepared by the UNHSC after a round table discussion with New Hampshire Asphalt Manufacturers (Rick Charbonneau, Mark Charbonneau, and Keith Dane of Continental Paving, Jeff Lewis of Brox Industries, and Mary Wescott, Dave Duncan, and Jeff Pochily of Pike Industries) and a round table discussion with design engineers. The 2009 specifications were also reviewed and revised by Antonio P. Ballestero, Jr., PE.

The UNH Stormwater Center is housed within the Environmental Research Group (ERG) at the University of New Hampshire (UNH) in Durham, New Hampshire. Funding for the program was and continues to be provided by the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) and the National Oceanic and Atmospheric Administration (NOAA).

PART 1 GENERAL

1.1 DESCRIPTION

A. This specification is intended to be used for porous asphalt pavement in parking lot applications. Stormwater management functions of porous asphalt installations include water quality treatment, peak flow reduction, storm volume reduction via groundwater recharge, and increased hydrograph time lag. This specification is intended for a cold climate application based upon the field experience at the UNHSC porous asphalt parking lot located in Durham, New Hampshire, however the specification can be adapted to projects elsewhere provided that selection of materials and system design reflects local conditions, constraints, and objectives.

B. The work of this Section includes subgrade preparation, installation of the underlying porous media beds, and porous asphalt mix (mix) design, production, and installation. Porous media beds refer to the material layers underlying the porous asphalt pavement. Porous asphalt pavement refers to the compacted mix of modified asphalt, aggregate, and additives.

C. The porous asphalt pavement specified herein is modified after the National Asphalt Pavement Association (NAPA) specification outlined in *Design, Construction, and Maintenance Guide for Porous Asphalt Pavements, Information Series 131* (2003) and *Design, Construction, and Maintenance of Open-Graded Friction Courses, Information Series 115* (2002).

D. Alternative specifications for mix, such as Open Graded Friction Courses (OGFC) from Federal Agencies or state Departments of Transportation (DOT), may be used if approved by the Engineer. The primary requirements for the specifications of the mix are performance grade (PG) asphalt binder, binder content, binder draindown, aggregate gradation, air void content, retained tensile strength (TSR).

1.2 SUBMITTALS

A. Submit a list of materials proposed for work under this Section including the name and address of the materials producers and the locations from which the materials are to be obtained.

B. Submit certificates, signed by the materials producers and the relevant subcontractors, stating that materials meet or exceed the specified requirements, for review and approval by the Engineer.

C. Submit samples of materials for review and approval by the Engineer. For mix materials, samples may be submitted only to the QA inspector with the Engineer's approval.

D. Submittal requirements for samples and certificates are summarized in 1.3 QC*/QA*

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

B. Codes and Standards - All materials, methods of construction and workmanship shall conform to applicable requirements of AASHTO ASTM Standards, NHDOT Standard Specifications for

Road and Bridge Construction, latest revised (including supplements and updates), or other standards as specified.

C. QC/QA requirements for production of mix are discussed in the Materials section, and for construction of the porous media beds and paving in the Execution section.

E. Table 1 and discussed in further detail in the Materials section.

1.3 QC/QA

D. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this section.

E. Codes and Standards - All materials, methods of construction and workmanship shall conform to applicable requirements of AASHTO ASTM Standards, NHDOT Standard Specifications for Road and Bridge Construction, latest revised (including supplements and updates), or other standards as specified.

F. QC/QA requirements for production of mix are discussed in the Materials section, and for construction of the porous media beds and paving in the Execution section.

Table 1. Submittal requirements.

