STORMWATER MANAGEMENT SUMMARY
SITE DEVELOPMENT AT 57 PERKINS ROW
TOPSFIELD, MASSACHUSETTS

JUNE 16, 2015

The Morin-Cameron
GROUP, INC.

June 16, 2015

Topsfield Planning Board
C/O Ms. Roberta Knight
8 West Common Street
Topsfield, MA 01983

Re: Definitive Subdivision Plan of 57 Perkins Row, Topsfield, MA
Stormwater Management Report

Dear Members of the Board:

On behalf of New Meadows Development, LLC, The Morin-Cameron Group, Inc. (MCG) has prepared this letter to provide supporting documentation on the existing and proposed stormwater conditions associated with the Definitive Subdivision Plan Approval application for the development of 57 Perkins Row in Topsfield, Massachusetts. Our analysis is based on the following:

- Multiple site visits
- Preliminary Subdivision Plan of Land dated March 10, 2015
- Definitive Subdivision Plan of Land for 57 Perkins Row, 10 sheets prepared by MCG dated June 16, 2015
- Figure 1: USGS Map, dated June 16, 2015
- Figure 2: Soil Conservation Service Report, dated June 16, 2015
- Figure 3: Existing Drainage Areas, prepared by MCG dated June 16, 2015
- Figure 4: FEMA FIRM 25009C0268F, dated June 16,2015
- Figure 5: Proposed Drainage Areas, prepared by MCG dated June 16, 2015
- Figure 6: Rational Drainage Areas, prepared by MCG dated June 16, 2015
- HydroCAD Stormwater Calculations prepared by MCG on June 16, 2015

Existing Site Conditions

The site consists of a single lot at 57 Perkins Row which encompasses a total area of 365,838 sf (8.2 acres) and has been utilized as a single family residence since 1952. The existing lot contains 2,609 sf buildings, 7,568 sf pavement, 285,941 sf pervious grass trees and open space and 60,720 sf wetlands resulting in 97.1% open space. Grades on site are moderately hilly with a high elevation of 73 ft. (NAVD88) immediately to the East of the existing home to a low elevation of 34 ft. at the southeast corner of the lot adjacent to the Ipswich River. Soils on site are considered to be Charlton Fine Sandy Loam and Scarboro mucky fine sandy loam as defined in the Soil Resource Report for Essex County, Massachusetts, Northern Part Version 10 dated December 17, 2013(See Figure 2: SCS Soils Map). Field testing performed by MCG on July 21 through 31, 2014 confirms this soil classification indicating a moderately drained B type soil.

ESHGWT was determined to be between 24 to 38 inches at the North end of the lot to 40 to 60 inches in the South end of the lot.

Drainage on site and immediately off site upstream of the tributary brook has been divided into four distinct sub-catchment areas as shown on the attached Figure 3: Existing Drainage Areas (EDA). The table below shows the total area, impervious area and pervious area for each sub catchment area.

Existing Drainage Area (ES)	Total Area (sf)	Impervious Area * (sf)	Pervious Area (sf)
1	12,198	665	11,533
2	176,742**	14,226	162,516
3	49,970	8,163	41,807
4	233,836	47,843	185,993
Totals	472,746	70,897	401,849

*Impervious areas include all impervious surfaces and water bodies

** Total Drainage area includes 60,811 sf on site and 115,931 sf off site

Catchment area E1 is at the North end of the property to the West of the driveway. It is comprised mostly of trees with a small portion of paved driveway. It sheet flows directly to Perkins Row which is Design Point 3 (DP3). Catchment area E2 is a heavily treed area between the West property boundary and the existing driveway and includes the small ponding area and wetlands upstream of the driveway crossing. It also includes an area off site on the tributary stream upstream of the ponding area. It discharges through a small conduit under the driveway to DP2. Catchment E3 is from the East property boundary to the West side of the driveway and up to the existing house. It includes mostly trees, grass, pavement, building and some wetlands. It discharges directly to DP2.Catchment E4 encompasses the entire South end of the property from the house to the Ipswich River. The vast majority of the area is heavily treed with a small section of buildings. It sheet flows directly to the Ipswich River which is DP1.

There are wetlands and jurisdictional buffer zones on the site as shown on the existing condition plan. The majority of the lot is shown to be in a Zone X on the FEMA Federal Insurance Rate Map (FIRM) #25009C0268F, dated July 3, 2012(See Figure 4: FEMA Flood Map). There is a small section along the South property line that is in the Zone A FEMA 100 year floodplain for the Ipswich River. The 100 year elevation is at approximately 36.5 ft. and extends about 670 ft. long adjacent to the river and 50 to 80 ft. deep into the property. The parcel is shown on Assessors Map 58, Lot 25.

Proposed Site Conditions

The project proponent proposes to develop the property for residential use. He proposes a five lot subdivision of single family homes with a 625 ft. dead end road with cul-de-sac, associated drainage and a constructed pocket stormwater wetland. Each house will have its own drywell to mitigate roof runoff and provide recharge along with the small pervious paving block detention pond at in the cul-de-sac. The proposed development results in an increase of 33,617 sf of impervious surface area (47.4% increase).

The proposed drainage system for the subdivision will consist of a pervious block detention pond in the cul-de-sac along with five deep sump hooded catch basins in the road collecting runoff and discharging to a sediment forebay in a constructed pocket stormwater wetland. The pocket wetland will attenuate peak flows before discharging to the existing wetland and

ponding area immediately upstream of the road crossing. The hydraulic crossing beneath the new road has been designed to mimic existing conditions by generally maintaining the same discharge flow and back water elevations as under existing conditions during all rainfall events. Flows from the existing ponding area will be controlled by a rectangular notch weir. An open bottom box culvert will be installed beneath the new roadway to allow the passage of indigenous wildlife through the stream corridor. This structure will be in full compliance with the Massachusetts River and Stream Crossing Standards as developed by the River and Stream Continuity Partnership and dated March 1, 2011. As mentioned before, each house will have its own drywell to mitigate flow and provide recharge to the existing groundwater. The drywells will be constructed of 40 – 18 inch deep StormTanks for each house. The pocket wetland and sediment forebay will also provide in excess of 80% Total Suspended Soils (TSS) removal.

The proposed development of the site results in the formation of seven sub catchment areas as shown on the Proposed Drainage Areas Plan Figure 5. The table below provides the total drainage area, area of impervious surface and area of pervious surface for each sub catchment area.

Proposed Drainage Area (PS)	Total Area (Sf)	Impervious Area* (Sf)	Pervious Area (Sf)
1	4,046	0	4,046
2	161,119**	15,717	145,402
3	8,338	2,571	5,767
4	228,698	55,986	172,712
5	22,644	1,925	20,719
6A	16,380	10,635	5,745
6B	29,420	17,680	11,740
Totals	472,769	104,514	368,255

* Impervious area includes all impervious surfaces and water bodies
** Total drainage area includes 45,188 sf on site and 115,931 sf off site.

Catchment area P1 is located at the North end of the property, is comprised totally of grass and trees and sheet flows to Perkins Row at DP3. Catchment P2 is located to the West of the new road and includes the existing ponding area, contributing drainage consists of mostly trees from on and off site and a small paved area. It discharges through the above mentioned open culvert beneath the road to DP2. Catchment P3 is a small area between the East side of the new Road and the East property boundary. It also includes a small portion of Lot5. It is mostly grass with some pavement and flows directly to DP2. Catchment P4 is entirely along the South end of the property adjacent to the Ipswich River. It is comprised mostly of heavy trees and wetland with some buildings and pavement. The drainage area sheet flows to DP1, the Ipswich River. Catchment P5 is a small area immediately adjacent to the existing on-site ponding area. It includes the pocket wetland and is mostly trees, grass and wetlands with some pavement. It discharges directly to the ponding area and eventually to DP2. Catchment P6A is mostly the new road from the high point to and including the cul-de-sac with pervious paving stone detention basin. It included some driveways and grass front yards. It discharges to the Pocket Wetland and eventually to DP2. Catchment 6B is the rest of the road with driveways and front lawns. It also discharges to the sediment forebay and eventually DP2.

Analysis:

The purpose of this analysis is to design an onsite drainage system which complies with the Town of Topsfield and the DEP Stormwater Management Standards.

This analysis was performed using the U.S. Soil Conservation Service (S.C.S) method of analysis contained in Technical Release #20 (TR-20) published by the U.S. Conservation Service. The model used for this calculation is referred to as HydroCAD. Hydro-Cad is a computer aided design program for analyzing the hydrology and hydraulics of storm water runoff. It utilizes the latest techniques of both fields to accurately predict the consequences of any given storm event. This analysis allows the engineer to verify that a given drainage system is adequate for the area under consideration, and further allows the engineer to predict where flooding or erosion are most likely to occur. This model was used to analyze the storm drainage system designed for the development in order to demonstrate that the drainage system is in compliance with the Town's Stormwater Management Standards.

The HydroCAD analysis was performed by examining three design points that were previously explained. Following is a listing of the total pre and post discharges for the proposed development for the 2, 10 and 100 year rainfall events:

Event (Years)	Existing Conditions (Peak CFS)	Proposed Conditions (Peak CFS)	Change in Peak (CFS)
DP1			
2	2.64	2.42	-0.22
10	7.77	7.15	-0.62
100	16.88	15.52	-1.36
DP2			
2	0.37	0.19	-0.18
10	1.21	0.66	-0.55
100	2.71	1.37	-1.34
DP3			
2	0.04	0.02	-0.02
10	0.17	0.09	-0.08
100	0.45	0.24	-0.21

Stormwater Management Standards

The development of 57 Perkins Row in Topsfield, Massachusetts will comply with all Stormwater Management Standards and will improve existing conditions. The proposed development results in a significant increase in impervious surface areas however the drainage system has been designed to reduce peak rates of stormwater runoff leaving the site. More stormwater will be recharged to groundwater through the five proposed drywells and the pervious paving block retention area. The five proposed hooded deep sump catch basins along with the constructed pocket stormwater wetlands with sediment forebay will provide all the required TSS removal. The following is an assessment of each Standard:

1. No stormwater conveyance system discharges untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth. There are no proposed stormwater conveyance systems that discharge untreated stormwater directly to the on-site wetlands or to the waters of the Commonwealth.

   The proposed development meets this standard.
2. The stormwater management system has been designed such that post-development peak discharge rates do not exceed pre-development discharge rates for all storm events.

   The proposed development meets this standard.
3. Loss of annual recharge to groundwater has been significantly reduced through the proposed addition of the five drywells and pervious block pavers. The annual recharge from the post development site exceeds the annual recharge from the pre development site. Stormwater recharge calculations indicate that the required volume of recharge due to increased impervious area is 949 cf. The proposed development provides 1,732 cf.

   4. *The proposed development meets this standard.*
5. The proposed stormwater management system has been designed to remove a major amount of the average annual post-construction load of Total Suspended Solids (TSS) utilizing five hooded catch basins with deep sumps and a constructed pocket wetland with sediment forebay. The deep sumps and outlet tees (hoods) within the catch basins will provide 25% pretreatment prior to discharge to the sediment forebay/pocket wetland which provides 80% removal. The proposed system will provide a total of 85% TSS removal fully meeting this standard. The provided 319 cf. of storage below the sediment forebay overflow berm exceeds the required 0.1 inches (271 cf.) of runoff from the contributing pavement area.

   The proposed development meets the standard.
6. Land Uses with Higher Potential Pollutant Load.

   This standard does not apply.
7. Discharges to critical areas.

   This standard does not apply.
8. Redevelopment Projects:

   This standard does not apply.
9. Construction Phase Operation and Maintenance Plan: A plan to control construction-related impacts has been developed and is included herein.

   The proposed development meets this standard.
10. A long-term operation and maintenance plan: A long-term O&M has been developed to insure that stormwater management systems function as designed. A copy of this O&M procedure was provided with the submitted documents.

    The proposed development meets this standard.
11. Illicit discharges: To the best of our knowledge and belief there are no illicit discharges to the stormwater management system on this site.

    The proposed development meets this standard.

This development, as proposed, is in full compliance with the Town of Topsfield Stormwater Standards and the MassDEP Stormwater Management Handbook. Peak rates of stormwater runoff leaving the site under proposed conditions are less than under existing conditions. Recharge to groundwater will be increased by adding five dry wells and the pervious paving block retention area strategically located throughout the subdivision. There are no illicit discharges to the waters of the Commonwealth. The proposed project will, therefore, comply

with the Town of Topsfield and Mass DEP stormwater standards The DEP Checklist for Stormwater Report is attached.

We trust this report and supporting documents and calculations provides sufficient demonstration that the project will result in a significant improvement to the site and meet all standards of the Town of Topsfield and the Mass DEP Stormwater Management Handbook. If you have any questions or comments, please do not hesitate to contact the undersigned at (978) 887-8586.

Sincerely,

THE MORIN-CAMERON GROUP, INC.

Scott P. Cameron, P.E.
Principal

SPC/kmm

Attachments

cc: New Meadows Development, LLC
Atty. N. McCann
Topsfield Conservation Commission

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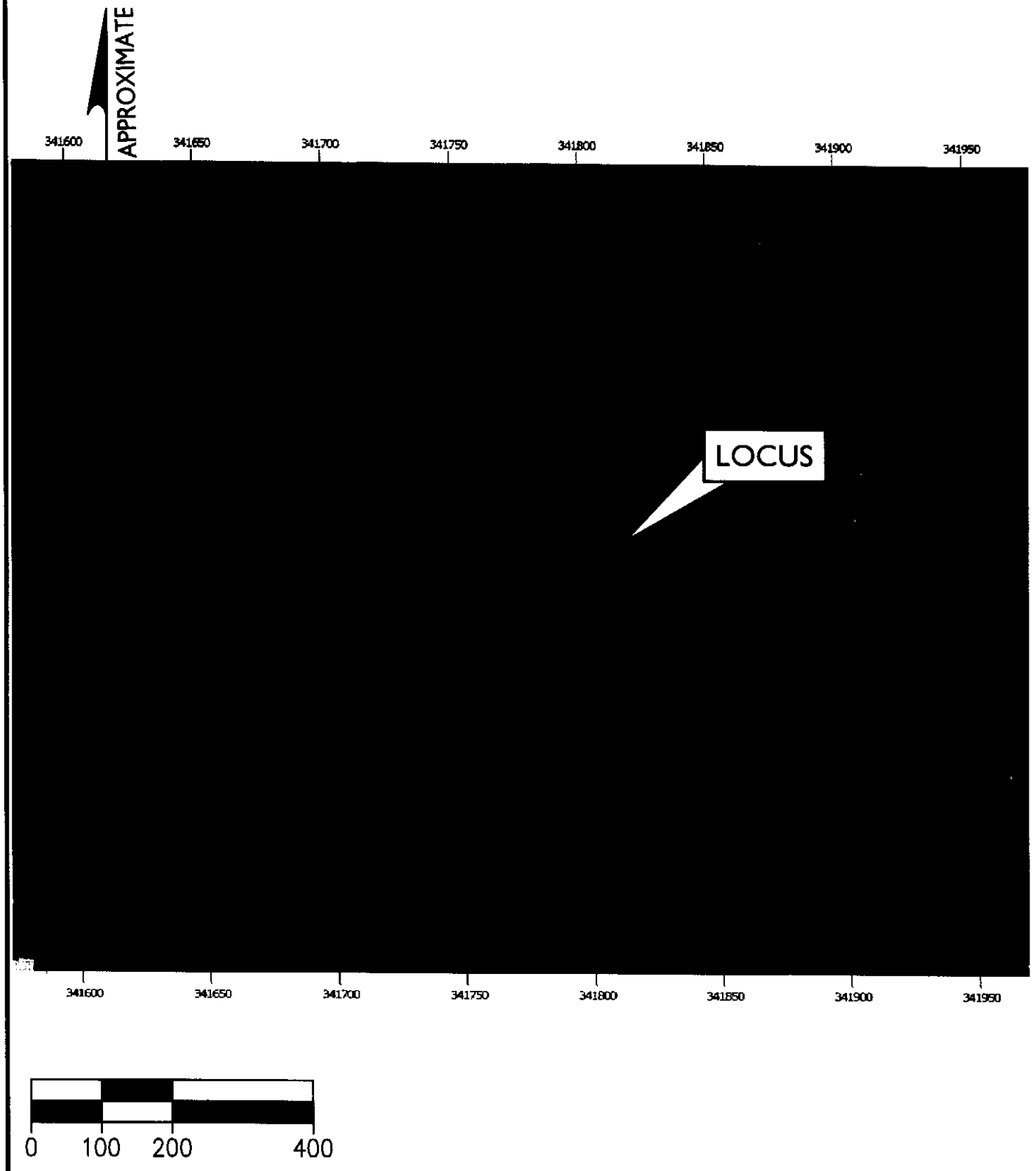
USGS MAP
57 PERKINS ROW
IN
TOPSFIELD, MA

DATE: JUNE 16, 2015 | SCALE: 1" = 500' | **FIGURE #1**



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SCS SOILS MAP
57 PERKINS ROW
IN
TOPSFIELD, MA

DATE: JUNE 16, 2015

SCALE: 1" = 200'

FIGURE #2

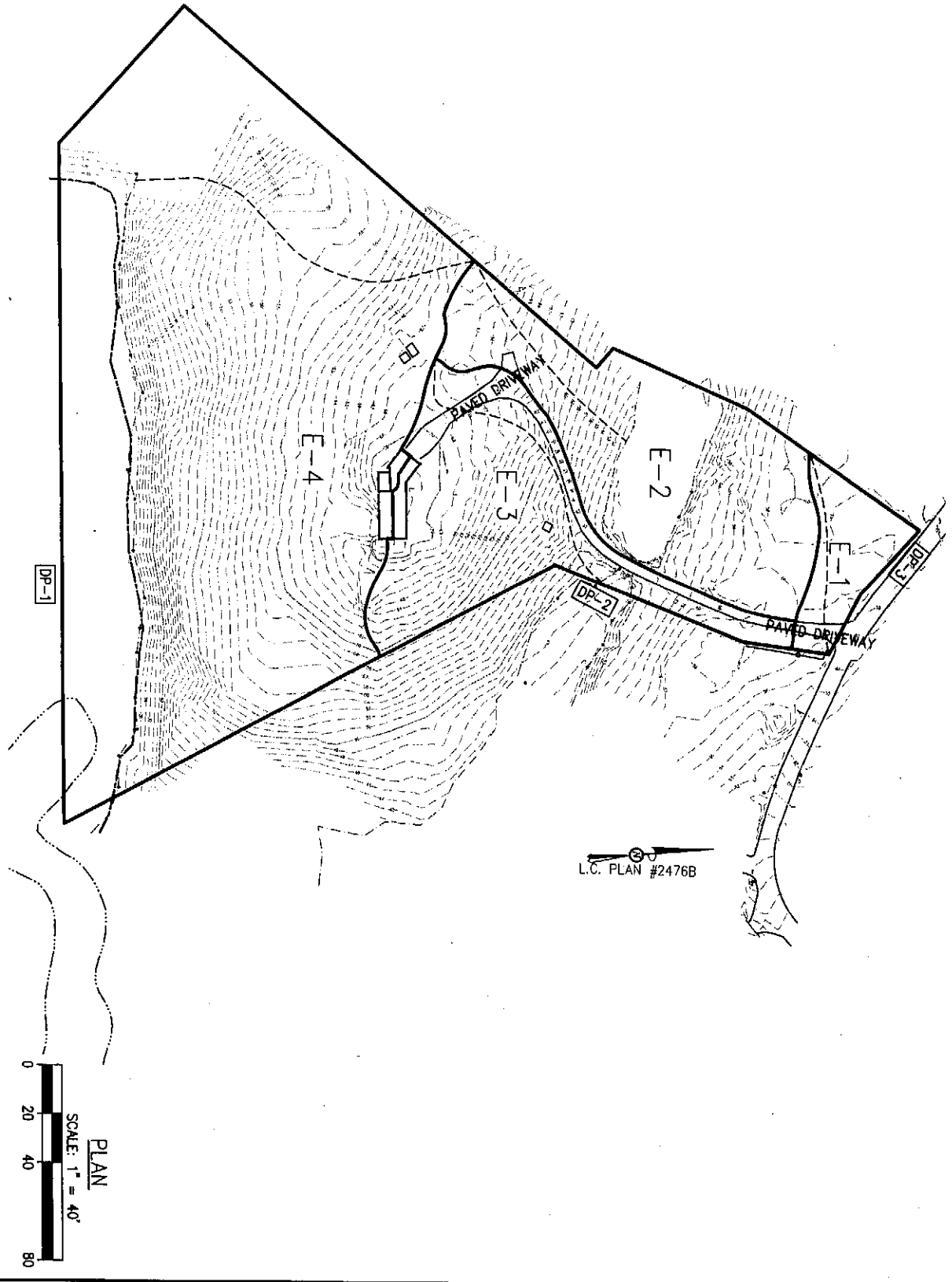

FIGURE #3
EXISTING SUBCATCHMENT AREAS
AT:
57 PERKINS ROW
TOPSFIELD, MASSACHUSETTS

DATE: JUNE 16, 2015
SCALE: 1" = 100'