Material or Pavement Course*	Properties to be reported on Certificate**
choker course, reservoir course	gradation, max. wash loss, min. durability index, max. abrasion loss, air voids (reservoir course)
filter course	gradation, permeability/ sat. hydraulic conductivity
filter blanket	gradation
geotextile filter fabric	manufacturer's certification, AOS/EOS, tensile strength
striping paint	certificate
binder	PGAB certification
coarse aggregate	gradation, wear, fracture faces (fractured and elongated)
fine aggregate	gradation,
silicone	manufacturer's certification
Fibers (optional)	manufacturer's certification
mineral filler (optional)	manufacturer's certification
fatty amines (optional anti-strip)	manufacturer's certification
hydrated lime (optional anti-strip)	manufacturer's certification

* Samples of each material shall be submitted to the Engineer (or QA inspector for mix). These samples must be in sufficient volume to perform the standardized tests for each material.
** At a minimum, more material properties may be required (refer to Materials Section).

1.4 PROJECT CONDITIONS

A. Site Assessment should be performed per the steps outlined in *IS 131* (NAPA, 2003).

B. Construction Phasing should be performed as outlined in IS 131 (NAPA, 2003).

C. Protection of Existing Improvements
    1. Protect adjacent work from the unintended dispersal/splashing of pavement materials. Remove all stains from exposed surfaces of pavement, structures, and grounds. Remove all waste and spillage. If necessary, limit access to adjacent work/structures with appropriate signage and/or barriers.
    2. Proper erosion and sediment control practices shall be provided in accordance with existing regulations. Do not damage or disturb existing improvements or vegetation. Provide suitable protection where required before starting work and maintain protection throughout the course of the work. This includes the regular, appropriate inspection and maintenance of the erosion and sediment control measures.
    3. Restore damaged areas, including existing pavement on or adjacent to the site that has been damaged as a result of construction work, to their original condition or repair as directed to the satisfaction of the Engineer at no additional cost.

D. Safety and Traffic Control
    1. Notify and cooperate with local authorities and other organizations having jurisdiction when construction work will interfere with existing roads and traffic.
    2. Provide temporary barriers, signs, warning lights, flaggers, and other protections as required to assure the safety of persons and vehicles around and within the construction area and to organize the smooth flow of traffic.

E. Weather Limitations
    1. Porous asphalt, Open graded friction course, or dense-mixed asphalt shall not be placed between November 15 and March 15, or when the ambient air temperature at the pavement site in the shade away from artificial heat is below 16 °C (60 °F) or when the actual ground temperature is below 10 °C (50 °F). Only the Engineer may adjust the air temperature requirement or extend the dates of the pavement season.
    2. The Contractor shall not pave on days when rain is forecast for the day, unless a change in the weather results in favorable conditions as determined by the Engineer.

1.5 REFERENCES

A. *General Porous Asphalt Bituminous Paving and Groundwater Infiltration Beds,* specification by UNH Stormwater Center, February, 2005.
B. *Design, Construction, and Maintenance Guide for Porous Asphalt Pavements, Information Series 131*, National Asphalt Pavement Association (NAPA), 2003.
C. *Design, Construction, and Maintenance of Open-Graded Friction Courses, Information Series 115*, NAPA, 2002.
D. *Annual Book of ASTM Standards*, American Society for Testing and Materials, Philadelphia, PA, 1997 or latest edition.
E. *Standards of the American Association of State Highway and Transportation Officials* (AASHTO), 1998 or latest edition.
F. *Section 401- Plant Mix Pavements – General*, in *Standard Specifications for Road and Bridge Construction – State of New Hampshire Department of Transportation,* 2006.
G. *Section 02725 - General Porous Pavement and Groundwater Infiltration Beds*, specification from NAPA Porous Asphalt Seminar handout, Cahill Associates, Inc., 2004.
H. *Correlations of Permeability and Grain Size*, Russell G. Shepherd, Groundwater 27 (5), 1989.

I. *Groundwater*, R. Allan Freeze and John A. Cherry, 1979.

PART 2 PRODUCTS

2.1 MATERIALS

A. Porous Media Infiltration Beds

Below the porous asphalt itself are located the porous media infiltration beds (Figure 1), from top to bottom: a 4" – 8 "(10 - 20 cm) (minimum) thick layer of choker course of crushed stone (8" is preferable to alleviate compaction issues with the porous asphalt); an 8" to 12" (20 cm to 30 cm) minimum thickness layer of filter course of poorly graded sand (a.k.a. bankrun gravel or modified 304.1); 3" (8 cm) minimum thickness filter blanket that is an intermediate setting bed (pea gravel); and a reservoir course of crushed stone, thickness dependant on required storage and underlying native materials. Alternatively, the pea gravel layer could be thickened and used as the reservoir course depending upon subsoil suitability. This alternative simplifies subbase construction. For lower permeability native soils, perforated or slotted drain pipe is located in the stone reservoir course for drainage. This drain pipe can be daylighted to receiving waters or connected into other stormwater management infrastructure (wetland, storm sewer, etc.). The fine gradation of the filter course is for enhanced filtration and delayed infiltration. The high air void content of the uniformly graded crushed stone reservoir course: maximizes storage of infiltrated water thereby allowing more time for water to infiltrate between storms; and creates a capillary barrier that arrests vertical water movement and in doing so prevents winter freeze-thaw and heaving. The filter blanket is placed to prevent downward migration of filter course material into the reservoir course. The optional underdrain in the reservoir course is for hydraulic relief (typically raised off of the bottom of the reservoir stone layer for enhanced groundwater recharge). Nonwoven geotextile filter fabric (geotextile) is used only for stabilizing the sloping sides of the porous asphalt system excavation and not to be used on the bottom of the system unless needed for structural reasons.

1. Choker Course

Material for the choker course and reservoir course shall meet the following:

Maximum Wash Loss of 0.5%
Minimum Durability Index of 35
Maximum Abrasion Loss of 10% for 100 revolutions, and maximum of 50% for 500 revolutions.

Material for the choker course and reservoir course shall have the AASHTO No. 57 and AASHTO No. 3 gradations, respectively, as specified in

Table 2. If the AASHTO No. 3 gradation cannot be met, AASHTO No. 5 is acceptable with approval of the Engineer. AASHTO no. 3 is also suitable for the choker course.

2. Filter course material

Filter course material shall have a hydraulic conductivity (also referred to as coefficient of permeability) of 10 to 60 ft/day at 95% standard proctor compaction unless otherwise approved by the Engineer. Great care needs to be used to not over compact materials. Over-compaction results with loss of infiltration capacity. The filter course material is commonly referred to as a bankrun gravel (modified NHDOT 304.1). In order to select an appropriate gradation, coefficient of permeability may be estimated through an equation that relates gradation to permeability, such as described in *Correlations of Permeability and Grain Size* (Shepherd, 1989) or in *Section 8.7 Estimation of Saturated Hydraulic Conductivity* (Freeze and Cherry, 1979). The hydraulic conductivity should be determined by ASTM D2434 and reported to the Engineer.

3. Filter blanket material

Filter blanket material between the filter course and the reservoir course shall be an intermediate size between the finer filter course above, and the coarser reservoir course below, for the purpose of preventing the migration of a fine setting bed into the coarser reservoir material. An acceptable gradation shall be calculated based on selected gradations of the filter course and reservoir course using criteria outlined in the *HEC 11* (Brown and Clyde, 1989). A pea-gravel with a median particle diameter of 3/8" (9.5 mm) is commonplace.

4. Reservoir Coarse

Reservoir Coarse thickness is dependent upon the following criteria (that vary from site to site):

a. A 4" (10 cm) minimum thickness of reservoir course acts as a capillary barrier for frost heave protection. The reservoir course is located at the interface between subbase and native materials.

b. 4-in. (10 cm) minimum thickness if the underlying native materials are either well drained (Hydrologic Group A soils).

c. 8-in. (30 cm) minimum thickness if subdrains are installed. Subdrains insure that the subbase is well drained

d. Subdrains, if included, are elevated a minimum of 4" (10 cm) from the reservoir course bottom to provide storage and infiltration for the water quality volume. If the system is lined ,

e. Subbase thickness is determined from subbase materials having sufficient void space to store the design storm,

> **Example:** If the 25-year storm is 5.1" (13 cm) of rainfall depth, and the reservoir void space is 30%, then the minimum subbase thickness = 5.1"/0.3 = 17" (43.2 cm).

f. Pavement system and subbase thickness are $\geq$ 0.65 * design frost depth for area.