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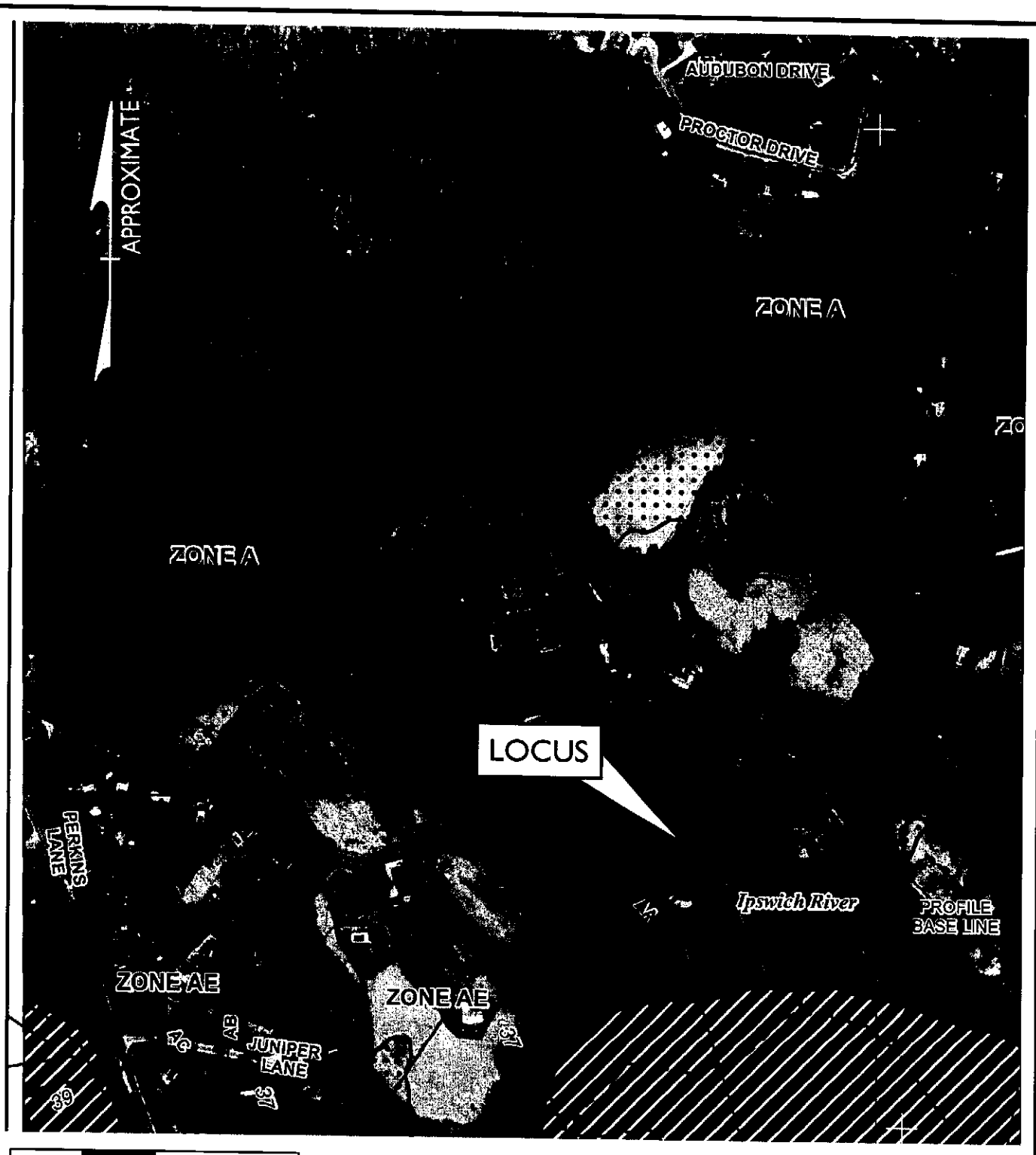

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FEMA MAP
57 PERKINS ROW
IN
TOPSFIELD, MA

DATE: JUNE 16, 2015

Scale: 1" = 500'

FIGURE #4

FIGURE #5
PROPOSED SUBCATCHMENT AREAS
AT:
57 PERKINS ROW
TOPSFIELD, MASSACHUSETTS

DATE: JUNE 16, 2015
SCALE: 1" = 100'

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

Checklist for Stormwater Report

A. Introduction

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

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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
SCOTT P. CAMERON
CIVIL
No. 47601
REGISTERED PROFESSIONAL ENGINEER

Signature and Date 6/16/15

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

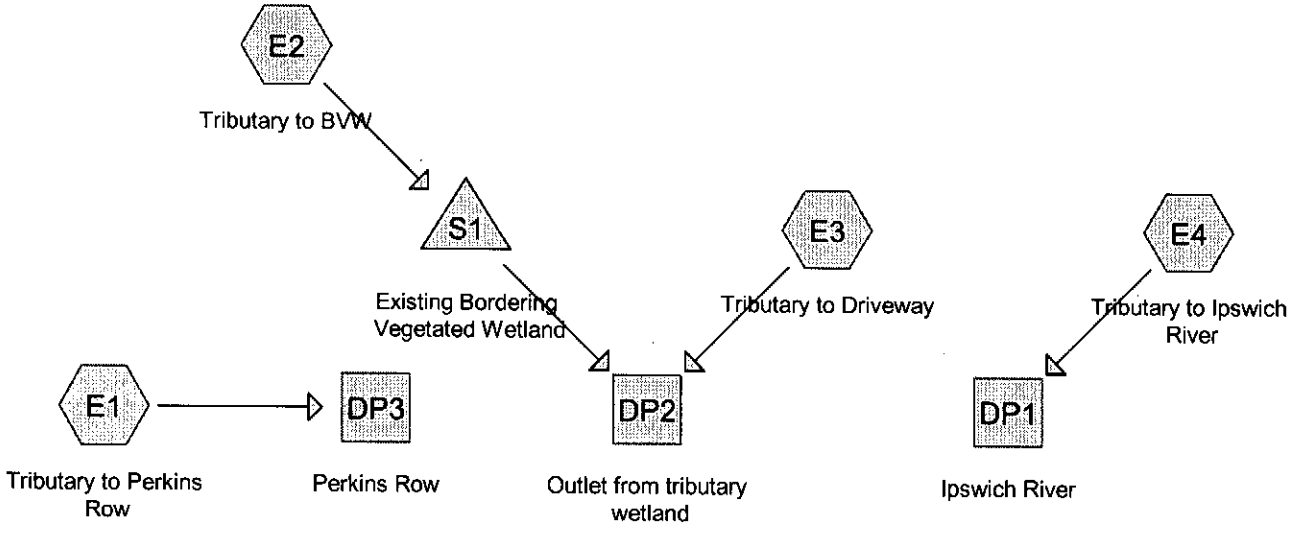
- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity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

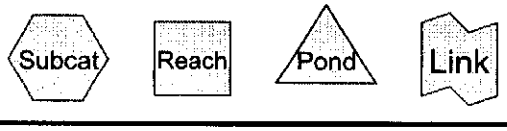
Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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





Routing Diagram for Pre Development Watershed Analysis
Prepared by The Morin-Cameron Group, Inc., Printed 6/15/2015
HydroCAD® 10.00-13 s/n 00401 © 2014 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.449	61	>75% Grass cover, Good, HSG B (E1, E2, E3, E4)
0.174	98	Paved parking, HSG B (E1, E2, E3)
0.060	98	Roofs, HSG B (E3, E4)
1.394	98	Water Surface, HSG B (E2, E3, E4)
7.776	55	Woods, Good, HSG B (E1, E2, E3, E4)
10.853	**62**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
10.853	HSG B	E1, E2, E3, E4
0.000	HSG C	
0.000	HSG D	
0.000	Other	
10.853		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	1.449	0.000	0.000	0.000	1.449	>75% Grass cover, Good	E1, E2, E3, E4
0.000	0.174	0.000	0.000	0.000	0.174	Paved parking	E1, E2, E3
0.000	0.060	0.000	0.000	0.000	0.060	Roofs	E3, E4
0.000	1.394	0.000	0.000	0.000	1.394	Water Surface	E2, E3, E4
0.000	7.776	0.000	0.000	0.000	7.776	Woods, Good	E1, E2, E3, E4
0.000	**10.853**	**0.000**	**0.000**	**0.000**	**10.853**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Tributary to Perkins Row Runoff Area=12,198 sf 5.45% Impervious Runoff Depth=0.31"
Flow Length=210' Tc=17.7 min CN=58 Runoff=0.04 cfs 0.007 af

Subcatchment E2: Tributary to BVW Runoff Area=176,742 sf 8.05% Impervious Runoff Depth=0.34"
Flow Length=240' Tc=8.2 min CN=59 Runoff=0.70 cfs 0.114 af

Subcatchment E3: Tributary to Driveway Runoff Area=49,970 sf 16.34% Impervious Runoff Depth=0.51"
Flow Length=287' Tc=17.3 min CN=64 Runoff=0.36 cfs 0.049 af

Subcatchment E4: Tributary to Ipswich Runoff Area=233,836 sf 20.46% Impervious Runoff Depth=0.55"
Flow Length=375' Tc=6.0 min CN=65 Runoff=2.64 cfs 0.247 af

Reach DP1: Ipswich River Inflow=2.64 cfs 0.247 af
Outflow=2.64 cfs 0.247 af

Reach DP2: Outlet from tributary wetland Inflow=0.37 cfs 0.150 af
Outflow=0.37 cfs 0.150 af

Reach DP3: Perkins Row Inflow=0.04 cfs 0.007 af
Outflow=0.04 cfs 0.007 af

Pond S1: Existing Bordering Vegetated Peak Elev=48.03' Storage=2,358 cf Inflow=0.70 cfs 0.114 af
Outflow=0.09 cfs 0.101 af

Total Runoff Area = 10.853 ac Runoff Volume = 0.418 af Average Runoff Depth = 0.46"
85.00% Pervious = 9.225 ac 15.00% Impervious = 1.628 ac

Summary for Subcatchment E1: Tributary to Perkins Row

Runoff = 0.04 cfs @ 12.45 hrs, Volume= 0.007 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
665	98	Paved parking, HSG B
9,967	55	Woods, Good, HSG B
1,566	61	>75% Grass cover, Good, HSG B
12,198	58	Weighted Average
11,533		94.55% Pervious Area
665		5.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.2	160	0.0188	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.7	210	Total			

Summary for Subcatchment E2: Tributary to BVW

Runoff = 0.70 cfs @ 12.20 hrs, Volume= 0.114 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
324	98	Paved parking, HSG B
154,478	55	Woods, Good, HSG B
13,902	98	Water Surface, HSG B
8,038	61	>75% Grass cover, Good, HSG B
176,742	59	Weighted Average
162,516		91.95% Pervious Area
14,226		8.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	190	0.0974	5.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.2	240	Total			

Summary for Subcatchment E3: Tributary to Driveway

Runoff = 0.36 cfs @ 12.32 hrs, Volume= 0.049 af, Depth= 0.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,069	98	Roofs, HSG B
6,579	98	Paved parking, HSG B
24,258	55	Woods, Good, HSG B
515	98	Water Surface, HSG B
17,549	61	>75% Grass cover, Good, HSG B
49,970	64	Weighted Average
41,807		83.66% Pervious Area
8,163		16.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	237	0.0865	4.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	287	Total			

Summary for Subcatchment E4: Tributary to Ipswich River

Runoff = 2.64 cfs @ 12.11 hrs, Volume= 0.247 af, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,540	98	Roofs, HSG B
150,026	55	Woods, Good, HSG B
46,303	98	Water Surface, HSG B
35,967	61	>75% Grass cover, Good, HSG B
233,836	65	Weighted Average
185,993		79.54% Pervious Area
47,843		20.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	50	0.0820	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.1	325	0.0969	5.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.6					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	375	Total			

Summary for Reach DP1: Ipswich River

Inflow Area =	5.368 ac,	20.46% Impervious,	Inflow Depth =	0.55" for 2-Year event
Inflow =	2.64 cfs @	12.11 hrs, Volume=	0.247 af	
Outflow =	2.64 cfs @	12.11 hrs, Volume=	0.247 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Outlet from tributary wetland

Inflow Area =	5.205 ac,	9.88% Impervious,	Inflow Depth >	0.35" for 2-Year event
Inflow =	0.37 cfs @	12.32 hrs, Volume=	0.150 af	
Outflow =	0.37 cfs @	12.32 hrs, Volume=	0.150 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3: Perkins Row

Inflow Area =	0.280 ac,	5.45% Impervious,	Inflow Depth =	0.31" for 2-Year event
Inflow =	0.04 cfs @	12.45 hrs, Volume=	0.007 af	
Outflow =	0.04 cfs @	12.45 hrs, Volume=	0.007 af,	Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond S1: Existing Bordering Vegetated Wetland

Inflow Area =	4.057 ac,	8.05% Impervious,	Inflow Depth =	0.34" for 2-Year event
Inflow =	0.70 cfs @	12.20 hrs, Volume=	0.114 af	
Outflow =	0.09 cfs @	16.80 hrs, Volume=	0.101 af,	Atten= 87%, Lag= 276.0 min
Primary =	0.09 cfs @	16.80 hrs, Volume=	0.101 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 48.03' @ 16.80 hrs Surf.Area= 10,488 sf Storage= 2,358 cf

Plug-Flow detention time= 387.5 min calculated for 0.101 af (88% of inflow)
Center-of-Mass det. time= 334.1 min (1,267.4 - 933.3)

Volume	Invert	Avail.Storage	Storage Description
#1	47.80'	65,726 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.80	9,945	0	0
50.00	15,123	27,575	27,575
52.00	23,028	38,151	65,726

Device	Routing	Invert	Outlet Devices
#1	Primary	47.80'	**12.0" Round Culvert w/ 9.0" inside fill** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.05' / 47.00' S= 0.0025 '/' Cc= 0.900

			n= 0.030 Rubble masonry, cemented, Flow Area= 0.15 sf
#2	Primary	51.10'	**20.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.09 cfs @ 16.80 hrs HW=48.03' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.09 cfs @ 0.70 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Tributary to Perkins Row Runoff Area=12,198 sf 5.45% Impervious Runoff Depth=0.90"
Flow Length=210' Tc=17.7 min CN=58 Runoff=0.17 cfs 0.021 af

Subcatchment E2: Tributary to BVW Runoff Area=176,742 sf 8.05% Impervious Runoff Depth=0.96"
Flow Length=240' Tc=8.2 min CN=59 Runoff=3.51 cfs 0.325 af

Subcatchment E3: Tributary to Driveway Runoff Area=49,970 sf 16.34% Impervious Runoff Depth=1.27"
Flow Length=287' Tc=17.3 min CN=64 Runoff=1.10 cfs 0.121 af

Subcatchment E4: Tributary to Ipswich Runoff Area=233,836 sf 20.46% Impervious Runoff Depth=1.33"
Flow Length=375' Tc=6.0 min CN=65 Runoff=7.77 cfs 0.595 af

Reach DP1: Ipswich River Inflow=7.77 cfs 0.595 af
Outflow=7.77 cfs 0.595 af

Reach DP2: Outlet from tributary wetland Inflow=1.21 cfs 0.416 af
Outflow=1.21 cfs 0.416 af

Reach DP3: Perkins Row Inflow=0.17 cfs 0.021 af
Outflow=0.17 cfs 0.021 af

Pond S1: Existing Bordering Vegetated Peak Elev=48.51' Storage=7,661 cf Inflow=3.51 cfs 0.325 af
Outflow=0.22 cfs 0.295 af

Total Runoff Area = 10.853 ac Runoff Volume = 1.062 af Average Runoff Depth = 1.17"
85.00% Pervious = 9.225 ac 15.00% Impervious = 1.628 ac

Summary for Subcatchment E1: Tributary to Perkins Row

Runoff = 0.17 cfs @ 12.29 hrs, Volume= 0.021 af, Depth= 0.90"

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

Area (sf)	CN	Description
665	98	Paved parking, HSG B
9,967	55	Woods, Good, HSG B
1,566	61	>75% Grass cover, Good, HSG B
12,198	58	Weighted Average
11,533		94.55% Pervious Area
665		5.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.2	160	0.0188	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.7	210	Total			

Summary for Subcatchment E2: Tributary to BVW

Runoff = 3.51 cfs @ 12.14 hrs, Volume= 0.325 af, Depth= 0.96"

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

Area (sf)	CN	Description
324	98	Paved parking, HSG B
154,478	55	Woods, Good, HSG B
13,902	98	Water Surface, HSG B
8,038	61	>75% Grass cover, Good, HSG B
176,742	59	Weighted Average
162,516		91.95% Pervious Area
14,226		8.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	190	0.0974	5.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.2	240	Total			

Summary for Subcatchment E3: Tributary to Driveway

Runoff = 1.10 cfs @ 12.26 hrs, Volume= 0.121 af, Depth= 1.27"

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

Area (sf)	CN	Description
1,069	98	Roofs, HSG B
6,579	98	Paved parking, HSG B
24,258	55	Woods, Good, HSG B
515	98	Water Surface, HSG B
17,549	61	>75% Grass cover, Good, HSG B
49,970	64	Weighted Average
41,807		83.66% Pervious Area
8,163		16.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	237	0.0865	4.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	287	Total			

Summary for Subcatchment E4: Tributary to Ipswich River

Runoff = 7.77 cfs @ 12.10 hrs, Volume= 0.595 af, Depth= 1.33"

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

Area (sf)	CN	Description
1,540	98	Roofs, HSG B
150,026	55	Woods, Good, HSG B
46,303	98	Water Surface, HSG B
35,967	61	>75% Grass cover, Good, HSG B
233,836	65	Weighted Average
185,993		79.54% Pervious Area
47,843		20.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	50	0.0820	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.1	325	0.0969	5.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.6					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	375	Total			

Summary for Reach DP1: Ipswich River

Inflow Area =	5.368 ac,	20.46% Impervious,	Inflow Depth =	1.33"	for 10-Year event
Inflow =	7.77 cfs @	12.10 hrs, Volume=	0.595 af		
Outflow =	7.77 cfs @	12.10 hrs, Volume=	0.595 af,	Atten= 0%,	Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Outlet from tributary wetland

Inflow Area =	5.205 ac,	9.88% Impervious,	Inflow Depth >	0.96"	for 10-Year event
Inflow =	1.21 cfs @	12.27 hrs, Volume=	0.416 af		
Outflow =	1.21 cfs @	12.27 hrs, Volume=	0.416 af,	Atten= 0%,	Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3: Perkins Row

Inflow Area =	0.280 ac,	5.45% Impervious,	Inflow Depth =	0.90"	for 10-Year event
Inflow =	0.17 cfs @	12.29 hrs, Volume=	0.021 af		
Outflow =	0.17 cfs @	12.29 hrs, Volume=	0.021 af,	Atten= 0%,	Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond S1: Existing Bordering Vegetated Wetland

Inflow Area =	4.057 ac,	8.05% Impervious,	Inflow Depth =	0.96"	for 10-Year event
Inflow =	3.51 cfs @	12.14 hrs, Volume=	0.325 af		
Outflow =	0.22 cfs @	16.38 hrs, Volume=	0.295 af,	Atten= 94%,	Lag= 254.9 min
Primary =	0.22 cfs @	16.38 hrs, Volume=	0.295 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 48.51' @ 16.38 hrs Surf.Area= 11,618 sf Storage= 7,661 cf

Plug-Flow detention time= 460.2 min calculated for 0.295 af (91% of inflow)
Center-of-Mass det. time= 415.0 min (1,304.4 - 889.4)

Volume	Invert	Avail.Storage	Storage Description
#1	47.80'	65,726 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.80	9,945	0	0
50.00	15,123	27,575	27,575
52.00	23,028	38,151	65,726

Device	Routing	Invert	Outlet Devices
#1	Primary	47.80'	**12.0" Round Culvert w/ 9.0" inside fill** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.05' / 47.00' S= 0.0025 '/' Cc= 0.900

			n= 0.030 Rubble masonry, cemented, Flow Area= 0.15 sf
#2	Primary	51.10'	**20.0' long x 10.0' 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) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.22 cfs @ 16.38 hrs HW=48.51' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.22 cfs @ 1.40 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment E1: Tributary to Perkins Row Runoff Area=12,198 sf 5.45% Impervious Runoff Depth=2.08"
Flow Length=210' Tc=17.7 min CN=58 Runoff=0.45 cfs 0.048 af