> **Example:** Durham, New Hampshire, 48" (122 cm) = $D_{maximum\ frost}$, therefore the *minimum* depth to the bottom of the subbase = 0.65(48") = 32" (81 cm).

5. Optional Bottom Liner

Bottom Liner is only recommended for aquifer protection or infiltration prevention. This liner is to be located at the interface between subbase and native materials and is dependent upon the following:

a. As with any infiltration system, care must be taken when siting porous asphalt systems close to locations where hazardous materials are handled/trafficked, or where high contaminant loading may threaten groundwater, or where infiltration is undesirable (nearby foundations, slope stability, etc.). In such cases, the systems can be lined to prevent infiltration yet still preserving water quality, hydrograph lag, and peak flow reduction benefits.

b. Refer to state or USEPA guidelines regarding the use of infiltration systems (USEPA, 1999, CalTrans, 2003, WI DNR, 2004, USEPA, 2004)

c. Suitable liners may include Hydrologic Group D soils, HDPE liners, or suitable equivalent. Refer to state or USEPA guidelines regarding selection of impermeable liners (USEPA, 2004).

d. Filter fabrics or geotextile liners are not recommended for use on the bottom of the porous asphalt system (at the base of the stone reservoir subbase) if designing for infiltration. Filter fabric usage in stormwater filtration has been known to clog prematurely. Graded stone filter blankets are recommended instead.

e. Geotextile filter fabrics may be used if designing on poor structural, and low conductivity soils. Fabric usage would be limited to the bottom and sides of the excavation. No fabric is to be used within the subbase, only on the perimeter.