Subcatchment E2: Tributary to BVW Runoff Area=176,742 sf 8.05% Impervious Runoff Depth=2.17"
Flow Length=240' Tc=8.2 min CN=59 Runoff=9.07 cfs 0.732 af

Subcatchment E3: Tributary to Driveway Runoff Area=49,970 sf 16.34% Impervious Runoff Depth=2.63"
Flow Length=287' Tc=17.3 min CN=64 Runoff=2.47 cfs 0.251 af

Subcatchment E4: Tributary to Ipswich Runoff Area=233,836 sf 20.46% Impervious Runoff Depth=2.72"
Flow Length=375' Tc=6.0 min CN=65 Runoff=16.88 cfs 1.217 af

Reach DP1: Ipswich River Inflow=16.88 cfs 1.217 af
Outflow=16.88 cfs 1.217 af

Reach DP2: Outlet from tributary wetland Inflow=2.71 cfs 0.853 af
Outflow=2.71 cfs 0.853 af

Reach DP3: Perkins Row Inflow=0.45 cfs 0.048 af
Outflow=0.45 cfs 0.048 af

Pond S1: Existing Bordering Vegetated Peak Elev=49.47' Storage=19,956 cf Inflow=9.07 cfs 0.732 af
Outflow=0.37 cfs 0.602 af

Total Runoff Area = 10.853 ac Runoff Volume = 2.249 af Average Runoff Depth = 2.49"
85.00% Pervious = 9.225 ac 15.00% Impervious = 1.628 ac

Summary for Subcatchment E1: Tributary to Perkins Row

Runoff = 0.45 cfs @ 12.26 hrs, Volume= 0.048 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
665	98	Paved parking, HSG B
9,967	55	Woods, Good, HSG B
1,566	61	>75% Grass cover, Good, HSG B
12,198	58	Weighted Average
11,533		94.55% Pervious Area
665		5.45% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
1.2	160	0.0188	2.21		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.7	210	Total			

Summary for Subcatchment E2: Tributary to BVW

Runoff = 9.07 cfs @ 12.13 hrs, Volume= 0.732 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
324	98	Paved parking, HSG B
154,478	55	Woods, Good, HSG B
13,902	98	Water Surface, HSG B
8,038	61	>75% Grass cover, Good, HSG B
176,742	59	Weighted Average
162,516		91.95% Pervious Area
14,226		8.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	50	0.0700	0.11		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.6	190	0.0974	5.02		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.2	240	Total			

Summary for Subcatchment E3: Tributary to Driveway

Runoff = 2.47 cfs @ 12.25 hrs, Volume= 0.251 af, Depth= 2.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,069	98	Roofs, HSG B
6,579	98	Paved parking, HSG B
24,258	55	Woods, Good, HSG B
515	98	Water Surface, HSG B
17,549	61	>75% Grass cover, Good, HSG B
49,970	64	Weighted Average
41,807		83.66% Pervious Area
8,163		16.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.5	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.8	237	0.0865	4.74		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
17.3	287	Total			

Summary for Subcatchment E4: Tributary to Ipswich River

Runoff = 16.88 cfs @ 12.09 hrs, Volume= 1.217 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,540	98	Roofs, HSG B
150,026	55	Woods, Good, HSG B
46,303	98	Water Surface, HSG B
35,967	61	>75% Grass cover, Good, HSG B
233,836	65	Weighted Average
185,993		79.54% Pervious Area
47,843		20.46% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	50	0.0820	0.26		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
1.1	325	0.0969	5.01		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.6					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	375	Total			

Summary for Reach DP1: Ipswich River

Inflow Area = 5.368 ac, 20.46% Impervious, Inflow Depth = 2.72" for 100-Year event
Inflow = 16.88 cfs @ 12.09 hrs, Volume= 1.217 af
Outflow = 16.88 cfs @ 12.09 hrs, Volume= 1.217 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Outlet from tributary wetland

Inflow Area = 5.205 ac, 9.88% Impervious, Inflow Depth > 1.97" for 100-Year event
Inflow = 2.71 cfs @ 12.25 hrs, Volume= 0.853 af
Outflow = 2.71 cfs @ 12.25 hrs, Volume= 0.853 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3: Perkins Row

Inflow Area = 0.280 ac, 5.45% Impervious, Inflow Depth = 2.08" for 100-Year event
Inflow = 0.45 cfs @ 12.26 hrs, Volume= 0.048 af
Outflow = 0.45 cfs @ 12.26 hrs, Volume= 0.048 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond S1: Existing Bordering Vegetated Wetland

Inflow Area = 4.057 ac, 8.05% Impervious, Inflow Depth = 2.17" for 100-Year event
Inflow = 9.07 cfs @ 12.13 hrs, Volume= 0.732 af
Outflow = 0.37 cfs @ 16.97 hrs, Volume= 0.602 af, Atten= 96%, Lag= 290.5 min
Primary = 0.37 cfs @ 16.97 hrs, Volume= 0.602 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 49.47' @ 16.97 hrs Surf.Area= 13,887 sf Storage= 19,956 cf

Plug-Flow detention time= 585.8 min calculated for 0.602 af (82% of inflow)
Center-of-Mass det. time= 510.5 min (1,373.0 - 862.4)

Volume	Invert	Avail.Storage	Storage Description
#1	47.80'	65,726 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.80	9,945	0	0
50.00	15,123	27,575	27,575
52.00	23,028	38,151	65,726

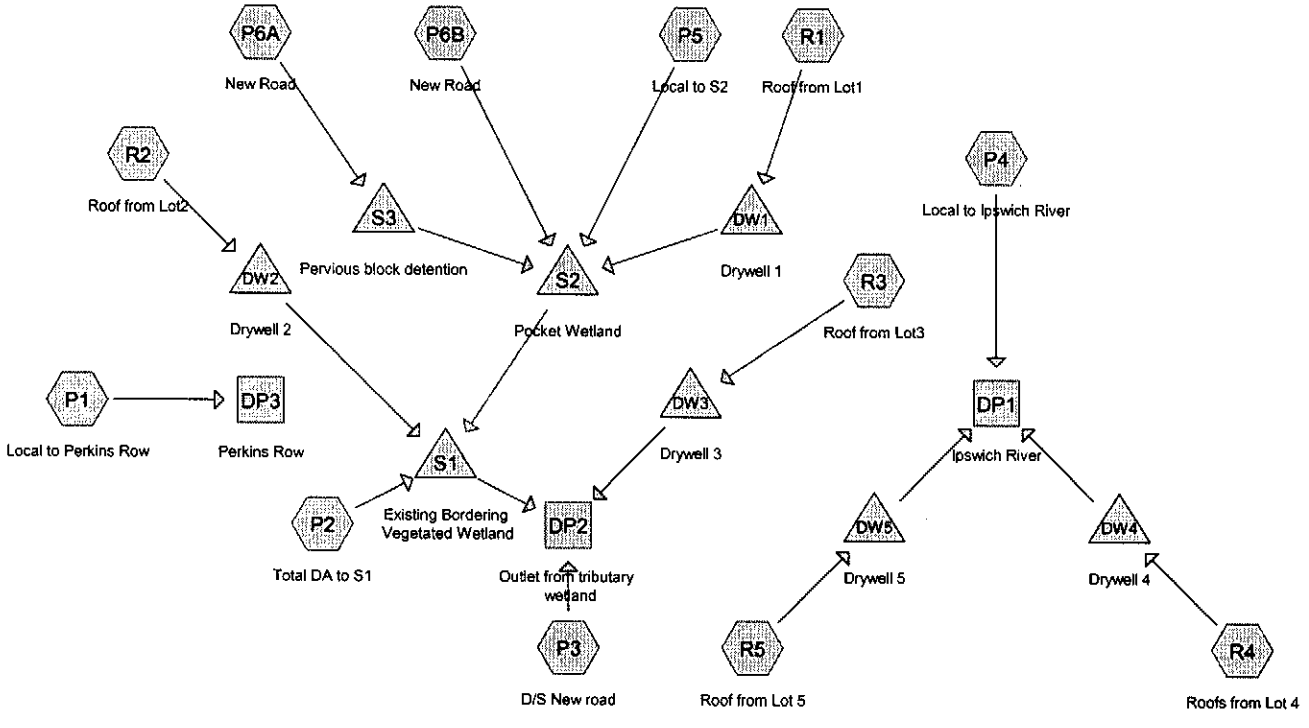
Device	Routing	Invert	Outlet Devices
#1	Primary	47.80'	**12.0" Round Culvert w/ 9.0" inside fill** L= 20.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.05' / 47.00' S= 0.0025 '/' Cc= 0.900

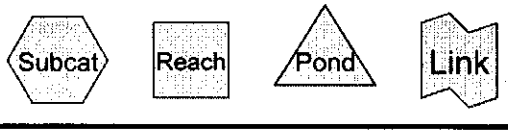
			n= 0.030 Rubble masonry, cemented, Flow Area= 0.15 sf
#2	Primary	51.10'	**20.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.37 cfs @ 16.97 hrs HW=49.47' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 0.37 cfs @ 2.38 fps)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Stage-Area-Storage for Pond S3: Pervious block detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
64.00	1,590	0
64.02	1,607	32
64.04	1,625	64
64.06	1,642	97
64.08	1,660	130
64.10	1,677	163
64.12	1,695	197
64.14	1,712	231
64.16	1,730	266
64.18	1,747	300
64.20	1,765	335
64.22	1,782	371
64.24	1,800	407
64.26	1,817	443
64.28	1,834	479
64.30	1,852	516
64.32	1,869	553
64.34	1,887	591
64.36	1,904	629
64.38	1,922	667
64.40	1,939	706
64.42	1,957	745
64.44	1,974	784
64.46	1,992	824
64.48	2,009	864
64.50	2,027	904
64.52	2,044	945
64.54	2,061	986
64.56	2,079	1,027
64.58	2,096	1,069
64.60	2,114	1,111
64.62	2,131	1,154
64.64	2,149	1,196
64.66	2,166	1,240
64.68	2,184	1,283
64.70	2,201	1,327
64.72	2,219	1,371
64.74	2,236	1,416
64.76	2,253	1,461
64.78	2,271	1,506
64.80	2,288	1,551
64.82	2,306	1,597
64.84	2,323	1,644
64.86	2,341	1,690
64.88	2,358	1,737
64.90	2,376	1,785
64.92	2,393	1,832
64.94	2,411	1,880
64.96	2,428	1,929
64.98	2,446	1,977
65.00	2,463	2,027
65.02	2,604	2,077
65.04	2,745	2,131
65.06	2,885	2,187
65.08	3,026	2,246
65.10	3,167	2,308
65.12	3,308	2,373
65.14	3,449	2,440
65.16	3,589	2,511
65.18	3,730	2,584
65.20	3,871	2,660
65.22	4,012	2,739
65.24	4,153	2,820
65.26	4,293	2,905
65.28	4,434	2,992
65.30	4,575	3,082
65.32	4,716	3,175
65.34	4,857	3,271
65.36	4,997	3,369
65.38	5,138	3,471
65.40	5,279	3,575
65.42	5,420	3,682
65.44	5,561	3,792
65.46	5,701	3,904
65.48	5,842	4,020
65.50	5,983	4,138
65.52	6,124	4,259
65.54	6,265	4,383
65.56	6,405	4,510
65.58	6,546	4,639
65.60	6,687	4,771
65.62	6,828	4,907
65.64	6,969	5,045
65.66	7,109	5,185
65.68	7,250	5,329
65.70	7,391	5,475
65.72	7,532	5,625
65.74	7,673	5,777
65.76	7,813	5,932
65.78	7,954	6,089
65.80	8,095	6,250
65.82	8,236	6,413
65.84	8,377	6,579
65.86	8,517	6,748
65.88	8,658	6,920
65.90	8,799	7,094
65.92	8,940	7,272
65.94	9,081	7,452
65.96	9,221	7,635
65.98	9,362	7,821
66.00	**9,503**	**8,010**





Routing Diagram for Post Development Watershed Analysis
Prepared by The Morin-Cameron Group, Inc., Printed 6/15/2015
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.133	61	>75% Grass cover, Good, HSG B (P1, P2, P3, P4, P5, P6A, P6B)
0.760	98	Paved parking, HSG B (P2, P3, P6A, P6B)
0.037	76	Paving Blocks HSG B (P6A)
0.221	98	Roofs, HSG B (R1, R2, R3, R4, R5)
1.383	98	Water Surface, HSG B (P2, P3, P4, P6B)
6.320	55	Woods, Good, HSG B (P1, P2, P3, P4, P5, P6A)
10.853	**66**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
10.853	HSG B	P1, P2, P3, P4, P5, P6A, P6B, R1, R2, R3, R4, R5
0.000	HSG C	
0.000	HSG D	
0.000	Other	
10.853		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	2.133	0.000	0.000	0.000	2.133	>75% Grass cover, Good	P1, P2, P3, P4, P5, P6A, P6B
0.000	0.760	0.000	0.000	0.000	0.760	Paved parking	P2, P3, P6A, P6B
0.000	0.037	0.000	0.000	0.000	0.037	Paving Blocks	P6A
0.000	0.221	0.000	0.000	0.000	0.221	Roofs	R1, R2, R3, R4, R5
0.000	1.383	0.000	0.000	0.000	1.383	Water Surface	P2, P3, P4, P6B
0.000	6.320	0.000	0.000	0.000	6.320	Woods, Good	P1, P2, P3, P4, P5, P6A
0.000	**10.853**	**0.000**	**0.000**	**0.000**	**10.853**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Local to Perkins Row Runoff Area=4,046 sf 0.00% Impervious Runoff Depth=0.37"
Flow Length=163' Tc=6.0 min CN=60 Runoff=0.02 cfs 0.003 af

Subcatchment P2: Total DA to S1 Runoff Area=161,294 sf 8.55% Impervious Runoff Depth=0.34"
Flow Length=193' Tc=6.0 min CN=59 Runoff=0.69 cfs 0.104 af

Subcatchment P3: D/S New road Runoff Area=6,413 sf 10.07% Impervious Runoff Depth=0.48"
Flow Length=220' Tc=9.4 min CN=63 Runoff=0.05 cfs 0.006 af

Subcatchment P4: Local to Ipswich River Runoff Area=218,856 sf 21.08% Impervious Runoff Depth=0.55"
Flow Length=375' Tc=6.5 min CN=65 Runoff=2.42 cfs 0.231 af

Subcatchment P5: Local to S2 Runoff Area=20,719 sf 0.00% Impervious Runoff Depth=0.31"
Flow Length=104' Tc=6.0 min CN=58 Runoff=0.07 cfs 0.012 af

Subcatchment P6A: New Road Runoff Area=22,392 sf 67.24% Impervious Runoff Depth=1.83"
Flow Length=137' Tc=8.1 min CN=87 Runoff=1.02 cfs 0.078 af

Subcatchment P6B: New Road Runoff Area=29,420 sf 60.10% Impervious Runoff Depth=1.53"
Flow Length=355' Tc=6.0 min CN=83 Runoff=1.21 cfs 0.086 af

Subcatchment R1: Roof from Lot1 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Subcatchment R2: Roof from Lot2 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Subcatchment R3: Roof from Lot3 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Subcatchment R4: Roofs from Lot 4 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Subcatchment R5: Roof from Lot 5 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=2.87"
Tc=6.0 min CN=98 Runoff=0.13 cfs 0.011 af

Reach DP1: Ipswich River Inflow=2.42 cfs 0.231 af
Outflow=2.42 cfs 0.231 af

Reach DP2: Outlet from tributary wetland Inflow=0.19 cfs 0.211 af
Outflow=0.19 cfs 0.211 af

Reach DP3: Perkins Row Inflow=0.02 cfs 0.003 af
Outflow=0.02 cfs 0.003 af

Pond DW1: Drywell 1 Peak Elev=58.68' Storage=250 cf Inflow=0.13 cfs 0.011 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.011 af

Pond DW2: Drywell 2 Peak Elev=63.67' Storage=249 cf Inflow=0.13 cfs 0.011 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.011 af

Pond DW3: Drywell 3 Peak Elev=62.18' Storage=250 cf Inflow=0.13 cfs 0.011 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.011 af

Pond DW4: Drywell 4 Peak Elev=64.17' Storage=249 cf Inflow=0.13 cfs 0.011 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.011 af

Pond DW5: Drywell 5 Peak Elev=56.67' Storage=249 cf Inflow=0.13 cfs 0.011 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.011 af

Pond S1: Existing Bordering Vegetated Peak Elev=48.11' Storage=3,212 cf Inflow=0.76 cfs 0.221 af
Outflow=0.19 cfs 0.206 af

Pond S2: Pocket Wetland Peak Elev=50.12' Storage=3,339 cf Inflow=1.68 cfs 0.132 af
Primary=0.13 cfs 0.116 af Secondary=0.00 cfs 0.000 af Outflow=0.13 cfs 0.116 af

Pond S3: Pervious block detention Peak Elev=64.42' Storage=737 cf Inflow=1.02 cfs 0.078 af
Discarded=0.05 cfs 0.045 af Primary=0.69 cfs 0.034 af Outflow=0.74 cfs 0.078 af

Total Runoff Area = 10.853 ac Runoff Volume = 0.573 af Average Runoff Depth = 0.63"
78.23% Pervious = 8.490 ac 21.77% Impervious = 2.363 ac

Summary for Subcatchment P1: Local to Perkins Row

Runoff = 0.02 cfs @ 12.13 hrs, Volume= 0.003 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
3,607	61	>75% Grass cover, Good, HSG B
439	55	Woods, Good, HSG B
4,046	60	Weighted Average
4,046		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
0.9	113	0.0177	2.14		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	163	Total			

Summary for Subcatchment P2: Total DA to S1

Runoff = 0.69 cfs @ 12.14 hrs, Volume= 0.104 af, Depth= 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
199	98	Paved parking, HSG B
136,680	55	Woods, Good, HSG B
13,593	98	Water Surface, HSG B
10,822	61	>75% Grass cover, Good, HSG B
161,294	59	Weighted Average
147,502		91.45% Pervious Area
13,792		8.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
0.5	143	0.0944	4.95		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	193	Total			

Summary for Subcatchment P3: D/S New road

Runoff = 0.05 cfs @ 12.17 hrs, Volume= 0.006 af, Depth= 0.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
2,154	55	Woods, Good, HSG B
3,613	61	>75% Grass cover, Good, HSG B
343	98	Paved parking, HSG B
303	98	Water Surface, HSG B
6,413	63	Weighted Average
5,767		89.93% Pervious Area
646		10.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	50	0.0500	0.09		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.10"
0.5	170	0.1088	5.31		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.4	220	Total			

Summary for Subcatchment P4: Local to Ipswich River

Runoff = 2.42 cfs @ 12.12 hrs, Volume= 0.231 af, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
125,440	55	Woods, Good, HSG B
47,272	61	>75% Grass cover, Good, HSG B
46,144	98	Water Surface, HSG B
218,856	65	Weighted Average
172,712		78.92% Pervious Area
46,144		21.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.1	325	0.1015	5.13		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.5	375	Total			

Summary for Subcatchment P5: Local to S2

Runoff = 0.07 cfs @ 12.16 hrs, Volume= 0.012 af, Depth= 0.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
10,149	61	>75% Grass cover, Good, HSG B
10,570	55	Woods, Good, HSG B
20,719	58	Weighted Average
20,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.1	54	0.2130	7.43		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	104	Total			

Summary for Subcatchment P6A: New Road

Runoff = 1.02 cfs @ 12.12 hrs, Volume= 0.078 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
	9,045	98	Paved parking, HSG B
	5,732	61	>75% Grass cover, Good, HSG B
	13	55	Woods, Good, HSG B
*	1,590	76	Paving Blocks HSG B
	6,012	98	Paved parking, HSG B
	22,392	87	Weighted Average
	7,335		32.76% Pervious Area
	15,057		67.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.6	87	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	137	Total			

Summary for Subcatchment P6B: New Road

Runoff = 1.21 cfs @ 12.09 hrs, Volume= 0.086 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
17,493	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
187	98	Water Surface, HSG B
29,420	83	Weighted Average
11,740		39.90% Pervious Area
17,680		60.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.1	305	0.0492	4.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.2					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	355	Total			

Summary for Subcatchment R1: Roof from Lot1

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R2: Roof from Lot2

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R3: Roof from Lot3

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R4: Roofs from Lot 4

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R5: Roof from Lot 5

Runoff = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Reach DP1: Ipswich River

Inflow Area = 5.113 ac, 22.45% Impervious, Inflow Depth = 0.54" for 2-Year event
Inflow = 2.42 cfs @ 12.12 hrs, Volume= 0.231 af
Outflow = 2.42 cfs @ 12.12 hrs, Volume= 0.231 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Outlet from tributary wetland

Inflow Area = 5.648 ac, 21.52% Impervious, Inflow Depth > 0.45" for 2-Year event
Inflow = 0.19 cfs @ 17.37 hrs, Volume= 0.211 af
Outflow = 0.19 cfs @ 17.37 hrs, Volume= 0.211 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3: Perkins Row