Figure 1: Typical Parking Area Cross-Section for Pervious Pavement System

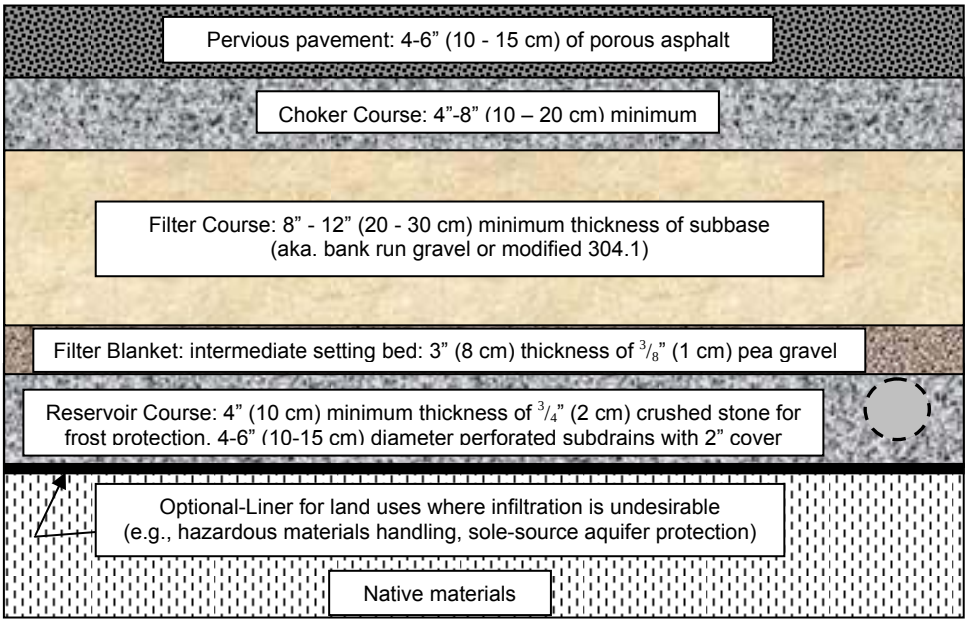

Pervious pavement: 4-6” (10 - 15 cm) of porous asphalt
Choker Course: 4”-8” (10 – 20 cm) minimum
Filter Course: 8” - 12” (20 - 30 cm) minimum thickness of subbase
(aka. bank run gravel or modified 304.1)
Filter Blanket: intermediate setting bed: 3” (8 cm) thickness of 3/8” (1 cm) pea gravel
Reservoir Course: 4” (10 cm) minimum thickness of 3/4” (2 cm) crushed stone for
frost protection. 4-6” (10-15 cm) diameter perforated subdrains with 2” cover
Optional-Liner for land uses where infiltration is undesirable
(e.g., hazardous materials handling, sole-source aquifer protection)
Native materials

Table 2. Gradations and compaction of choker, filter, and reservoir course materials.

US Standard Sieve Size Inches/mm	Percent Passing (%)			
	Choker Course (AASHTO No. 57)	Filter Course (Modified NHDOT 304.1)	Reservoir Course (AASHTO No. 3)	Reservoir Course Alternative* (AASHTO No. 5)
6/150	-	100	-	
2½/63	-		100	-
2 /50	-		90 – 100	-
1½/37.5	100		35 – 70	100
1/25	95 - 100		0 – 15	90 – 100
¾/19	-		-	20 - 55
½/12.5	25 - 60		0 - 5	0 - 10
3/8/9.5	-		-	0 - 5
#4/4.75	0 - 10	70-100	-	
#8/2.36	0 - 5		-	
#200/0.075		0 – 6**		
% Compaction ASTM D698 / AASHTO T99	95	95	95	95

* Alternate gradations (e.g. AASHTO No. 5) may be accepted upon Engineer's approval.
** Preferably less than 4% fines

6. Non-woven geotextile filter fabric

Filter fabric is *only recommended* for the sloping sides of the porous asphalt system excavation. It shall be Mirafi 160N, or approved equal and shall conform to the specifications in

Table 3. Mirafi ® 160N is a non-woven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. 160N is inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids.

7. Alternative Applications and Residential Driveways.

The recommendations above are based on a commercial parking application for both traffic and contaminant load. Alternative applications such as residential driveways and low use applications may justify the use of alternative subbase thicknesses for the porous media beds, filter blanket, and geotextiles. Residential driveway applications have been designed with a subbase limited to only an 8" compacted choker course. Variations should consider structural load requirements for material thickness, and contaminant load for filter course thickness. A reduced total system thickness (Section 2.1.3.f) will subject the pavement to greater freeze thaw susceptibility.

Permeable Interlocking Concrete Pavement (PICP) for Stormwater Management

Benefits and Uses

- Quantity, Pollutant Reduction, and Flood Control
- Recharges Groundwater
- Reduction in Stormwater Infrastructure (Piping, Catch-Basins, Ponds, Curbing, etc.)
- Suitable for Cold-Climate Applications, Maintains Recharge Capacity When Frozen
- No Standing Water or Black Ice Development During Winter Weather Conditions
- Maintains Traction While Wet
- Reduced Surface Temperatures; Minimizes the Urban Heat Island Effect
- Potential for Extended Pavement Life Due to Well Drained Base and Reduced Freeze-Thaw
- No curing time – ready for traffic upon installation completion

Limitations

- Requires Routine Vacuum Sweeping (Vacuum-Assisted Dry Sweeper Only)
- ICPI Recommends a PICP Installer Technician On-site During Installation
- Proper Soil Stabilization and Erosion Control Required to Prevent Clogging

Cost & Maintenance

Total Project Cost Can Be Comparable for PICP with Reduced Stormwater Infrastructure VS. Standard Pavement Applications where Stormwater Infrastructure is Required

- Paver Surface and Bedding Cost is 25-35% More Than Traditional Concrete
- Long-term Maintenance Required by Routine Vacuum Sweeping
- Sweeping Cost May Be Off-set by Possible Reduction in Deicing Costs
- Repairs Can be Made in Freezing Temperatures with Reinstated Concrete Paver Units and Aggregate Jointing/Bedding Materials

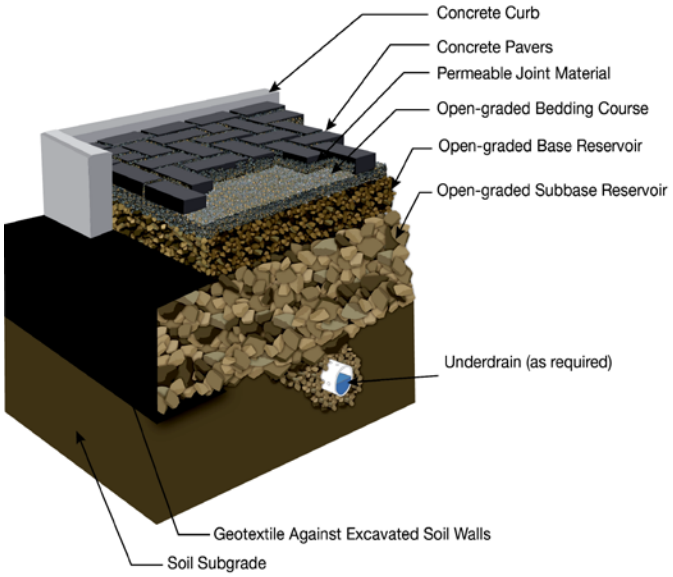
Design Criteria

*** Source: ICPI**

Recommended Soil Permeability 0.01 - 3.0 In./Hr

- Recommended Drainage Time 24-72 Hrs
- Use Underdrains to Remove Water That Cannot be Infiltrated within Drainage Time
- For Parking Lots, Alleys, Low-Use Roadways and Sidewalks
- Required Vertical Separation from Seasonal High Groundwater (1-3 ft. typical)
- Minimum Surface Infiltration (New) – 100 In./Hr and Minimum In-service Infiltration Indicating Vacuum Cleaning – 10 In./Hr Using ASTM C1781
- AASHTO Layer Coefficients: 0.3 for Concrete Pavers and Aggregate Bedding; 0.9 for Base Reservoir; 0.6 for Subbase Reservoir Thicknesses
- Can use stabilized open-graded bases for heavy traffic

TYPICAL CROSS-SECTION



Additional Resources

- US EPA Permeable Interlocking Concrete Pavement Fact Sheet http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=browse&Rbutton=detail&bmp=136
- Interlocking Concrete Pavement Institute, *Permeable Interlocking Concrete Pavement* (2011)
- Interlocking Concrete Pavement Institute: http://www.icpi.org/

Regular Inspection and Maintenance Guidance for Bioretention Systems / Tree Filters

Maintenance of bioretention systems and tree filters can typically be performed as part of standard landscaping. Regular inspection and maintenance is critical to the effective operation of bioretention systems and tree filters to insure they remain clear of leaves and debris and free draining. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, overly wet or dry (I.E., drought), regional hydrologic conditions, and the upstream land use.

ACTIVITIES

The most common maintenance activity is the removal of leaves from the system and bypass structure. Visual inspections are routine for system maintenance. This includes looking for standing water, accumulated leaves, holes in the soil media, signs of plant distress, and debris and sediment accumulation in the system. Mulch and/or vegetation coverage is integral to the performance of the system, including infiltration rate and nutrient uptake. Vegetation care is important to system productivity and health.