Inflow Area = 0.093 ac, 0.00% Impervious, Inflow Depth = 0.37" for 2-Year event
Inflow = 0.02 cfs @ 12.13 hrs, Volume= 0.003 af
Outflow = 0.02 cfs @ 12.13 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond DW1: Drywell 1

Inflow Area = 0.044 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event
Inflow = 0.13 cfs @ 12.08 hrs, Volume= 0.011 af
Outflow = 0.00 cfs @ 9.68 hrs, Volume= 0.011 af, Atten= 97%, Lag= 0.0 min
Discarded = 0.00 cfs @ 9.68 hrs, Volume= 0.011 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 58.68' @ 15.53 hrs Surf.Area= 189 sf Storage= 250 cf

Plug-Flow detention time= 486.0 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 486.1 min (1,243.2 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	57.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A**
			378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	57.50'	270 cf	**StormTank 18** x 42 Inside #1
			Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf
			Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf
			6 Rows of 7 Chambers
#3	59.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
59.00	1	0	0
60.50	1	2	2
60.51	50,000	250	252
61.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	61.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	57.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.03'

Discarded OutFlow Max=0.00 cfs @ 9.68 hrs HW=57.05' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=57.00' TW=46.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond DW2: Drywell 2

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event			
Inflow =	0.13 cfs @	12.08 hrs, Volume=	0.011 af	
Outflow =	0.00 cfs @	9.81 hrs, Volume=	0.011 af, Atten= 97%, Lag= 0.0 min	
Discarded =	0.00 cfs @	9.81 hrs, Volume=	0.011 af	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 63.67' @ 15.53 hrs Surf.Area= 189 sf Storage= 249 cf

Plug-Flow detention time= 483.3 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 483.4 min (1,240.5 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A**
			378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	62.50'	270 cf	**StormTank 18** x 42 Inside #1
			Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf
			Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf
			6 Rows of 7 Chambers
#3	64.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious

50,060 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	1	0	0
65.50	1	2	2
65.51	50,000	250	252
66.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	65.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	62.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 9.81 hrs HW=62.05' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.00' TW=47.80' (Dynamic Tailwater)
└**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond DW3: Drywell 3

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event			
Inflow =	0.13 cfs @	12.08 hrs, Volume=	0.011 af	
Outflow =	0.00 cfs @	9.74 hrs, Volume=	0.011 af, Atten= 97%, Lag= 0.0 min	
Discarded =	0.00 cfs @	9.74 hrs, Volume=	0.011 af	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 62.18' @ 15.53 hrs Surf.Area= 189 sf Storage= 250 cf

Plug-Flow detention time= 486.0 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 486.1 min (1,243.2 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.50'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	61.00'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	62.50'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.50	1	0	0
64.50	1	2	2
64.51	50,000	250	252
65.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	64.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	60.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.03'

Discarded OutFlow Max=0.00 cfs @ 9.74 hrs HW=60.55' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=60.50' TW=0.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond DW4: Drywell 4

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event			
Inflow =	0.13 cfs @	12.08 hrs, Volume=	0.011 af	
Outflow =	0.00 cfs @	9.81 hrs, Volume=	0.011 af, Atten= 97%, Lag= 0.0 min	
Discarded =	0.00 cfs @	9.81 hrs, Volume=	0.011 af	
Primary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 64.17' @ 15.53 hrs Surf.Area= 189 sf Storage= 249 cf

Plug-Flow detention time= 483.3 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 483.4 min (1,240.5 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	62.50'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	63.00'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	64.50'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.50	1	0	0
66.00	1	2	2
66.01	50,000	250	252
67.00	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	66.00'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	62.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 9.81 hrs HW=62.55' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=62.50' TW=0.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond DW5: Drywell 5

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 2.87" for 2-Year event				
Inflow =	0.13 cfs @	12.08 hrs,	Volume=	0.011 af	
Outflow =	0.00 cfs @	9.81 hrs,	Volume=	0.011 af,	Atten= 97%, Lag= 0.0 min
Discarded =	0.00 cfs @	9.81 hrs,	Volume=	0.011 af	
Primary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 56.67' @ 15.53 hrs Surf.Area= 189 sf Storage= 249 cf

Plug-Flow detention time= 483.3 min calculated for 0.011 af (100% of inflow)
Center-of-Mass det. time= 483.4 min (1,240.5 - 757.1)

Volume	Invert	Avail.Storage	Storage Description
#1A	55.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	55.50'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	57.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	1	0	0
58.50	1	2	2
58.51	50,000	250	252
59.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	58.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	55.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 9.81 hrs HW=55.05' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=55.00' TW=0.00' (Dynamic Tailwater)
└─**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond S1: Existing Bordering Vegetated Wetland

Inflow Area =	5.456 ac, 21.20% Impervious, Inflow Depth > 0.49" for 2-Year event				
Inflow =	0.76 cfs @	12.15 hrs, Volume=	0.221 af		
Outflow =	0.19 cfs @	17.48 hrs, Volume=	0.206 af,	Atten= 76%,	Lag= 320.1 min
Primary =	0.19 cfs @	17.48 hrs, Volume=	0.206 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 48.11' @ 17.48 hrs Surf.Area= 10,678 sf Storage= 3,212 cf

Plug-Flow detention time= 285.7 min calculated for 0.206 af (93% of inflow)
Center-of-Mass det. time= 248.4 min (1,268.7 - 1,020.3)

Volume	Invert	Avail.Storage	Storage Description
#1	47.80'	65,726 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.80	9,945	0	0
50.00	15,123	27,575	27,575
52.00	23,028	38,151	65,726

Device	Routing	Invert	Outlet Devices
#1	Primary	47.80'	**168.0" W x 50.0" H Box BoxCulvert** L= 35.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.80' / 47.00' S= 0.0229 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides, Flow Area= 58.33 sf
#2	Device 1	47.80'	**4.0" W x 8.5" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	50.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.19 cfs @ 17.48 hrs HW=48.11' TW=0.00' (Dynamic Tailwater)
└─**1=BoxCulvert** (Passes 0.19 cfs of 6.72 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.19 cfs @ 1.79 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond S2: Pocket Wetland

Inflow Area =	1.709 ac, 46.55% Impervious, Inflow Depth = 0.92" for 2-Year event				
Inflow =	1.68 cfs @	12.13 hrs, Volume=	0.132 af		
Outflow =	0.13 cfs @	14.04 hrs, Volume=	0.116 af,	Atten= 92%,	Lag= 114.6 min
Primary =	0.13 cfs @	14.04 hrs, Volume=	0.116 af		
Secondary =	0.00 cfs @	0.00 hrs, Volume=	0.000 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 50.12' @ 14.04 hrs Surf.Area= 2,153 sf Storage= 3,339 cf

Plug-Flow detention time= 326.7 min calculated for 0.116 af (88% of inflow)
Center-of-Mass det. time= 274.6 min (1,100.1 - 825.4)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	8,251 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.00	1	0	0
47.80	1	2	2
47.81	767	4	6
48.00	834	152	158
49.00	1,452	1,143	1,301
50.00	2,103	1,778	3,078
51.00	2,515	2,309	5,387
52.00	3,213	2,864	8,251

Device	Routing	Invert	Outlet Devices
#1	Primary	48.20'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 48.20' / 48.00' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	48.50'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	50.75'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	51.00'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=0.13 cfs @ 14.04 hrs HW=50.12' TW=48.04' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.13 cfs of 3.56 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.13 cfs @ 5.97 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=46.00' TW=47.80' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond S3: Pervious block detention

Inflow Area =	0.514 ac, 67.24% Impervious, Inflow Depth = 1.83" for 2-Year event				
Inflow =	1.02 cfs @	12.12 hrs,	Volume=	0.078 af	
Outflow =	0.74 cfs @	12.21 hrs,	Volume=	0.078 af,	Atten= 28%, Lag= 5.5 min
Discarded =	0.05 cfs @	12.21 hrs,	Volume=	0.045 af	
Primary =	0.69 cfs @	12.21 hrs,	Volume=	0.034 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 64.42' @ 12.21 hrs Surf.Area= 1,953 sf Storage= 737 cf

Plug-Flow detention time= 65.3 min calculated for 0.078 af (100% of inflow)
Center-of-Mass det. time= 65.3 min (887.4 - 822.2)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	8,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	1,590	0	0
65.00	2,463	2,027	2,027
66.00	9,503	5,983	8,010

Device	Routing	Invert	Outlet Devices
#1	Primary	62.00'	**12.0" Round Culvert** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 62.00' / 58.00' S= 0.0400 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	64.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	64.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.05 cfs @ 12.21 hrs HW=64.42' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=0.69 cfs @ 12.21 hrs HW=64.42' TW=49.25' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.69 cfs of 4.13 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 0.69 cfs @ 1.33 fps)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Local to Perkins Row Runoff Area=4,046 sf 0.00% Impervious Runoff Depth=1.02"
Flow Length=163' Tc=6.0 min CN=60 Runoff=0.09 cfs 0.008 af

Subcatchment P2: Total DA to S1 Runoff Area=161,294 sf 8.55% Impervious Runoff Depth=0.96"
Flow Length=193' Tc=6.0 min CN=59 Runoff=3.48 cfs 0.297 af

Subcatchment P3: D/S New road Runoff Area=6,413 sf 10.07% Impervious Runoff Depth=1.20"
Flow Length=220' Tc=9.4 min CN=63 Runoff=0.17 cfs 0.015 af

Subcatchment P4: Local to Ipswich River Runoff Area=218,856 sf 21.08% Impervious Runoff Depth=1.33"
Flow Length=375' Tc=6.5 min CN=65 Runoff=7.15 cfs 0.557 af

Subcatchment P5: Local to S2 Runoff Area=20,719 sf 0.00% Impervious Runoff Depth=0.90"
Flow Length=104' Tc=6.0 min CN=58 Runoff=0.41 cfs 0.036 af

Subcatchment P6A: New Road Runoff Area=22,392 sf 67.24% Impervious Runoff Depth=3.10"
Flow Length=137' Tc=8.1 min CN=87 Runoff=1.72 cfs 0.133 af

Subcatchment P6B: New Road Runoff Area=29,420 sf 60.10% Impervious Runoff Depth=2.73"
Flow Length=355' Tc=6.0 min CN=83 Runoff=2.16 cfs 0.153 af

Subcatchment R1: Roof from Lot1 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Subcatchment R2: Roof from Lot2 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Subcatchment R3: Roof from Lot3 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Subcatchment R4: Roofs from Lot 4 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Subcatchment R5: Roof from Lot 5 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=4.26"
Tc=6.0 min CN=98 Runoff=0.19 cfs 0.016 af

Reach DP1: Ipswich River Inflow=7.15 cfs 0.558 af
Outflow=7.15 cfs 0.558 af

Reach DP2: Outlet from tributary wetland Inflow=0.66 cfs 0.540 af
Outflow=0.66 cfs 0.540 af

Reach DP3: Perkins Row Inflow=0.09 cfs 0.008 af
Outflow=0.09 cfs 0.008 af

Pond DW1: Drywell 1 Peak Elev=60.51' Storage=424 cf Inflow=0.19 cfs 0.016 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.011 af

Pond DW2: Drywell 2 Peak Elev=65.51' Storage=418 cf Inflow=0.19 cfs 0.016 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.012 af

Pond DW3: Drywell 3 Peak Elev=64.51' Storage=418 cf Inflow=0.19 cfs 0.016 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.012 af

Pond DW4: Drywell 4 Peak Elev=66.01' Storage=418 cf Inflow=0.19 cfs 0.016 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.012 af

Pond DW5: Drywell 5 Peak Elev=58.51' Storage=418 cf Inflow=0.19 cfs 0.016 af
Discarded=0.00 cfs 0.011 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.012 af

Pond S1: Existing Bordering Vegetated Peak Elev=48.51' Storage=7,669 cf Inflow=3.60 cfs 0.547 af
Outflow=0.64 cfs 0.525 af

Pond S2: Pocket Wetland Peak Elev=50.98' Storage=5,329 cf Inflow=3.69 cfs 0.266 af
Primary=1.38 cfs 0.250 af Secondary=0.00 cfs 0.000 af Outflow=1.38 cfs 0.250 af

Pond S3: Pervious block detention Peak Elev=64.52' Storage=936 cf Inflow=1.72 cfs 0.133 af
Discarded=0.05 cfs 0.056 af Primary=1.41 cfs 0.077 af Outflow=1.45 cfs 0.133 af

Total Runoff Area = 10.853 ac Runoff Volume = 1.277 af Average Runoff Depth = 1.41"
78.23% Pervious = 8.490 ac 21.77% Impervious = 2.363 ac

Summary for Subcatchment P1: Local to Perkins Row

Runoff = 0.09 cfs @ 12.10 hrs, Volume= 0.008 af, Depth= 1.02"

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

Area (sf)	CN	Description
3,607	61	>75% Grass cover, Good, HSG B
439	55	Woods, Good, HSG B
4,046	60	Weighted Average
4,046		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow**
					Grass: Short n= 0.150 P2= 3.10"
0.9	113	0.0177	2.14		**Shallow Concentrated Flow, Shallow Concentrated Flow**
					Unpaved Kv= 16.1 fps
0.2					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	163	Total			

Summary for Subcatchment P2: Total DA to S1

Runoff = 3.48 cfs @ 12.10 hrs, Volume= 0.297 af, Depth= 0.96"

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

Area (sf)	CN	Description
199	98	Paved parking, HSG B
136,680	55	Woods, Good, HSG B
13,593	98	Water Surface, HSG B
10,822	61	>75% Grass cover, Good, HSG B
161,294	59	Weighted Average
147,502		91.45% Pervious Area
13,792		8.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		**Sheet Flow,**
					Grass: Dense n= 0.240 P2= 3.10"
0.5	143	0.0944	4.95		**Shallow Concentrated Flow,**
					Unpaved Kv= 16.1 fps
0.1					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	193	Total			

Summary for Subcatchment P3: D/S New road

Runoff = 0.17 cfs @ 12.15 hrs, Volume= 0.015 af, Depth= 1.20"

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

Area (sf)	CN	Description
2,154	55	Woods, Good, HSG B
3,613	61	>75% Grass cover, Good, HSG B
343	98	Paved parking, HSG B
303	98	Water Surface, HSG B
6,413	63	Weighted Average
5,767		89.93% Pervious Area
646		10.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	50	0.0500	0.09		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.10"
0.5	170	0.1088	5.31		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.4	220	Total			

Summary for Subcatchment P4: Local to Ipswich River

Runoff = 7.15 cfs @ 12.10 hrs, Volume= 0.557 af, Depth= 1.33"

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

Area (sf)	CN	Description
125,440	55	Woods, Good, HSG B
47,272	61	>75% Grass cover, Good, HSG B
46,144	98	Water Surface, HSG B
218,856	65	Weighted Average
172,712		78.92% Pervious Area
46,144		21.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.1	325	0.1015	5.13		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.5	375	Total			

Summary for Subcatchment P5: Local to S2

Runoff = 0.41 cfs @ 12.11 hrs, Volume= 0.036 af, Depth= 0.90"

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

Area (sf)	CN	Description
10,149	61	>75% Grass cover, Good, HSG B
10,570	55	Woods, Good, HSG B
20,719	58	Weighted Average
20,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.1	54	0.2130	7.43		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	104	Total			

Summary for Subcatchment P6A: New Road

Runoff = 1.72 cfs @ 12.11 hrs, Volume= 0.133 af, Depth= 3.10"

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

	Area (sf)	CN	Description
	9,045	98	Paved parking, HSG B
	5,732	61	>75% Grass cover, Good, HSG B
	13	55	Woods, Good, HSG B
*	1,590	76	Paving Blocks HSG B
	6,012	98	Paved parking, HSG B
	22,392	87	Weighted Average
	7,335		32.76% Pervious Area
	15,057		67.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.6	87	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	137	Total			

Summary for Subcatchment P6B: New Road

Runoff = 2.16 cfs @ 12.09 hrs, Volume= 0.153 af, Depth= 2.73"

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

Area (sf)	CN	Description
17,493	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
187	98	Water Surface, HSG B
29,420	83	Weighted Average
11,740		39.90% Pervious Area
17,680		60.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.1	305	0.0492	4.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.2					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	355	Total			

Summary for Subcatchment R1: Roof from Lot1

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 4.26"

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

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R2: Roof from Lot2

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 4.26"

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

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R3: Roof from Lot3

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 4.26"

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

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R4: Roofs from Lot 4

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 4.26"

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

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R5: Roof from Lot 5

Runoff = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af, Depth= 4.26"

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

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Reach DP1: Ipswich River

Inflow Area = 5.113 ac, 22.45% Impervious, Inflow Depth = 1.31" for 10-Year event
Inflow = 7.15 cfs @ 12.10 hrs, Volume= 0.558 af
Outflow = 7.15 cfs @ 12.10 hrs, Volume= 0.558 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Outlet from tributary wetland

Inflow Area = 5.648 ac, 21.52% Impervious, Inflow Depth > 1.15" for 10-Year event
Inflow = 0.66 cfs @ 13.94 hrs, Volume= 0.540 af
Outflow = 0.66 cfs @ 13.94 hrs, Volume= 0.540 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3: Perkins Row

Inflow Area = 0.093 ac, 0.00% Impervious, Inflow Depth = 1.02" for 10-Year event
Inflow = 0.09 cfs @ 12.10 hrs, Volume= 0.008 af
Outflow = 0.09 cfs @ 12.10 hrs, Volume= 0.008 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond DW1: Drywell 1

Inflow Area = 0.044 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event
Inflow = 0.19 cfs @ 12.08 hrs, Volume= 0.016 af
Outflow = 0.00 cfs @ 8.52 hrs, Volume= 0.011 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.00 cfs @ 8.52 hrs, Volume= 0.011 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 60.51' @ 16.83 hrs Surf.Area= 189 sf Storage= 424 cf

Plug-Flow detention time= 564.5 min calculated for 0.011 af (73% of inflow)
Center-of-Mass det. time= 474.3 min (1,224.1 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	57.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A**
			378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	57.50'	270 cf	**StormTank 18** x 42 Inside #1
			Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf
			Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf
			6 Rows of 7 Chambers
#3	59.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
59.00	1	0	0
60.50	1	2	2
60.51	50,000	250	252
61.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	61.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	57.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.03'

Discarded OutFlow Max=0.00 cfs @ 8.52 hrs HW=57.05' (Free Discharge)
└→**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=57.00' TW=46.00' (Dynamic Tailwater)
└→**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond DW2: Drywell 2

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event			
Inflow =	0.19 cfs @	12.08 hrs, Volume=	0.016 af	
Outflow =	0.00 cfs @	16.40 hrs, Volume=	0.012 af, Atten= 97%, Lag= 259.2 min	
Discarded =	0.00 cfs @	8.64 hrs, Volume=	0.011 af	
Primary =	0.00 cfs @	16.40 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 65.51' @ 16.40 hrs Surf.Area= 189 sf Storage= 418 cf

Plug-Flow detention time= 555.5 min calculated for 0.012 af (75% of inflow)
Center-of-Mass det. time= 469.8 min (1,219.6 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A**
			378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	62.50'	270 cf	**StormTank 18** x 42 Inside #1
			Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf
			Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf
			6 Rows of 7 Chambers
#3	64.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious

50,060 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	1	0	0
65.50	1	2	2
65.51	50,000	250	252
66.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	65.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	62.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 8.64 hrs HW=62.05' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 16.40 hrs HW=65.51' TW=48.42' (Dynamic Tailwater)
└─**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.26 fps)

Summary for Pond DW3: Drywell 3

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event				
Inflow =	0.19 cfs @	12.08 hrs,	Volume=	0.016 af	
Outflow =	0.00 cfs @	16.40 hrs,	Volume=	0.012 af,	Atten= 97%, Lag= 259.2 min
Discarded =	0.00 cfs @	8.58 hrs,	Volume=	0.011 af	
Primary =	0.00 cfs @	16.40 hrs,	Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 64.51' @ 16.40 hrs Surf.Area= 189 sf Storage= 418 cf

Plug-Flow detention time= 557.0 min calculated for 0.012 af (75% of inflow)
Center-of-Mass det. time= 471.1 min (1,220.9 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.50'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	61.00'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	62.50'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.50	1	0	0
64.50	1	2	2
64.51	50,000	250	252
65.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	64.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	60.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.03'

Discarded OutFlow Max=0.00 cfs @ 8.58 hrs HW=60.55' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 16.40 hrs HW=64.51' TW=0.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.26 fps)

Summary for Pond DW4: Drywell 4

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event			
Inflow =	0.19 cfs @	12.08 hrs, Volume=	0.016 af	
Outflow =	0.00 cfs @	16.40 hrs, Volume=	0.012 af, Atten= 97%, Lag= 259.2 min	
Discarded =	0.00 cfs @	8.64 hrs, Volume=	0.011 af	
Primary =	0.00 cfs @	16.40 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 66.01' @ 16.40 hrs Surf.Area= 189 sf Storage= 418 cf

Plug-Flow detention time= 555.5 min calculated for 0.012 af (75% of inflow)
Center-of-Mass det. time= 469.8 min (1,219.6 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	62.50'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	63.00'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	64.50'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.50	1	0	0
66.00	1	2	2
66.01	50,000	250	252
67.00	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	66.00'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	62.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 8.64 hrs HW=62.55' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 16.40 hrs HW=66.01' TW=0.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.26 fps)

Summary for Pond DW5: Drywell 5

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 4.26" for 10-Year event			
Inflow =	0.19 cfs @	12.08 hrs, Volume=	0.016 af	
Outflow =	0.00 cfs @	16.40 hrs, Volume=	0.012 af, Atten= 97%, Lag= 259.2 min	
Discarded =	0.00 cfs @	8.64 hrs, Volume=	0.011 af	
Primary =	0.00 cfs @	16.40 hrs, Volume=	0.000 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 58.51' @ 16.40 hrs Surf.Area= 189 sf Storage= 418 cf

Plug-Flow detention time= 555.7 min calculated for 0.012 af (75% of inflow)
Center-of-Mass det. time= 469.8 min (1,219.6 - 749.8)

Volume	Invert	Avail.Storage	Storage Description
#1A	55.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	55.50'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	57.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	1	0	0
58.50	1	2	2
58.51	50,000	250	252
59.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	58.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	55.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 8.64 hrs HW=55.05' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 16.40 hrs HW=58.51' TW=0.00' (Dynamic Tailwater)
└─**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.26 fps)

Summary for Pond S1: Existing Bordering Vegetated Wetland

Inflow Area =	5.456 ac, 21.20% Impervious, Inflow Depth > 1.20" for 10-Year event			
Inflow =	3.60 cfs @ 12.10 hrs, Volume=	0.547 af		
Outflow =	0.64 cfs @ 14.01 hrs, Volume=	0.525 af, Atten= 82%, Lag= 114.1 min		
Primary =	0.64 cfs @ 14.01 hrs, Volume=	0.525 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 48.51' @ 14.01 hrs Surf.Area= 11,619 sf Storage= 7,669 cf

Plug-Flow detention time= 225.6 min calculated for 0.525 af (96% of inflow)
Center-of-Mass det. time= 194.0 min (1,167.7 - 973.7)

Volume	Invert	Avail.Storage	Storage Description
#1	47.80'	65,726 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.80	9,945	0	0
50.00	15,123	27,575	27,575
52.00	23,028	38,151	65,726

Device	Routing	Invert	Outlet Devices
#1	Primary	47.80'	**168.0" W x 50.0" H Box BoxCulvert** L= 35.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.80' / 47.00' S= 0.0229 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides, Flow Area= 58.33 sf
#2	Device 1	47.80'	**4.0" W x 8.5" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	50.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.64 cfs @ 14.01 hrs HW=48.51' TW=0.00' (Dynamic Tailwater)
└─**1=BoxCulvert** (Passes 0.64 cfs of 24.87 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.64 cfs @ 2.72 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond S2: Pocket Wetland

Inflow Area =	1.709 ac, 46.55% Impervious, Inflow Depth = 1.87" for 10-Year event			
Inflow =	3.69 cfs @ 12.11 hrs, Volume=	0.266 af		
Outflow =	1.38 cfs @ 12.47 hrs, Volume=	0.250 af, Atten= 63%, Lag= 21.6 min		
Primary =	1.38 cfs @ 12.47 hrs, Volume=	0.250 af		
Secondary =	0.00 cfs @ 0.00 hrs, Volume=	0.000 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 50.98' @ 12.47 hrs Surf.Area= 2,505 sf Storage= 5,329 cf

Plug-Flow detention time= 294.0 min calculated for 0.250 af (94% of inflow)
Center-of-Mass det. time= 263.5 min (1,075.9 - 812.4)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	8,251 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.00	1	0	0
47.80	1	2	2
47.81	767	4	6
48.00	834	152	158
49.00	1,452	1,143	1,301
50.00	2,103	1,778	3,078
51.00	2,515	2,309	5,387
52.00	3,213	2,864	8,251

Device	Routing	Invert	Outlet Devices
#1	Primary	48.20'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 48.20' / 48.00' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	48.50'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	50.75'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	51.00'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=1.38 cfs @ 12.47 hrs HW=50.98' TW=48.26' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.38 cfs of 4.50 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.16 cfs @ 7.45 fps)
  └─**3=Broad-Crested Rectangular Weir** (Weir Controls 1.22 cfs @ 1.34 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=46.00' TW=47.80' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond S3: Pervious block detention

Inflow Area =	0.514 ac, 67.24% Impervious, Inflow Depth = 3.10" for 10-Year event			
Inflow =	1.72 cfs @ 12.11 hrs, Volume=	0.133 af		
Outflow =	1.45 cfs @ 12.17 hrs, Volume=	0.133 af, Atten= 15%, Lag= 3.5 min		
Discarded =	0.05 cfs @ 12.17 hrs, Volume=	0.056 af		
Primary =	1.41 cfs @ 12.17 hrs, Volume=	0.077 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 64.52' @ 12.17 hrs Surf.Area= 2,040 sf Storage= 936 cf

Plug-Flow detention time= 54.8 min calculated for 0.133 af (100% of inflow)
Center-of-Mass det. time= 54.8 min (861.9 - 807.1)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	8,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	1,590	0	0
65.00	2,463	2,027	2,027
66.00	9,503	5,983	8,010

Device	Routing	Invert	Outlet Devices
#1	Primary	62.00'	**12.0" Round Culvert** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 62.00' / 58.00' S= 0.0400 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	64.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	64.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.05 cfs @ 12.17 hrs HW=64.52' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=1.41 cfs @ 12.17 hrs HW=64.52' TW=50.28' (Dynamic Tailwater)
└─**1=Culvert** (Passes 1.41 cfs of 4.24 cfs potential flow)
  └─**2=Orifice/Grate** (Weir Controls 1.41 cfs @ 1.68 fps)

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment P1: Local to Perkins Row Runoff Area=4,046 sf 0.00% Impervious Runoff Depth=2.26"
Flow Length=163' Tc=6.0 min CN=60 Runoff=0.24 cfs 0.017 af

Subcatchment P2: Total DA to S1 Runoff Area=161,294 sf 8.55% Impervious Runoff Depth=2.17"
Flow Length=193' Tc=6.0 min CN=59 Runoff=8.96 cfs 0.668 af

Subcatchment P3: D/S New road Runoff Area=6,413 sf 10.07% Impervious Runoff Depth=2.53"
Flow Length=220' Tc=9.4 min CN=63 Runoff=0.38 cfs 0.031 af

Subcatchment P4: Local to Ipswich River Runoff Area=218,856 sf 21.08% Impervious Runoff Depth=2.72"
Flow Length=375' Tc=6.5 min CN=65 Runoff=15.52 cfs 1.139 af

Subcatchment P5: Local to S2 Runoff Area=20,719 sf 0.00% Impervious Runoff Depth=2.08"
Flow Length=104' Tc=6.0 min CN=58 Runoff=1.09 cfs 0.082 af

Subcatchment P6A: New Road Runoff Area=22,392 sf 67.24% Impervious Runoff Depth=5.00"
Flow Length=137' Tc=8.1 min CN=87 Runoff=2.71 cfs 0.214 af

Subcatchment P6B: New Road Runoff Area=29,420 sf 60.10% Impervious Runoff Depth=4.56"
Flow Length=355' Tc=6.0 min CN=83 Runoff=3.55 cfs 0.257 af

Subcatchment R1: Roof from Lot1 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af

Subcatchment R2: Roof from Lot2 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af

Subcatchment R3: Roof from Lot3 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af

Subcatchment R4: Roofs from Lot 4 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af

Subcatchment R5: Roof from Lot 5 Runoff Area=1,925 sf 100.00% Impervious Runoff Depth=6.26"
Tc=6.0 min CN=98 Runoff=0.28 cfs 0.023 af

Reach DP1: Ipswich River Inflow=15.52 cfs 1.143 af
Outflow=15.52 cfs 1.143 af

Reach DP2: Outlet from tributary wetland Inflow=1.37 cfs 1.143 af
Outflow=1.37 cfs 1.143 af

Reach DP3: Perkins Row Inflow=0.24 cfs 0.017 af
Outflow=0.24 cfs 0.017 af

Pond DW1: Drywell 1 Peak Elev=60.51' Storage=693 cf Inflow=0.28 cfs 0.023 af
Discarded=0.00 cfs 0.012 af Primary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.012 af

Pond DW2: Drywell 2 Peak Elev=65.51' Storage=672 cf Inflow=0.28 cfs 0.023 af
Discarded=0.00 cfs 0.012 af Primary=0.00 cfs 0.002 af Outflow=0.01 cfs 0.014 af

Pond DW3: Drywell 3 Peak Elev=64.51' Storage=673 cf Inflow=0.28 cfs 0.023 af
Discarded=0.00 cfs 0.012 af Primary=0.00 cfs 0.002 af Outflow=0.01 cfs 0.014 af

Pond DW4: Drywell 4 Peak Elev=66.01' Storage=672 cf Inflow=0.28 cfs 0.023 af
Discarded=0.00 cfs 0.012 af Primary=0.00 cfs 0.002 af Outflow=0.01 cfs 0.014 af

Pond DW5: Drywell 5 Peak Elev=58.51' Storage=672 cf Inflow=0.28 cfs 0.023 af
Discarded=0.00 cfs 0.012 af Primary=0.00 cfs 0.002 af Outflow=0.01 cfs 0.014 af

Pond S1: Existing Bordering Vegetated Peak Elev=49.54' Storage=20,845 cf Inflow=13.82 cfs 1.139 af
Outflow=1.33 cfs 1.110 af

Pond S2: Pocket Wetland Peak Elev=51.21' Storage=5,935 cf Inflow=6.56 cfs 0.485 af
Primary=3.90 cfs 0.431 af Secondary=1.98 cfs 0.038 af Outflow=5.88 cfs 0.469 af

Pond S3: Pervious block detention Peak Elev=64.62' Storage=1,155 cf Inflow=2.71 cfs 0.214 af
Discarded=0.05 cfs 0.067 af Primary=2.30 cfs 0.147 af Outflow=2.35 cfs 0.214 af

Total Runoff Area = 10.853 ac Runoff Volume = 2.524 af Average Runoff Depth = 2.79"
78.23% Pervious = 8.490 ac 21.77% Impervious = 2.363 ac

Summary for Subcatchment P1: Local to Perkins Row

Runoff = 0.24 cfs @ 12.09 hrs, Volume= 0.017 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
3,607	61	>75% Grass cover, Good, HSG B
439	55	Woods, Good, HSG B
4,046	60	Weighted Average
4,046		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 3.10"
0.9	113	0.0177	2.14		**Shallow Concentrated Flow, Shallow Concentrated Flow** Unpaved Kv= 16.1 fps
0.2					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	163	Total			

Summary for Subcatchment P2: Total DA to S1

Runoff = 8.96 cfs @ 12.10 hrs, Volume= 0.668 af, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
199	98	Paved parking, HSG B
136,680	55	Woods, Good, HSG B
13,593	98	Water Surface, HSG B
10,822	61	>75% Grass cover, Good, HSG B
161,294	59	Weighted Average
147,502		91.45% Pervious Area
13,792		8.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
0.5	143	0.0944	4.95		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.1					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	193	Total			

Summary for Subcatchment P3: D/S New road

Runoff = 0.38 cfs @ 12.14 hrs, Volume= 0.031 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
2,154	55	Woods, Good, HSG B
3,613	61	>75% Grass cover, Good, HSG B
343	98	Paved parking, HSG B
303	98	Water Surface, HSG B
6,413	63	Weighted Average
5,767		89.93% Pervious Area
646		10.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	50	0.0500	0.09		**Sheet Flow,** Grass: Bermuda n= 0.410 P2= 3.10"
0.5	170	0.1088	5.31		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
9.4	220	Total			

Summary for Subcatchment P4: Local to Ipswich River

Runoff = 15.52 cfs @ 12.10 hrs, Volume= 1.139 af, Depth= 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
125,440	55	Woods, Good, HSG B
47,272	61	>75% Grass cover, Good, HSG B
46,144	98	Water Surface, HSG B
218,856	65	Weighted Average
172,712		78.92% Pervious Area
46,144		21.08% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	50	0.0600	0.16		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
1.1	325	0.1015	5.13		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.5	375	Total			

Summary for Subcatchment P5: Local to S2

Runoff = 1.09 cfs @ 12.10 hrs, Volume= 0.082 af, Depth= 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
10,149	61	>75% Grass cover, Good, HSG B
10,570	55	Woods, Good, HSG B
20,719	58	Weighted Average
20,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	50	0.0300	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.1	54	0.2130	7.43		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.0					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	104	Total			

Summary for Subcatchment P6A: New Road

Runoff = 2.71 cfs @ 12.11 hrs, Volume= 0.214 af, Depth= 5.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
	9,045	98	Paved parking, HSG B
	5,732	61	>75% Grass cover, Good, HSG B
	13	55	Woods, Good, HSG B
*	1,590	76	Paving Blocks HSG B
	6,012	98	Paved parking, HSG B
	22,392	87	Weighted Average
	7,335		32.76% Pervious Area
	15,057		67.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.5	50	0.0100	0.11		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.6	87	0.0230	2.44		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
8.1	137	Total			

Summary for Subcatchment P6B: New Road

Runoff = 3.55 cfs @ 12.09 hrs, Volume= 0.257 af, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
17,493	98	Paved parking, HSG B
11,740	61	>75% Grass cover, Good, HSG B
187	98	Water Surface, HSG B
29,420	83	Weighted Average
11,740		39.90% Pervious Area
17,680		60.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	50	0.0200	1.18		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.1	305	0.0492	4.50		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
4.2					**Direct Entry, Adjust to Minimum 0.1 Hours**
6.0	355	Total			

Summary for Subcatchment R1: Roof from Lot1

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R2: Roof from Lot2

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R3: Roof from Lot3

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R4: Roofs from Lot 4

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Subcatchment R5: Roof from Lot 5

Runoff = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af, Depth= 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
1,925	98	Roofs, HSG B
1,925		100.00% Impervious Area

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

Summary for Reach DP1: Ipswich River

Inflow Area = 5.113 ac, 22.45% Impervious, Inflow Depth = 2.68" for 100-Year event
Inflow = 15.52 cfs @ 12.10 hrs, Volume= 1.143 af
Outflow = 15.52 cfs @ 12.10 hrs, Volume= 1.143 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP2: Outlet from tributary wetland

Inflow Area = 5.648 ac, 21.52% Impervious, Inflow Depth > 2.43" for 100-Year event
Inflow = 1.37 cfs @ 13.51 hrs, Volume= 1.143 af
Outflow = 1.37 cfs @ 13.51 hrs, Volume= 1.143 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Reach DP3: Perkins Row

Inflow Area = 0.093 ac, 0.00% Impervious, Inflow Depth = 2.26" for 100-Year event
Inflow = 0.24 cfs @ 12.09 hrs, Volume= 0.017 af
Outflow = 0.24 cfs @ 12.09 hrs, Volume= 0.017 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Summary for Pond DW1: Drywell 1

Inflow Area = 0.044 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event
Inflow = 0.28 cfs @ 12.08 hrs, Volume= 0.023 af
Outflow = 0.00 cfs @ 7.01 hrs, Volume= 0.012 af, Atten= 98%, Lag= 0.0 min
Discarded = 0.00 cfs @ 7.01 hrs, Volume= 0.012 af
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 60.51' @ 18.48 hrs Surf.Area= 189 sf Storage= 693 cf

Plug-Flow detention time= 560.9 min calculated for 0.012 af (52% of inflow)
Center-of-Mass det. time= 433.9 min (1,177.9 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	57.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A**
			378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	57.50'	270 cf	**StormTank 18** x 42 Inside #1
			Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf
			Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf
			6 Rows of 7 Chambers
#3	59.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
59.00	1	0	0
60.50	1	2	2
60.51	50,000	250	252
61.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	61.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	57.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.03'

Discarded OutFlow Max=0.00 cfs @ 7.01 hrs HW=57.05' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=57.00' TW=46.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Controls 0.00 cfs)

Summary for Pond DW2: Drywell 2

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event			
Inflow =	0.28 cfs @	12.08 hrs, Volume=	0.023 af	
Outflow =	0.01 cfs @	17.46 hrs, Volume=	0.014 af, Atten= 98%, Lag= 322.4 min	
Discarded =	0.00 cfs @	7.16 hrs, Volume=	0.012 af	
Primary =	0.00 cfs @	17.46 hrs, Volume=	0.002 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 65.51' @ 17.46 hrs Surf.Area= 189 sf Storage= 672 cf

Plug-Flow detention time= 567.9 min calculated for 0.014 af (60% of inflow)
Center-of-Mass det. time= 455.0 min (1,199.0 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	62.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A**
			378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	62.50'	270 cf	**StormTank 18** x 42 Inside #1
			Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf
			Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf
			6 Rows of 7 Chambers
#3	64.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious

50,060 cf Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	1	0	0
65.50	1	2	2
65.51	50,000	250	252
66.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	65.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	62.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 7.16 hrs HW=62.05' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 17.46 hrs HW=65.51' TW=49.08' (Dynamic Tailwater)
└**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.36 fps)

Summary for Pond DW3: Drywell 3

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event				
Inflow =	0.28 cfs @	12.08 hrs,	Volume=	0.023 af	
Outflow =	0.01 cfs @	17.46 hrs,	Volume=	0.014 af,	Atten= 98%, Lag= 322.4 min
Discarded =	0.00 cfs @	7.08 hrs,	Volume=	0.012 af	
Primary =	0.00 cfs @	17.46 hrs,	Volume=	0.002 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 64.51' @ 17.46 hrs Surf.Area= 189 sf Storage= 673 cf

Plug-Flow detention time= 569.5 min calculated for 0.014 af (59% of inflow)
Center-of-Mass det. time= 456.3 min (1,200.3 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	60.50'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	61.00'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	62.50'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
62.50	1	0	0
64.50	1	2	2
64.51	50,000	250	252
65.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	64.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	60.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.03'

Discarded OutFlow Max=0.00 cfs @ 7.08 hrs HW=60.55' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 17.46 hrs HW=64.51' TW=0.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.36 fps)

Summary for Pond DW4: Drywell 4

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event			
Inflow =	0.28 cfs @	12.08 hrs, Volume=	0.023 af	
Outflow =	0.01 cfs @	17.46 hrs, Volume=	0.014 af, Atten= 98%, Lag= 322.4 min	
Discarded =	0.00 cfs @	7.16 hrs, Volume=	0.012 af	
Primary =	0.00 cfs @	17.46 hrs, Volume=	0.002 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 66.01' @ 17.46 hrs Surf.Area= 189 sf Storage= 672 cf

Plug-Flow detention time= 567.9 min calculated for 0.014 af (60% of inflow)
Center-of-Mass det. time= 455.0 min (1,199.0 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	62.50'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	63.00'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	64.50'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.50	1	0	0
66.00	1	2	2
66.01	50,000	250	252
67.00	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	66.00'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	62.50'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 7.16 hrs HW=62.55' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 17.46 hrs HW=66.01' TW=0.00' (Dynamic Tailwater)
└**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.36 fps)

Summary for Pond DW5: Drywell 5

Inflow Area =	0.044 ac,100.00% Impervious, Inflow Depth = 6.26" for 100-Year event			
Inflow =	0.28 cfs @	12.08 hrs, Volume=	0.023 af	
Outflow =	0.01 cfs @	17.46 hrs, Volume=	0.014 af, Atten= 98%, Lag= 322.4 min	
Discarded =	0.00 cfs @	7.16 hrs, Volume=	0.012 af	
Primary =	0.00 cfs @	17.46 hrs, Volume=	0.002 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 58.51' @ 17.46 hrs Surf.Area= 189 sf Storage= 672 cf

Plug-Flow detention time= 568.1 min calculated for 0.014 af (60% of inflow)
Center-of-Mass det. time= 455.0 min (1,199.0 - 744.0)

Volume	Invert	Avail.Storage	Storage Description
#1A	55.00'	38 cf	**9.00'W x 21.00'L x 2.00'H Field A** 378 cf Overall - 284 cf Embedded = 95 cf x 40.0% Voids
#2A	55.50'	270 cf	**StormTank 18** x 42 Inside #1 Inside= 18.0"W x 18.0"H => 2.15 sf x 3.00'L = 6.4 cf Outside= 18.0"W x 18.0"H => 2.25 sf x 3.00'L = 6.8 cf 6 Rows of 7 Chambers
#3	57.00'	49,752 cf	**Open Area Above Outlet (Prismatic)** Listed below (Recalc) -Impervious
		50,060 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
57.00	1	0	0
58.50	1	2	2
58.51	50,000	250	252
59.50	50,000	49,500	49,752