ACTIVITY	FREQUENCY
A record should be kept of the time to drain for the system completely after a storm event. The system should drain completely within 72 hours.	After every major storm in the first few months, then biannually.
Check to insure the filter surface remains well draining after storm events. **Remedy**: If filter bed is clogged, draining poorly, or standing water covers more than 15% of the surface 48 hours after a precipitation event, then remove top few inches of discolored material. Till or rake remaining material as needed.	
Check inlets and outlets for leaves and debris. **Remedy**: Rake in and around the system to clear it of debris. Also, clear the inlet and overflow if obstructed.	Quarterly initially, biannually, frequency adjusted as needed after 3 inspections
Check for animal burrows and short circuiting in the system. **Remedy:** Soil erosion from short circuiting or animal boroughs should be repaired when they occur. The holes should be filled and lightly compacted	
Check to insure the filter bed does not contain more than 2 inches accumulated material **Remedy:** Remove sediment as necessary. If 2 inches or more of filter bed has been removed, replace media with either mulch or a (50% sand, 20% woodchips, 20% compost, 10% soil) mixture.	
During extended periods without rainfall, inspect plants for signs of distress. **Remedy:** Plants should be watered until established (typical only for first few months) or as needed thereafter.	
Inspect inlets and outlets to ensure good condition and no evidence of deterioration. Check to see if high-flow bypass is functioning. **Remedy:** Repair or replace any damaged structural parts, inlets, outlets, sidewalls.	Annually
Check for robust vegetation coverage throughout the system. **Remedy:** If at least 50 % vegetation coverage is not established after 2 years, reinforcement planting should be performed.	
Check for dead or dying plants, and general long term plant health. **Remedy:** This vegetation should be cut and removed from the system. If woody vegetation is present, care should be taken to remove dead or decaying plant Material. Separation of Herbaceous vegetation rootstock should occur when over-crowding is observed.	As needed

CHECKLIST FOR INSPECTION OF BIORETENTION SYSTEM / TREE FILTERS

Location: Inspector:

Date: Time: Site Conditions:

Date Since Last Rain Event:

Inspection Items	Satisfactory (S) or Unsatisfactory (U)		Comments/Corrective Action
1. Initial Inspection After Planting and Mulching			
Plants are stable, roots not exposed	**S**	**U**	
Surface is at design level, typically 4" below overpass	**S**	**U**	
Overflow bypass / inlet (if available) is functional	**S**	**U**	
2. Debris Cleanup (2 times a year minimum, Spring & Fall)			
Litter, leaves, and dead vegetation removed from the system	**S**	**U**	
Prune perennial vegetation	**S**	**U**	
3. Standing Water (1 time a year, After large storm events)			
No evidence of standing water after 72 hours	**S**	**U**	
4. Short Circuiting & Erosion (1 times a year, After large storm events)			
No evidence of animal burrows or other holes	**S**	**U**	
No evidence of erosion	**S**	**U**	
5. Drought Conditions (As needed)			
Water plants as needed	**S**	**U**	
Dead or dying plants	**S**	**U**	
6. Overflow Bypass / Inlet Inspection (1 times a year, After large storm events)			
No evidence of blockage or accumulated leaves	**S**	**U**	
Good condition, no need for repair	**S**	**U**	
7. Vegetation Coverage (once a year)			
50 % coverage established throughout system by first year	**S**	**U**	
Robust coverage by year 2 or later	**S**	**U**	
8. Mulch Depth (if applicable)(once every 2 years)			
Mulch at original design depth after tilling or replacement	**S**	**U**	
9. Vegetation Health (once every 3 years)			
Dead or decaying plants removed from the system	**S**	**U**	
10. Tree Pruning (once every 3 years)			
Prune dead, diseased, or crossing branches	**S**	**U**	

Corrective Action Needed	Due Date
1.	
2.	
3.	

Regular Inspection and Maintenance Guidance for Porous Pavements

Regular inspection and maintenance is critical to the effective operation of porous pavement. It is the responsibility of the owner to maintain the pavement in accordance with the minimum design standards. This page provides guidance on maintenance activities that are typically required for these systems, along with the suggested frequency for each activity. Individual systems may have more, or less, frequent maintenance needs, depending on a variety of factors including the occurrence of large storm events, seasonal changes, and traffic conditions.

Inspection Activities

Visual inspections are an integral part of system maintenance. This includes monitoring pavement to ensure water drainage, debris accumulation, and surface deterioration.

ACTIVITY	FREQUENCY
Check for standing water on the surface of the pavement after a precipitation event. If standing water remains within 30 minutes after rainfall had ended, cleaning of porous pavement is recommended.	2 to 4 times per year, more frequently for high use sites or sites with higher potential for run-on
Vacuum sweeper shall be used regularly to remove sediment and organic debris on the pavement surface. The sweeper may be fitted with water jets.	
Pavement vacuuming should occur during spring cleanup following the last snow event to remove accumulated debris, at minimum.	
Pavement vacuuming should occur during fall cleanup to remove dead leaves, at minimum.	
Power washing can be an effective tool for cleaning clogged areas. This should occur at mid pressure typically less than 500 psi and at an angle of 30 degrees or less.	
Check for debris accumulating on pavement, especially debris buildup in winter. For loose debris, a power/leaf blower or gutter broom can be used to remove leaves and trash.	
Check for damage to porous pavements from non-design loads. Damaged areas may be repaired by use of infrared heating and rerolling of pavement. Typical costs may be 2,000/ day for approximately 500 ft of trench.	

Maintenance Activities

Routine preventative cleaning is more effective than corrective cleaning.

Activity	Frequency
Controlling run-on and debris tracking is key to extending the life of porous surfaces. Erosion and sedimentation control of adjacent areas is crucial. Vacuuming adjacent non porous asphalt can be effective at minimizing run-on.	Whenever vacuuming adjacent porous pavements
Repairs may be needed from cuts of utilities. Repairs can be made using standard (non-porous) asphalt for most damages. Repairs using standard asphalt should not exceed 15% of total area.	As needed
Do not store materials such as sand/salt, mulch, soil, yard waste, and other stock piles on porous surfaces.	
Stockpiled snow areas on porous pavements will require additional maintenance and vacuuming. Stockpiling on snow on porous pavements is not recommended and will lead to premature clogging.	
Damage can occur to porous pavement from non-design loads. Precautions such as clearance bars, signage, tight turning radius, high curbs, and video surveillance may be required where there is a risk off non-design loads.	
Posting of signage is recommended indicating presence of porous pavement. Signage should display limitation of design load (i.e. passenger vehicles only, light truck traffic, etc. as per pavement durability rating.)	

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CHECKLIST FOR INSPECTION OF POROUS PAVEMENTS

Location: Inspector:

Date: Time: Site Conditions:

Date Since Last Rain Event:

Inspection Items	Satisfactory (S) or Unsatisfactory (U)		Comments/Corrective Action
1. Salt / Deicing *Note complete winter maintenance guidance is available at UNHSC			
Use salt only for ice management	**S**	**U**	
Piles of accumulated salt removed in spring	**S**	**U**	
2. Debris Cleanup (2-4 times a year minimum, Spring & Fall)			
Clean porous pavement to remove sediment and organic debris on the pavement surface via vacuum street sweeper.	**S**	**U**	
Adjacent non porous pavement vacuumed	**S**	**U**	
Clean catch basins (if available)	**S**	**U**	
3**. Controlling Run-On (2-4 times a year)**			
Adjacent vegetated areas show no signs of erosion and run-on to porous pavement	**S**	**U**	
4. Outlet / Catch Basin Inspection (if available) (2 times a year, After large storm events)			
No evidence of blockage	**S**	**U**	
Good condition, no need for cleaning/repair	**S**	**U**	
5. Poorly Drained Pavement (2-4 times a year)			
Pavement has been pressure washed and vacuumed	**S**	**U**	
6. Pavement Condition (2-4 times a year minimum, Spring & Fall)			
No evidence of deterioration	**S**	**U**	
No cuts from utilities visible	**S**	**U**	
No evidence of improper design load applied	**S**	**U**	
7. Signage / Stockpiling (As Needed)			
Proper signage posted indicating usage for traffic load	**S**	**U**	
No stockpiling of materials and no seal coating	**S**	**U**	

Corrective Action Needed	Due Date
1.	
2.	
3.	

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