Device	Routing	Invert	Outlet Devices
#1	Primary	58.50'	**3.0" W x 2.0" H Vert. Scupper Outlet** C= 0.600
#2	Discarded	55.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.00 cfs @ 7.16 hrs HW=55.05' (Free Discharge)
└─**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

Primary OutFlow Max=0.00 cfs @ 17.46 hrs HW=58.51' TW=0.00' (Dynamic Tailwater)
└─**1=Scupper Outlet** (Orifice Controls 0.00 cfs @ 0.36 fps)

Summary for Pond S1: Existing Bordering Vegetated Wetland

Inflow Area =	5.456 ac, 21.20% Impervious, Inflow Depth > 2.51" for 100-Year event				
Inflow =	13.82 cfs @	12.13 hrs, Volume=	1.139 af		
Outflow =	1.33 cfs @	13.71 hrs, Volume=	1.110 af, Atten= 90%, Lag= 94.8 min		
Primary =	1.33 cfs @	13.71 hrs, Volume=	1.110 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 49.54' @ 13.71 hrs Surf.Area= 14,037 sf Storage= 20,845 cf

Plug-Flow detention time= 230.9 min calculated for 1.110 af (97% of inflow)
Center-of-Mass det. time= 207.5 min (1,118.0 - 910.5)

Volume	Invert	Avail.Storage	Storage Description
#1	47.80'	65,726 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
47.80	9,945	0	0
50.00	15,123	27,575	27,575
52.00	23,028	38,151	65,726

Device	Routing	Invert	Outlet Devices
#1	Primary	47.80'	**168.0" W x 50.0" H Box BoxCulvert** L= 35.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 47.80' / 47.00' S= 0.0229 '/' Cc= 0.900 n= 0.040 Earth, cobble bottom, clean sides, Flow Area= 58.33 sf
#2	Device 1	47.80'	**4.0" W x 8.5" H Vert. Orifice/Grate** C= 0.600
#3	Device 1	50.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.33 cfs @ 13.71 hrs HW=49.54' TW=0.00' (Dynamic Tailwater)
└─**1=BoxCulvert** (Passes 1.33 cfs of 94.84 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.33 cfs @ 5.65 fps)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond S2: Pocket Wetland

Inflow Area =	1.709 ac, 46.55% Impervious, Inflow Depth = 3.41" for 100-Year event				
Inflow =	6.56 cfs @	12.10 hrs, Volume=	0.485 af		
Outflow =	5.88 cfs @	12.15 hrs, Volume=	0.469 af, Atten= 10%, Lag= 3.1 min		
Primary =	3.90 cfs @	12.15 hrs, Volume=	0.431 af		
Secondary =	1.98 cfs @	12.15 hrs, Volume=	0.038 af		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 51.21' @ 12.15 hrs Surf.Area= 2,663 sf Storage= 5,935 cf

Plug-Flow detention time= 196.1 min calculated for 0.469 af (97% of inflow)
Center-of-Mass det. time= 177.6 min (980.2 - 802.5)

Volume	Invert	Avail.Storage	Storage Description
#1	46.00'	8,251 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
46.00	1	0	0
47.80	1	2	2
47.81	767	4	6
48.00	834	152	158
49.00	1,452	1,143	1,301
50.00	2,103	1,778	3,078
51.00	2,515	2,309	5,387
52.00	3,213	2,864	8,251

Device	Routing	Invert	Outlet Devices
#1	Primary	48.20'	**12.0" Round Culvert** L= 20.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 48.20' / 48.00' S= 0.0100 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	48.50'	**2.0" Vert. Orifice** C= 0.600
#3	Device 1	50.75'	**4.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Secondary	51.00'	**8.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Primary OutFlow Max=3.89 cfs @ 12.15 hrs HW=51.21' TW=48.60' (Dynamic Tailwater)
└─**1=Culvert** (Passes 3.89 cfs of 4.73 cfs potential flow)
  ├─**2=Orifice** (Orifice Controls 0.17 cfs @ 7.78 fps)
  └─**3=Broad-Crested Rectangular Weir** (Weir Controls 3.72 cfs @ 2.02 fps)

Secondary OutFlow Max=1.98 cfs @ 12.15 hrs HW=51.21' TW=48.60' (Dynamic Tailwater)
└─**4=Broad-Crested Rectangular Weir** (Weir Controls 1.98 cfs @ 1.17 fps)

Summary for Pond S3: Pervious block detention

Inflow Area =	0.514 ac, 67.24% Impervious, Inflow Depth = 5.00" for 100-Year event			
Inflow =	2.71 cfs @	12.11 hrs, Volume=	0.214 af	
Outflow =	2.35 cfs @	12.16 hrs, Volume=	0.214 af, Atten= 13%, Lag= 3.2 min	
Discarded =	0.05 cfs @	12.16 hrs, Volume=	0.067 af	
Primary =	2.30 cfs @	12.16 hrs, Volume=	0.147 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 64.62' @ 12.16 hrs Surf.Area= 2,132 sf Storage= 1,155 cf

Plug-Flow detention time= 46.7 min calculated for 0.214 af (100% of inflow)
Center-of-Mass det. time= 46.7 min (840.6 - 793.8)

Volume	Invert	Avail.Storage	Storage Description
#1	64.00'	8,010 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
64.00	1,590	0	0
65.00	2,463	2,027	2,027
66.00	9,503	5,983	8,010

Device	Routing	Invert	Outlet Devices
#1	Primary	62.00'	**12.0" Round Culvert** L= 100.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 62.00' / 58.00' S= 0.0400 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Device 1	64.25'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Discarded	64.00'	**1.020 in/hr Exfiltration over Surface area** Phase-In= 0.02'

Discarded OutFlow Max=0.05 cfs @ 12.16 hrs HW=64.62' (Free Discharge)
└─**3=Exfiltration** (Exfiltration Controls 0.05 cfs)

Primary OutFlow Max=2.30 cfs @ 12.16 hrs HW=64.62' TW=51.21' (Dynamic Tailwater)
└─**1=Culvert** (Passes 2.30 cfs of 4.35 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 2.30 cfs @ 2.93 fps)

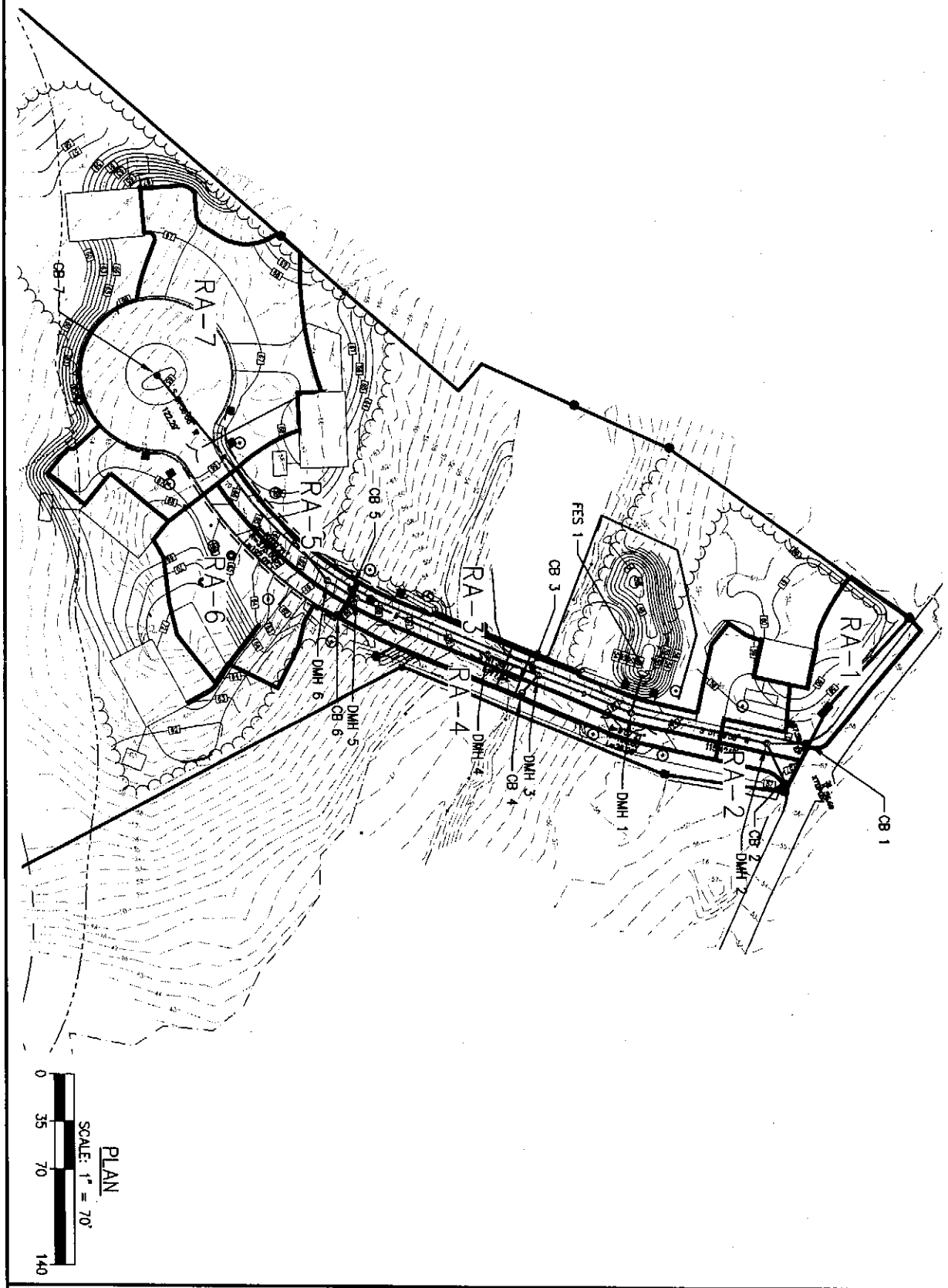

FIGURE #6
CATCH BASIN DRAINAGE AREAS
AT:
57 PERKINS ROW
TOPSFIELD, MASSACHUSETTS

DATE: JUNE 16, 2015
SCALE: 1" = 70'

The Morin-Cameron GROUP, INC.
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Weighted Runoff Coefficients "C" for Rational Method

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C'- Coefficients

Pervious B-Soil	0.35
Impervious	0.9

Description of Area RA-1	Area (acres)	Runoff Coefficient	A x C
Pervious	0.120	0.35	0.04
Impervious	0.040	0.90	0.04
Totals =	**0.160**		0.08

Weighted Runoff Coefficient = **S(AxC) / SA 0.49**

Description of Area RA-2	Area (acres)	Runoff Coefficient	A x C
Pervious	0.000	0.35	0.00
Impervious	0.020	0.90	0.02
Totals =	**0.020**		0.02

Weighted Runoff Coefficient = **S(AxC) / SA 0.90**

Description of Area RA-3	Area (acres)	Runoff Coefficient	A x C
Pervious	0.036	0.35	0.01
Impervious	0.166	0.90	0.15
Totals =	**0.202**		0.16

Weighted Runoff Coefficient = **S(AxC) / SA 0.80**

Description of Area RA-4	Area (acres)	Runoff Coefficient	A x C
Pervious	0.000	0.35	0.00
Impervious	0.087	0.90	0.08
Totals =	**0.087**		0.08

Weighted Runoff Coefficient = **S(AxC) / SA 0.90**

Description of Area RA-5	Area (acres)	Runoff Coefficient	A x C
Pervious	0.000	0.35	0.00
Impervious	0.052	0.90	0.05
Totals =	**0.052**		0.05

Weighted Runoff Coefficient = **S(AxC) / SA 0.90**

Description of Area RA-6	Area (acres)	Runoff Coefficient	A x C
Pervious	0.193	0.35	0.07
Impervious	0.059	0.90	0.05
Totals =	**0.252**		0.12

Weighted Runoff Coefficient = **S(AxC) / SA 0.48**

Description of Area RA-7	Area (acres)	Runoff Coefficient	A x C
Pervious	0.266	0.35	0.09
Impervious	0.374	0.90	0.34
Totals =	**0.640**		0.43

Weighted Runoff Coefficient = **S(AxC) / SA 0.67**

Pipe Sizing Calculation Spreadsheet:

THE MORIN-CAMERON GROUP, INC.
447 Boston Street
Topsfield, MA 01983
P: (978) 887-8586
F: (978) 887-3480
W: www.morincameron.com

Name: Definitive Subdivision
Location: 58 Perkins Row Topsfield
Topsfield, MA
County: Essex County
Owner: New Meadows Development, LLC

Proj. No.: 3274
Date: 6/16/2015
Revised:
Computed by: Scott P, Cameron, P.E.
Checked by: Scott P, Cameron, P.E.

Design Parameters:
IDF Curve
100 **Year Storm** Boston, MA
k_e= **0.2**

DESCRIPTION	LOCATION		AREA (AC.)	C	C x A	SUM C x A	FLOW TIME (MIN)		i*	DESIGN					CAPACITY		PIPE PROFILE				
	FROM	TO					PIPE	CONC. TIME		Q cfs	V fps	n	PIPE SIZE	SLOPE	Q full ft^3/s	V full ft/s	LENGTH ft	FALL ft	RIM	INV UPPER	INV LOWER
RA-1	CB -1	DMH-2	0.16	0.49	0.08	0.08	0.11	5.0	6.0	0.5	3.7	0.01	12	0.020	6.6	8.3	25	0.50	57.50	53.34	52.84
RA-2	CB-2	DMH-2	0.02	0.90	0.02	0.02	0.25	5.0	6.0	0.1	1.8	0.01	12	0.020	6.6	8.3	28	0.56	57.00	53.40	52.84
	DMH-2	DMH-1				0.10	0.39	5.3	5.9	0.6	4.1	0.01	12	0.022	6.9	8.8	98	2.19	57.30	52.74	50.55
RA-7	CB-7	DMH-6	0.64	0.67	0.43	0.43	0.42	5.0	6.0	2.6	7.5	0.01	12	0.028	7.7	9.8	189	5.20	64.24	62.00	56.80
	DMH-6	DMH-5				0.43	0.03	5.4	5.9	2.5	10.3	0.01	12	0.072	12.5	15.9	21	1.52	60.43	56.70	55.18
RA-5	CB-5	DMH-5	0.05	0.90	0.05	0.05	0.02	5.0	6.0	0.3	3.0	0.01	12	0.020	6.6	8.3	4	0.08	59.20	55.26	55.18
RA-6	CB-6	DMH-5	0.25	0.48	0.12	0.12	0.06	5.0	6.0	0.7	4.4	0.01	12	0.020	6.6	8.3	15	0.30	59.20	55.48	55.18
	DMH-5	DMH-4				0.60	0.29	5.0	6.0	3.6	5.7	0.01	12	0.010	4.6	5.9	101	1.01	58.95	54.27	53.26
	DMH-4	DMH-3				0.60	0.11	5.3	5.9	3.5	5.7	0.01	12	0.010	4.6	5.9	36	0.36	55.40	53.16	52.80
RA-3	CB-3	DMH-3	0.20	0.80	0.16	0.16	0.01	5.0	6.0	1.0	4.8	0.01	12	0.020	6.6	8.3	4	0.08	55.09	51.56	51.48
RA-4	CB-4	DMH-3	0.09	0.90	0.08	0.08	0.06	5.0	6.0	0.5	3.7	0.01	12	0.020	6.6	8.3	14	0.28	55.09	51.76	51.48
	DMH-3	DMH-1				0.84	0.17	5.1	6.0	5.0	6.7	0.01	12	0.012	5.1	6.5	69	0.83	55.20	51.38	50.55
	DMH-1	FES-1				0.93	0.05	5.2	5.9	5.5	8.3	0.01	12	0.020	6.6	8.3	25	0.50	56.28	50.45	49.95

Stormwater Management Calculations

Standard 3: Recharge To Groundwater: Static Method

Existing Impervious Area =10,193 SF

Proposed Impervious Area = 42,732 SF

There is an increase in the amount of impervious surface of 32,539 SF

Hydrologic Soil Group	Recharge Rainfall Depth
B	0.35"

Recharge Volume Required = [0.35" x 32,539 SF] = 11,389/12 SF-In = 949 CF

The five individual house dry wells and the pervious block detention pond provide a total of 1,965 CF recharge volume to groundwater.

Drawdown Analysis: Static Method

Dry Wells Average Bottom Area=174 SF

Infiltration volume (below lowest outlet) =261 CF

Drawdown for each drywell = ((261/1.02)X12)/174=**17.6 hours**

Pervious block retention area Average bottom area = 1,699 SF

Infiltration Volume (below lowest outlet) = 425 CF

Pervious paver drawdown time = ((425/1.02)X12)/1,699 = **2.9 hours**

Standard 4: Water Quality Volume (WQV):

Sediment Forebay at Pocket Wetland

0.1" Design Volume
Impervious Area entering forebay 32,539SF
0.1"X (32,539 SF) X 1'/12"= 271 CF required

319 CF provided below berm in sediment forebay

Pocket Wetland (Constructed Stormwater Wetland)

Tributary Area = <1 to 10 acres (1.57 acres provided)
Surface Area to Watershed Area>0.01 (0.039 provided)
Length to Width Ratio >2:1 (2.6:1 provided)
Surface Area of Pocket Wetland: 2,663 SF

0.5"Water Quality Volume

Impervious Area=32,539 SF
0.5"X (32,539) X 1'/12"=1,356 CF Required

1,732CF provided below outlets

THE MORIN-CAMERON GROUP, INC.
447 Boston Street, US Route 1
Topsfield, MA 01983
p | 978.887.8586 m | 781.520.9496

Standard 4: Total Suspended Solids Calculation for Roadway

Name: Definitive Subdivision
Location: 58 Perkins Row Topsfield
Topsfield, MA
County: Essex County
Owner: New Meadows Development, L

Proj. No.: 3274
Date: 6/16/2015
Revised:
Computed by: Scott P, Cameron, P.E.
Checked by: Scott P, Cameron, P.E.

TSS Removal Calculation

B BMP	C TSS Removal Rate	D Starting TSS Load (*F)	E Amount Removed (C*D)	F Remaining Load (D-E)
Deep Sump and Hooded Catch Basin	**0.25**	**1.00**	**0.25**	**0.75**
Constructed Stormwater Wetland	**0.80**	**0.75**	**0.60**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**
	0.00	**0.15**	**0.00**	**0.15**

Total TSS Removal = **85%**

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

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

Mass. Dept. of Environmental Protection

Stage-Area-Storage for Pond DW4: Drywell 4 (TYPICAL ALL DRYWELLS)

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
62.50	**189**	0
62.55	189	4
62.60	189	8
62.65	189	11
62.70	189	15
62.75	189	19
62.80	189	23
62.85	189	26
62.90	189	30
62.95	189	34
63.00	189	38
63.05	189	47
63.10	189	56
63.15	189	65
63.20	189	74
63.25	189	83
63.30	189	92
63.35	189	101
63.40	189	110
63.45	189	119
63.50	189	128
63.55	189	137
63.60	189	146
63.65	189	155
63.70	189	164
63.75	189	173
63.80	189	182
63.85	189	191
63.90	189	200
63.95	189	209
64.00	189	218
64.05	189	227
64.10	189	236
64.15	189	245
64.20	189	254
64.25	189	263
64.30	189	272
64.35	189	281
64.40	189	290
64.45	189	299
64.50	189	308
64.55	189	308
64.60	189	308
64.65	189	308
64.70	189	308
64.75	189	308
64.80	189	308
64.85	189	308
64.90	189	309
64.95	189	309
65.00	189	309
65.05	189	309
65.10	189	309
65.15	189	309
65.20	189	309
65.25	189	309
65.30	189	309
65.35	189	309
65.40	189	309
65.45	189	309
65.50	189	309
65.55	189	309
65.60	189	309
65.65	189	309
65.70	189	309
65.75	189	309
65.80	189	309
65.85	189	309
65.90	189	310
65.95	189	310
66.00	189	310
66.05	189	2,560
66.10	189	5,060
66.15	189	7,560
66.20	189	10,060
66.25	189	12,560
66.30	189	15,060
66.35	189	17,560
66.40	189	20,060
66.45	189	22,560
66.50	189	25,060
66.55	189	27,560
66.60	189	30,060
66.65	189	32,560
66.70	189	35,060
66.75	189	37,560
66.80	189	40,060
66.85	189	42,560
66.90	189	45,060
66.95	189	47,560
67.00	189	**50,060**

RECHARGE VOLUME
X5 LOTS = 1,540 CF

Stage-Area-Storage for Pond S3: Pervious block detention

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
64.00	1,590	0
64.02	1,607	32
64.04	1,625	64
64.06	1,642	97
64.08	1,660	130
64.10	1,677	163
64.12	1,695	197
64.14	1,712	231
64.16	1,730	266
64.18	1,747	300
64.20	1,765	335
64.22	1,782	371
64.24	1,800	407
64.26	1,817	443
64.28	1,834	479
64.30	1,852	516
64.32	1,869	553
64.34	1,887	591
64.36	1,904	629
64.38	1,922	667
64.40	1,939	706
64.42	1,957	745
64.44	1,974	784
64.46	1,992	824
64.48	2,009	864
64.50	2,027	904
64.52	2,044	945
64.54	2,061	986
64.56	2,079	1,027
64.58	2,096	1,069
64.60	2,114	1,111
64.62	2,131	1,154
64.64	2,149	1,196
64.66	2,166	1,240
64.68	2,184	1,283
64.70	2,201	1,327
64.72	2,219	1,371
64.74	2,236	1,416
64.76	2,253	1,461
64.78	2,271	1,506
64.80	2,288	1,551
64.82	2,306	1,597
64.84	2,323	1,644
64.86	2,341	1,690
64.88	2,358	1,737
64.90	2,376	1,785
64.92	2,393	1,832
64.94	2,411	1,880
64.96	2,428	1,929
64.98	2,446	1,977
65.00	2,463	2,027
65.02	2,604	2,077
65.04	2,745	2,131
65.06	2,885	2,187
65.08	3,026	2,246
65.10	3,167	2,308
65.12	3,308	2,373
65.14	3,449	2,440
65.16	3,589	2,511
65.18	3,730	2,584
65.20	3,871	2,660
65.22	4,012	2,739
65.24	4,153	2,820
65.26	4,293	2,905
65.28	4,434	2,992
65.30	4,575	3,082
65.32	4,716	3,175
65.34	4,857	3,271
65.36	4,997	3,369
65.38	5,138	3,471
65.40	5,279	3,575
65.42	5,420	3,682
65.44	5,561	3,792
65.46	5,701	3,904
65.48	5,842	4,020
65.50	5,983	4,138
65.52	6,124	4,259
65.54	6,265	4,383
65.56	6,405	4,510
65.58	6,546	4,639
65.60	6,687	4,771
65.62	6,828	4,907
65.64	6,969	5,045
65.66	7,109	5,185
65.68	7,250	5,329
65.70	7,391	5,475
65.72	7,532	5,625
65.74	7,673	5,777
65.76	7,813	5,932
65.78	7,954	6,089
65.80	8,095	6,250
65.82	8,236	6,413
65.84	8,377	6,579
65.86	8,517	6,748
65.88	8,658	6,920
65.90	8,799	7,094
65.92	8,940	7,272
65.94	9,081	7,452
65.96	9,221	7,635
65.98	9,362	7,821
66.00	**9,503**	**8,010**

AVE = 425 CF FOR 64.25

RECHARGE VOLUME

Stage-Area-Storage for Pond S2: Pocket Wetland

Elevation (feet)	Surface (sq-ft)	Storage (cubic-feet)
46.00	1	0
46.10	1	0
46.20	1	0
46.30	1	0
46.40	1	0
46.50	1	1
46.60	1	1
46.70	1	1
46.80	1	1
46.90	1	1
47.00	1	1
47.10	1	1
47.20	1	1
47.30	1	1
47.40	1	1
47.50	1	2
47.60	1	2
47.70	1	2
47.80	1	2
47.90	799	76
48.00	834	158
48.10	896	244
48.20	958	337
48.30	1,019	436
48.40	1,081	541
48.50	1,143	652
48.60	1,205	769
48.70	1,267	893
48.80	1,328	1,023
48.90	1,390	1,159
49.00	1,452	1,301
49.10	1,517	1,449
49.20	1,582	1,604
49.30	1,647	1,766
49.40	1,712	1,934
49.50	1,778	2,108
49.60	1,843	2,289
49.70	1,908	2,477
49.80	1,973	2,671
49.90	2,038	2,871
50.00	2,103	3,078
50.10	2,144	3,291
50.20	2,185	3,507
50.30	2,227	3,728
50.40	2,268	3,952
50.50	2,309	4,181
50.60	2,350	4,414
50.70	2,391	4,651
50.80	2,433	4,892
50.90	2,474	5,138
51.00	2,515	5,387
51.10	2,585	5,642
51.20	2,655	5,904
51.30	2,724	6,173
51.40	2,794	6,449
51.50	2,864	6,732
51.60	2,934	7,022
51.70	3,004	7,319
51.80	3,073	7,623
51.90	3,143	7,933
52.00	**3,213**	**8,251**

48.85 = 0.5" WATER QUALITY VOLUME
=1,356 CF

Long Term Stormwater Best Management Practices
Operation and Maintenance Plan
for
57 Perkins Row
Topsfield, Massachusetts

The following operation and maintenance plan has been provided to satisfy the requirements of Standard 9 of the Mass DEP Stormwater Management Handbook. The success of the Stormwater Management Plan depends on the proper implementation, operation and maintenance of several management components. The following procedures shall be implemented to ensure success of the Stormwater Management Plan:

1. The contractor shall comply with the details of construction of the site as shown on the approved plans.
2. The catch basins, Storm Tank infiltration systems and constructed pocket wetland shall be inspected and maintained as shown in the manufacturer's guidelines and as indicated below.
3. Effective erosion control measurers during and after construction shall be maintained until a stable turf is established on all altered areas.
4. The project is subject to an EPA National Pollutant Discharge Elimination System – Construction General Permit regulations and a Stormwater Pollution Prevention Plan (NDPES-SWPPP). The plan shall be implemented at least 14 days prior to the start of earth disturbance activities.

Basic Information

Stormwater Management System Owner:	New Meadows Development, LLC 60 North Main Street Middleton, MA 01949 P: (978) 879-3144
Topsfield Highway Department:	DPW Facility 279 Boston Street Topsfield, MA 01983 P: (978) 887-1542
Topsfield Planning Board:	Town Hall 8 West Common Drive Topsfield, MA 01983 P: (978) 887-1504
Topsfield Board of Health:	Town Hall 8 West Common Drive Topsfield, MA 01983 P: (978) 887-1520

Topsfield Conservation Commission:

Town Hall
8 West Common Drive
Topsfield, MA 01983
P: (978) 887-1510

Erosion and Sedimentation Controls During Construction:

The site and drainage construction contractor shall be responsible for maintaining the stormwater system during construction. Routine maintenance of all items shall be performed to ensure adequate runoff and pollution control during construction.

A proposed silt fence will be placed as shown on the Site Layout prior to the commencement of any clearing, grubbing, and earth removal or construction activity. The integrity of the erosion control barrier will be maintained by periodic inspection and replacement as necessary. The erosion control barrier will remain in place until the first course of pavement has been placed and all side slopes have been loamed and seeded and vegetation has been established. A silt sack will also be placed over the new catch basins once constructed.

Operations and maintenance plans for the Stormwater Management construction phase and long term operation of the system have been attached to this report.

General Conditions

1. The property owner shall be responsible for scheduling regular inspections and maintenance of the stormwater BMP's as detailed in the following long-term pollution prevention plan and illustrated on the approved design plans:

   "Definitive Subdivision Plan of for 57 Perkins Topsfield, Massachusetts, eight sheets prepared by The Morin-Cameron Group, Inc. dated June 16, 2015 as revised and approved by the Topsfield Planning Board.

2. All Stormwater BMP's shall be operated and maintained in accordance with the design plans and the following Long-Term Pollution Prevention Plan.

3. The owner shall:

   a. Maintain an Operation and Maintenance Log (see Attachment A) for the last three years. The Log shall include all BMP inspections, repairs, replacement activities and disposal activities (disposal material and disposal location shall be included in the Log);

   b. Make the log available to the Topsfield Highway Department s and Planning Board upon request;

   c. Allow members and agents of the Topsfield Highway Department, Planning Board, Board of Health and Conservation Commission to enter the premises and ensure that the Owner has complied with the Operation and Maintenance Plan requirements for each BMP.

4. A recommended inspection and maintenance schedule is outlined below based on statewide averages. This inspection and maintenance schedule shall be adhered to at a minimum for the first year of service of all BMP's referenced in this document. At the commencement of the first year of service, a more accurate inspection/maintenance schedule shall be determined based on the level of service for this site.

Long-Term Pollution Prevention Plan (LTPPP)

Vegetated Areas:

Immediately after construction, monitoring of the erosion control systems shall occur until establishment of natural vegetation. Afterwards, vegetated areas shall be maintained as such. Vegetation shall be replaced as necessary to ensure proper stabilization of the site.

Cost: Included with annual landscaping budget. Consult with local landscape contractors.

Deep Sump Hooded Catch Basins

The Catch basin grates shall be checked quarterly and following heavy rainfalls to verify that the inlet openings are not clogged by debris. Debris shall be removed from the grates and disposed of properly. Deep sump catch basins shall be inspected and cleaned quarterly as needed when accumulated sediments exceed 2' from the bottom of the sump (approximately 1/2 of the sump capacity). Catch basins with tees shall be inspected annually to check oil build-up and outlet obstructions. Material shall be removed from catch basins and disposed of in accordance with all applicable regulations

Cost: Estimated $50 - $100 per cleaning per catch basin as needed. The Owner shall consult local vacuum cleaning contractors for detailed cost estimates.

Public Safety Concerns: Catch basins shall not be left open and unattended at any time during inspection, cleaning or otherwise. Broken grates or frames shall be replaced immediately. At no time shall any person enter the basin structure unless measures have been taken to ensure safe access in accordance with enclosed space regulations.

Sediment Forebay/Pocket Wetland:

The Sediment Forebay/Pocket Wetland shall be inspected after every major storm event for the first 3 months after construction; a major storm event is 3.9 inches of rainfall in a 24 hour period (5 year storm). Thereafter, the system shall be inspected twice per year. If the system does not drain within 72 hours of a rainstorm, the operator shall inform the design engineer.

Periodic failure of the pocket wetland is caused by lack of regular maintenance. The pocket wetland requires careful attention while plants are being established and seasonal landscape maintenance thereafter. Inspect the system regularly for sediment build-up, structural damage and standing water. Inspect soil and repair eroded areas as needed. Remove litter and debris monthly. Treat diseased vegetation twice per year in spring and fall. Remove invasive species as needed to prevent these species from spreading into the pocket wetland .Replace mulch every two years in the early spring. **Snow cannot be stored in the pocket wetland.** Following is a schedule of the required maintenance activities along with their frequency of occurrence:

Activity	Time of Year	Frequency
Inspect and remove trash	Year Round	Monthly
Mulch	Spring	Annually
Remove Dead Vegetation	Fall or Spring	Annually
Replace Dead Vegetation	Spring	Annually
Prune	spring or Fall	Annually

Cost: The owner shall consult local landscaping contractor for details.

Permeable Pavers:

The permeable pavers should be vacuum swept by a high efficiency vacuum sweeper on an annual basis along with the regular street sweeping. In the event that water does not drain from the pavers within 72 hours, use a pressure washer to dislodge accumulated particles from the top surface between the blocks. Be careful not to displace the sand between the paving units as this is used to both drain the surface and hold the paving units in place.

Debris & Litter:

All debris and litter shall be removed from the area as necessary to prevent migration into the drainage system.

Pesticides, Herbicides, and Fertilizers:

Pesticides and herbicides shall be used sparingly. Fertilizers shall be restricted to the use of organic fertilizers only. All fertilizers, herbicides, pesticides, sand and salt for deicing and the like shall be stored in dry area that is protected from weather.

Cost: Included in the routine landscaping maintenance schedule. The Owner shall consult local landscaping contractors for details.

Public Safety Concerns: Chemicals shall be stored in a secure area to prevent children from obtaining access to them. Any major spills shall be reported to municipal officials.

Prevention of Illicit Discharges:

Illicit discharges to the stormwater management system are not allowed. Illicit discharges are discharges that are not comprised entirely of stormwater. Pursuant to Mass DEP Stormwater Standards the following activities or facilities are not considered illicit discharges: firefighting, water line flushing, landscape irrigation, uncontaminated groundwater, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, DE chlorinated water from swimming pools, water used for street washing and water used to clean residential building without detergents.

To prevent illicit discharges to the stormwater management system the following policies should be implemented:

1. Provisions For Storing Materials And Waste Products Inside Or Under Cover
2. Vehicle Maintenance And Washing Controls
3. Requirements for Routine Inspections of the Stormwater Management System (i.e.: catch basins, proprietary treatment unit & subsurface infiltration system.)
4. Spill Prevention and Response Plans.

Stormwater Pollution Prevention Plan

(Erosion and Sediment Control Plan)

For:
New Meadows Development, LLC
69 North Main Street
Middleton, MA 01949

Owner(s):
New Meadows Development, LLC
69 North Main Street
Middleton, MA 01949
P: (978) 423-7332

Operator(s):
TBD

Stormwater Manager and SWPPP Contact(s):
TBD

Scott P. Cameron, PE
The Morin-Cameron Group, Inc.
447 Boston Street
Topsfield, MA 01983
P: (978) 887-8586
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SWPPP Preparation Date:
TBD

Estimated Project Dates:
Start of Construction: TBD
End of Construction: TBD

EPA Tracking #:
TBD

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SECTION 1: CONTACT INFORMATION/RESPONSIBLE PARTIES

1.1 Operator(s) / Subcontractor(s)

Owner(s):

New Meadows Development, LLC
69 North Main Street
Middleton, MA 01949
P: (978) 423-7332

Operator(s):

TBD

Project Manager(s) or Site Supervisor(s):

TBD TBD

Stormwater Manager and SWPPP Contact(s):

TBD

This SWPPP Was Prepared By:

Scott P Cameron, PE
The Morin-Cameron Group, Inc.
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Topsfield, MA 01983
P: (978) 887-8586

Subcontractor(s):

See Appendix G

Emergency 24 hour contact:

TBD

Note: Any discrepancies between this SWPPP and the construction period Poll-Prev-Plan enclosed herein shall use the SWPPP as the controlling document.

SECTION 2: SITE EVALUATION, ASSESSMENT, AND PLANNING

2.1 Project/Site Information

Project Name and Address

Project/Site Name: Definitive Subdivision

Project Street/Location: 57 Perkins Row

City: Topsfield

State: MA

ZIP Code: 01983

County or Similar Subdivision: Essex (Northern)

Project Latitude/Longitude

(Use **one** of three possible formats, and specify method)

Latitude:

1. 42 º 37 '38" N (degrees, minutes, seconds)
2. _ _ º _ _ . _ _' N (degrees, minutes, decimal)
3. (decimal)

Longitude:

1. 70 º 55 ' 49" W (degrees, minutes, seconds)
2. _ _ º _ . _ _' W (degrees, minutes, decimal)
3. (decimal)

Method for determining latitude/longitude:

☐ USGS topographic map (specify scale:) ☐ EPA Web site ☐ GPS

☒ Other (please specify): Google Earth

Horizontal Reference Datum:

☐ NAD 27 ☒ NAD 83 or WGS 84 ☐ Unknown

If you used a U.S.G.S topographic map, what was the scale? _____

Additional Project Information

Is the project/site located on Indian country lands, or located on a property of religious or cultural significance to an Indian tribe? ☐ Yes ☒ No

If yes, provide the name of the Indian tribe associated with the area of Indian country (including the name of Indian reservation if applicable), or if not in Indian country, provide the name of the Indian tribe associated with the property:

If you are conducting earth-disturbing activities in response to a public emergency, document the cause of the public emergency *(e.g., natural disaster, extreme flooding conditions)*, information substantiating its occurrence *(e.g., state disaster declaration)*, and a description of the construction necessary to reestablish effective public services:

Are you applying for permit coverage as a "federal operator" as defined in Appendix A of the 2012 CGP?

☐ Yes ☒ No

2.2 Discharge Information

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)?

☐ Yes ☒ No Private closed drainage discharge to intermittent streams and wetlands

Are there any surface waters that are located within 50 feet of your construction disturbances?

☒ Yes ☐ No

Receiving Waters:

- **Description of receiving waters:** No name bordering vegetated wetland
- **Description of storm sewer systems:** New construction stormwater wetland, grassed channel, detention basin, subsurface infiltration basin
- **Description of impaired waters or waters subject to TMDLs**: N/A

Table 1 – Names of Receiving Waters

1. No name bordering vegetated wetland tributary to the Ipswich River

Table 2 – Impaired Waters / TMDLs(Answer the following for each surface water listed in Table 1 above)

	Is this surface water listed as "impaired"?	If you answered yes, then answer the following:			
		What pollutant(s) are causing the impairment?	Has a TMDL been completed?	Title of the TMDL document	Pollutant(s) for which there is a TMDL
1.	☐ YES ☒ NO		☐ YES ☐ NO		
2.	☐ YES ☐ NO		☐ YES ☐ NO		

2.3 Nature of the Construction Activity

General Description of Project

See Stormwater Report

Size of Construction Project

What is the size of the property (in acres), the total area expected to be disturbed by the construction activities (in acres), and the maximum area expected to be disturbed at any one time?

Construction Site Area to be disturbed	3.1 acres +/-
Total Project Site Area	8.2 acres +/-
Percentage impervious area before construction	15%
Runoff coefficient before construction (CN)	62
Percentage impervious area after construction	21.77%
Runoff coefficient after construction(CN)	66

Construction Support Activities (only provide if applicable)

Describe any construction support activities for the project

- Material storage areas
- Borrow areas

2.4 Sequence and Estimated Dates of Construction Activities

Single-Family Lot Development

- Start: TBD
- Finish: TBD
- Major Activities
  - Install Silt Fencing
  - Install sediment basins, drainage swales, & washout areas. Install catch basin silt sacks. (New catch basins shall also be equipped with silt sacks).
  - Stockpile haybales & silt fencing/Install erosion controls
  - Clear and Grub Site
  - Import select fill
  - Site grading to sub base elevations
  - Preparation of site for construction of parking areas & infrastructure
  - Construction of utilities and infrastructure.
  - Finish grading, stabilize site and pavement.
- Silt fencing and haybales will be installed around stockpile areas as needed. The permanent erosion control line will also be installed.

- Material stockpiling areas will be stabilized with either an erosion control grass-seed mixture or other stabilizing measures if the stockpile shall remain untouched for 14 or more consecutive days.
- Erosion controls will remain in place until permanent stabilization is established.

2.5 Allowable Non-Stormwater Discharges

List of Allowable Non-Stormwater Discharges Present at the Site

Type of Allowable Non-Stormwater Discharge	Likely to be Present at Your Site?
Discharges from emergency fire-fighting activities	☐ YES ☒ NO
Fire hydrant flushings	☐ YES ☒ NO
Landscape irrigation	☒ YES ☐ NO
Waters used to wash vehicles and equipment	☒ YES ☐ NO
Water used to control dust	☒ YES ☐ NO
Potable water including uncontaminated water line flushings	☒ YES ☐ NO
Routine external building wash down	☒ YES ☐ NO
Pavement wash waters	☒ YES ☐ NO
Uncontaminated air conditioning or compressor condensate	☐ YES ☒ NO
Uncontaminated, non-turbid discharges of ground water or spring water	☒ YES ☐ NO
Foundation or footing drains	☐ YES ☒ NO
Construction dewatering water	☒ YES ☐ NO

De-watering:

De-watering is anticipated at this job site. If necessary, dewatering practices shall conform to the following guidelines:

- Any water that is pumped and discharged from a trench and/or excavation shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
- Under no circumstances shall the Contractor discharge water to wetland resource areas. When constructing near a wetland resource area, the Contractor shall discharge uncontaminated water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method.
- The pumped water shall be filtered through either: bailed hay, a vegetative filter strip, a vegetative channel or a mechanical tank system to trap sediment occurring as a result of the construction operations. Vegetated channels, if utilized shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.

No other non-stormwater discharges are anticipated or will be allowed without written consent and update to this plan by the Operators.

2.6 Site Maps

See Appendix A

SECTION 3: DOCUMENTATION OF COMPLIANCE WITH OTHER FEDERAL REQUIREMENTS

3.1 Endangered Species Protection

Eligibility Criterion

Under which criterion listed in Appendix D are you eligible for coverage under this permit?

☒A ☐B ☐C ☐D ☐E

For reference purposes, the eligibility criteria listed in Appendix D are as follows:

Criterion A. No federally-listed threatened or endangered species or their designated critical habitat(s) are likely to occur in your site's "action area" as defined in Appendix A of this permit.

Criterion B. The construction site's discharges and discharge-related activities were already addressed in another operator's valid certification of eligibility for your action area under eligibility Criterion A, C, D, E, or F and there is no reason to believe that federally-listed species or federally-designated critical habitat not considered in the prior certification may be present or located in the "action area". To certify your eligibility under this Criterion, there must be no lapse of NPDES permit coverage in the other operator's certification. By certifying eligibility under this Criterion, you agree to comply with any effluent limitations or conditions upon which the other operator's certification was based. You must include in your NOI the tracking number from the other operator's notification of authorization under this permit. If your certification is based on another operator's certification under Criterion C, you must provide EPA with the relevant supporting information required of existing dischargers in Criterion C in your NOI form.

Criterion C. Federally-listed threatened or endangered species or their designated critical habitat(s) are likely to occur in or near your site's "action area,"and your site's discharges and discharge-related activities are not likely to adversely affect listed threatened or endangered species or critical habitat. This determination may include consideration of any stormwater controls and/or management practices you will adopt to ensure that your discharges and discharge-related activities are not likely to adversely affect listed species and critical habitat. To make this certification, you must include the following in your NOI: 1) any federally listed species and/or designated habitat located in your "action area"; and 2) the distance between your site and the listed species or designated critical habitat (in miles). You must also include a copy of your site map with your NOI.

Criterion D. Coordination between you and the Services has been concluded. The coordination must have addressed the effects of your site's discharges and discharge-related activities on federally-listed threatened or endangered species and federally-designated critical habitat, and must have resulted in a written concurrence from the relevant Service(s) that your site's discharges and discharge-related activities are not likely to adversely affect listed species or critical habitat. You must include copies of the correspondence between yourself and the Services in your SWPPP and your NOI.

Criterion E. Consultation between a Federal Agency and the U.S. Fish and Wildlife Service and/or the National Marine Fisheries Service under section 7 of the ESA has been concluded. The consultation must have addressed the effects of the construction site's discharges and discharge-related activities on federally-listed threatened or endangered species and federally-designated critical habitat. The result of this consultation must be either:

i. a biological opinion that concludes that the action in question (taking into account the effects of your site's discharges and discharge-related activities) is not likely to jeopardize the continued existence of listed species, nor the destruction or adverse modification of critical habitat; or

ii. written concurrence from the applicable Service(s) with a finding that the site's discharges and discharge-related activities are not likely to adversely affect federally-listed species or federally-designated habitat.

You must include copies of the correspondence between yourself and the Services in your SWPPP and your NOI.

Criterion F. Your construction activities are authorized through the issuance of a permit under section 10 of the ESA, and this authorization addresses the effects of the site's discharges and discharge-related activities on federally-listed species and federally-designated critical habitat. You must include copies of the correspondence between yourself and the Services in your SWPPP and your NOI.

Supporting Documentation

Provide documentation for the applicable eligibility criterion you select in Appendix D, as follows:

For criterion A, indicate the basis for your determination that no federally-listed threatened or endangered species or their designated critical habitat(s) are likely to occur in your site's action area (as defined in Appendix A of the permit). Check the applicable source of information you relied upon:

- ☒ Specific communication with staff of the U.S. Fish & Wildlife Service or National Marine Fisheries Service.
- ☐ Publicly available species list. 2008 NHESP Atlas (MA GIS)
- ☐ Other source:

3.2 Historic Preservation

Appendix E, Step 1

Do you plan on installing any of the following stormwater controls at your site? Check all that apply below, and proceed to Appendix E, Step 2.

- ☐ Dike
- ☒ Berm
- ☒ Catch Basin
- ☒ Pond
- ☒ Stormwater Conveyance Channel (e.g., ditch, trench, perimeter drain, swale, etc.)

☒ Culvert

☒ Other type of ground-disturbing stormwater control: sediment forebays

Appendix E, Step 2

If you answered yes in Step 1, have prior surveys or evaluations conducted on the site already determined that historic properties do not exist, or that prior disturbances at the site have precluded the existence of historic properties? ☒ YES ☐ NO

- See Appendix L

3.3 Safe Drinking Water Act Underground Injection Control Requirements

Do you plan to install any of the following controls? Check all that apply below.

☐ Infiltration trenches (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

☐ Commercially manufactured pre-cast or pre-built proprietary subsurface detention vaults, chambers, or other devices designed to capture and infiltrate stormwater flow

☐ Drywells, seepage pits, or improved sinkholes (if stormwater is directed to any bored, drilled, driven shaft or dug hole that is deeper than its widest surface dimension, or has a subsurface fluid distribution system)

SECTION 4: EROSION AND SEDIMENT CONTROLS

4.1 Natural Buffers or Equivalent Sediment Controls

Buffer Compliance Alternatives

Are there any surface waters within 50 feet of your project's earth disturbances? ☒ YES ☐ NO

4.2 Perimeter Controls

BMP Description: Hay-bales/Silt Fence – Hay-bales and siltation fence shall be installed in accordance with the approved plans where stormwater runoff can enter into the tributary wetlands except at the location of the driveway access if applicable.

- Installation Schedule: Prior to Start of land disturbance
- Maintenance and Inspection: The site supervisor shall inspect the silt fence at least once per week and shall repair any damaged or affected areas of the fence at the time they are noted.
- Responsible Staff: Site Supervisor

BMP Description: Temporary Sedimentation Basin for Runoff & Drainage Swale: The proposed infiltration basin will be used as a temporary sedimentation basin once it is constructed and prior to stabilization of the rear of the site. The basin will be constructed at the beginning of site work during Phase 1. Once the site is stabilized, sediment will be cleaned out of the basin and disposed of in a manner consistent with MA DEP guidelines.

- Installation Schedule: Throughout Construction until final stabilization is achieved.
- Maintenance and Inspection: The site supervisor will inspect grades weekly to determine that water is properly percolating through soil that the basin is maintained and not damaged by other construction activity. No maintenance will be required unless grade is failing to percolate stormwater. The low point shall be periodically cleaned of debris, at least once per month.

- Responsible Staff: Site Supervisor

4.3 Sediment Track-Out

BMP Description: Stabilized Construction Exit: Prior to the commencement of site work, crushed stone anti-tracking pads will be installed at the entrance to the site. This will prevent trucks from tracking material onto Brookwood Road or Hale Street from the construction site. If, at any point during the project, the tracking pad becomes ineffective due to accumulation of soil, the crushed stone shall be replaced. Details for construction of the stabilized entrance can be found in the Erosion Control Details sheet that is part of the comprehensive permit plan set associated with the project.

- Installation Schedule: Prior to commencement of site work
- Maintenance and Inspection: The site supervisor will inspect the tracking pads weekly to ensure that they are properly limiting the tracking of soil onto Brookwood Road or Hale Street. If tracking onto the roadway is noted, it shall be removed immediately via a mechanical street sweeper.
- Responsible Staff: Site Supervisor

4.4 Stockpiled Sediment or Soil

BMP Description: Stockpiled Topsoil Protection – all topsoil shall be stripped from the work area and stockpiled in the location as delineated on the site plans. Once topsoil is stockpiled, the topsoil shall be planted within seven days with a "winter rye" grass see over the stockpiled topsoil to prevent erosion and damage of the topsoil. In addition, a silt fence shall be installed around the entire perimeter of the pile.

☐ Permanent ☒ Temporary

- Installation Schedule: Install after topsoil is stripped
- Maintenance and Inspection: The site supervisor shall inspect the stockpile and the coverage/integrity of the topsoil and silt fence once per week. In the event areas become exposed or there is evidence of damage or erosion of the stockpile, the site supervisor shall take corrective erosion to repair.
- Responsible Staff: Site Supervisor

BMP Description: Exposed soil protections – In the event work is delayed or inactive for a period in excess of 14 days, soil shall be stabilized by the installation of mulch cover or seeding with "winter rye" over the existing areas not protected by other means or BMP's

☐ Permanent ☒ Temporary

- Installation Schedule: Install after topsoil is stripped
- Maintenance and Inspection: The site supervisor shall monitor progress. In the event activity at the site is anticipated to be delayed for a period in excess of 14 days, after the removal of topsoil, mulch cover or seeding with "winter rye" shall be installed prior to stopping work.
- Responsible Staff: Site Supervisor

4.5 Minimize Dust

BMP Description: Dust Control – During dry weather, exposed soil will be hand sprayed with water to control dust. Water trucks used for dust control shall contain contaminant-free water and will be used only as necessary.

- Installation Schedule: As needed

- Responsible Staff: Site Supervisor

4.6 *Minimize the Disturbance of Steep Slopes*

BMP Description: Geotextiles - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

Practice	Manufacturer	Product	Remarks
Sediment Fence	Amoco	Woven polypropylene 1198 or equivalent	0.425 mm opening
Construction Entrance	Amoco	Woven polypropylene 2002 or equivalent	0.300 mm opening
Outlet Protection	Amoco	Nonwoven polypropylene 4551 or equivalent	0.150 mm opening
Erosion Control (slope stability)	Amoco	Supergrow or equivalent	Erosion control revegetation mix, open polypropylene fiber on degradable polypropylene net scrim

Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

- Installation Schedule: Upon final grading of any slope which exceeds 3H:1V.
- Maintenance and Inspection: In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.
- Responsible Staff: Site Supervisor

4.7 *Topsoil*

BMP Description: Minimize Disturbed Area and Protect Natural Features and Soil

- The existing property is comprised of an approximate 92.7 acre site, of that approximately 1.5 acres will be disturbed. Erosion barriers will be maintained at all active portions of the site. Inactive portions of the site will be fully stabilized if work is to cease for a period of greater than two weeks. Construction of the site as detailed below includes all pavement, infrastructure and associated site grading as specified in the approved construction drawings.
- Topsoil, as exists, will be stripped from the work area, stockpiled within the work area and will be seeded and surrounded by a silt fence to prevent erosion of the pile.
- Installation Schedule: Duration of project.

4.8 *Soil Compaction*

- Soil shall be compacted as necessary as specified on certified design plans and details from the design engineer.

- Once finish grading is complete, construction fencing shall be used to prevent traffic from disturbing ground prior to permanent stabilization.

4.9 Storm Drain Inlet

BMP Description: Inlet Protection - Inlet Protection will be installed at the entrance to the existing culvert located within the site that will be subject to stormwater flows from the site during construction. The inlet protection will allow the storm drain inlet to be used before final stabilization. Haybale checkdams and sediment forebays or equivalent will be utilized for the inlet protection.

- Installation Schedule: Sediment traps should be installed prior to clearing and grubbing.
- Maintenance and Inspection: All trapping devices and the structures they protect should be inspected after every rain storm and repairs made as necessary. Sediment should be removed from the trapping devices after the sediment has reached a maximum depth of one-half the depth of the trap. Sediment should be disposed of in a suitable area and protected from erosion by either structural or vegetative means. The hay bales must be replaced as needed.
- Responsible Staff: Site Supervisor

4.10 Constructed Stormwater Conveyance Channels

BMP Description: Temporary Sedimentation Basin for Runoff: The site excavator will manipulate the grade to create a low point within the project work area and direct stormwater within the project site. This will be a simple area of recessed grade with surrounding grades sloped towards the basin for the purpose of water collection during rain events, prevent ponding in other areas of the site under construction operations and eliminate collection of water toward adjacent roads where it may otherwise find its way off site. The proposed conveyance channels will be used as a temporary conveyance measures until final stabilization is achieved. Once the site is stabilized, sediment will be cleaned out of the channels and disposed of in a manner consistent with MA DEP guidelines.

- Installation Schedule: Duration of project.
- Maintenance and Inspection: The site supervisor will inspect grades weekly to determine that water is properly percolating through soil that the basin is maintained and not damaged by other construction activity. No maintenance will be required unless grade is failing to percolate stormwater. The low point shall be periodically cleaned of debris, at least once per month.
- Responsible Staff: Site Supervisor

BMP Description: Grade site to direct runoff towards culvert and away from undisturbed areas of the site.

- Installation Schedule: After installation of sediment basin.
- Maintenance and Inspection: The site supervisor will ensure that grades within the work are maintained to prevent water and runoff from being directed off site or outside the work area. Site supervisor shall walk the perimeter of the work once per week and after any rain event totaling ½" or more of precipitation to ensure that there are no signs of runoff or passage of storm water from the work area to the areas designated to be undisturbed. In the event these conditions are discovered the Site Supervisor shall install measures to redirect runoff within work area – these measure may include re-grading, installation of barriers or berms or repair of existing BMP's
- Responsible Staff: Site Supervisor

4.11 Sediment Basins

BMP Description: Temporary Sedimentation Basin for Runoff: The site excavator will manipulate the grade to create a low point within the project work area and direct stormwater within the project site. This will be a simple area of recessed grade with surrounding grades sloped towards the basin for the purpose of water collection during rain events that will allow for on site infiltration, prevent ponding in other areas of the site under construction operations and eliminate collection of water toward adjacent roads where it may otherwise find its way off site.

- Installation Schedule: Duration of project.
- Maintenance and Inspection: The site supervisor will inspect grades weekly to determine that water is properly percolating through soil that the basin is maintained and not damaged by other construction activity. No maintenance will be required unless grade is failing to percolate stormwater. The low point shall be periodically cleaned of debris, at least once per month.
- Responsible Staff: Site Supervisor

4.12 Chemical Treatment

- No chemical treatment will be used on this project.

4.13 Dewatering Practices

De-watering:

- De-watering is not anticipated at this job site. If necessary, dewatering practices shall conform to the following guidelines:
    - Any water that is pumped and discharged from a trench and/or excavation shall be filtered by an approved method prior to its discharge into a receiving water or drainage system.
    - Under no circumstances shall the Contractor discharge water to wetland resource areas. When constructing near a wetland resource area, the Contractor shall discharge uncontaminated water from dewatering operations directly to the nearest drainage system, stream, or waterway after filtering by an approved method.
    - The pumped water shall be filtered through either: bailed hay, a vegetative filter strip, a vegetative channel or a mechanical tank system to trap sediment occurring as a result of the construction operations. Vegetated channels, if utilized shall be constructed such that the discharge flow rate shall not exceed a velocity of more than 1 foot per second. Accumulated sediment shall be cleared from the channel periodically.

4.14 Other Stormwater Controls

BMP Description: Materials Staging Area – The site supervisor shall designate a materials staging area on site. This area shall be covered with 2" of gravel (this gravel shall be subsequently stripped and can be reused as a base for paving or other construction activities)

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall inspect this area once week to ensure orderly materials storage is confined to the designated area. The site supervisor shall coordinate all materials delivery to ensure proper placement of materials.
- Responsible Staff: Site Supervisor

BMP Description: Install washout area - The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall instruct all washout and cleaning activities to be confined area on the site.

- Installation Schedule: Washout area shall be constructed at the start of grading activities at the site.
- Maintenance and Inspection: The site supervisor shall inspect this area once per week, except during periods of interior painting and drywall/plaster work during which the area will be inspected three times per week. The site supervisor shall coordinate maintenance of this area and shall notify all subcontractors of their responsibilities to confine washing and cleaning activities to the designated area.
- Responsible Staff: Site Supervisor

BMP Description: Refueling/maintenance Rules – The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. This document shall include language that shall specify the maintenance of vehicles on the job site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. Refueling for vehicles or equipment shall occur either within the designated washout area or shall utilize temporary drip protection measures at the location of fueling. The site supervisor or their representative shall be present at the time of any fueling procedure. The site supervisor shall have a fuel spill plan and measures on site to initiate containment and clean-up in the event a fuel spill occurs.

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

BMP Description: Vehicle Washing Rules - The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall include language that shall limit vehicle washing on the job site to be confined within the work area and conducted in a manner to prevent water drainage beyond the specified area of work.

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

BMP Description: Recycling / Waste Area –The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall instruct all waste to be properly distributed to a designated area. The general contractor and site supervisor shall assemble a recycling and waste management area on the site, in the location indicated on the plans, after excavation and preliminary site grading have been completed. This area shall include dumpsters and storage areas for materials recycling and construction waste. Waste and recycling shall be removed from the site on a weekly basis as appropriate to the stage of construction.

- Installation Schedule: Prior to start of Work

- Maintenance and Inspection: The site supervisor shall inspect the waste and recycling area on a daily basis to ensure the proper sorting and disposal of materials. This shall also include evaluation that waste/recycling are confined to the designated area. The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

BMP Description: Construction Vehicle Parking – Construction vehicles shall be parked as far away from wetland resource areas as possible. If parked outside of the work area depicted on the plans, vehicles should not be parked within 100' of wetland resource areas or 200' of perennial streams known to be on the property.

- Responsible Staff: Site Supervisor

4.15 Site Stabilization

Site Stabilization Practice(only use this if you are not located in an arid, semi-arid, or drought-stricken area)

☐ *Vegetative* ☐ *Non-Vegetative*

☒ *Temporary* ☐ *Permanent*

BMP Description: Geotextiles - Geotextiles such as jute netting will be used in combination with other practices such as mulching to stabilize slopes. The following geotextile materials or equivalent are to be utilized for structural and nonstructural controls as shown in the following table.

Practice	Manufacturer	Product	Remarks
Sediment Fence	Amoco	Woven polypropylene 1198 or equivalent	0.425 mm opening
Construction Entrance	Amoco	Woven polypropylene 2002 or equivalent	0.300 mm opening
Outlet Protection	Amoco	Nonwoven polypropylene 4551 or equivalent	0.150 mm opening
Erosion Control (slope stability)	Amoco	Supergrow or equivalent	Erosion control revegetation mix, open polypropylene fiber on degradable polypropylene net scrim

Netting and matting require firm, continuous contact between the materials and the soil. If there is no contact, the material will not hold the soil and erosion will occur underneath the material.

- Installation Schedule: Upon final grading of any slope which exceeds 3H:1V.
- Maintenance and Inspection: In the field, regular inspections should be made to check for cracks, tears, or breaches in the fabric. The appropriate repairs should be made.
- Responsible Staff: Site Supervisor

Site Stabilization Practice (only use this if you are located in an arid, semi-arid, or drought-stricken area)

☐ *Vegetative* ☐ *Non-Vegetative*

☐ *Temporary* ☒ *Permanent*

Description of Practice

- Permanent ground seeding – hydroseeding, winter rye, wildflower & meadow seeding
- See approved landscape plans for details and installation specifications

SECTION 5: POLLUTION PREVENTION STANDARDS

5.1 Potential Sources of Pollution

Potentials sources of sediment to stormwater runoff:

- Clearing, Grading, Excavating and unstabilized areas of the site during construction
- Paving operations
- Material Delivery and Storage
- Landscaping operations

Potential pollutants and sources, other than sediment, to stormwater runoff (Note: None of the following are anticipated to be present in significant measurable quantities, but may be present on the job site from time to time):

- Nutrients – from Construction painting/cleaning, Materials delivery and use. A washout area for cleaning will be established on site to contain any pollutants from being distributed into runoff.
- Heavy Metals – from Concrete washout and waste, Materials delivery and use. A washout area for cleaning will be established on site to contain any pollutants from being distributed into runoff.
- pH – from Concrete washout and waste, Construction painting/clea*ning, Materials deliv*ery and use. A washout area for cleaning will be established on *site to contain any p*ollutants from being distributed into runoff.
- Trash, debris and solids – from all construction activity. A recycling and waste management plan has been developed for the site to address and manage all waste from project related activities.

5.2 Spill Prevention and Response

- The site supervisor or their representative shall be present on the job site at all times during the course of work and shall be present during the delivery, removal of any liquid/chemical materials to or from the job site. They will also be present during any refueling practices. All subcontractors will be notified of their responsibilities in writing. In the event a spill occurs, the site supervisor shall be notified immediately. The site supervisor shall have in place a spill prevention plan and resources to contain and clean up any potential spills in a timely manner.

5.3 Fueling and Maintenance of Equipment or Vehicles

BMP Description: Refueling/maintenance Rules – The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. This document shall include language that shall specify the maintenance of vehicles on the job site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. Refueling for vehicles or equipment shall occur either within the designated washout area or shall utilize temporary drip protection measures at the location of fueling. The site

supervisor or their representative shall be present at the time of any fueling procedure. The site supervisor shall have a fuel spill plan and measures on site to initiate containment and clean-up in the event a fuel spill occurs.

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

5.4 *Washing of Equipment and Vehicles*

BMP Description: Vehicle Washing Rules - The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall include language that shall limit vehicle washing on the job site to be confined within the work area and conducted in a manner to prevent water drainage beyond the specified area of work.

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

5.5 *Storage, Handling, and Disposal of Construction Products, Materials, and Wastes*

BMP Description: Recycling / Waste Area –The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall instruct all waste to be properly distributed to a designated area. The general contractor and site supervisor shall assemble a recycling and waste management area on the site, in the location indicated on the plans, after excavation and preliminary site grading have been completed. This area shall include dumpsters and storage areas for materials recycling and construction waste. Waste and recycling shall be removed from the site on a weekly basis as appropriate to the stage of construction.

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall inspect the waste and recycling area on a daily basis to ensure the proper sorting and disposal of materials. This shall also include evaluation that waste/recycling are confined to the designated area. The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

BMP Description: Materials Staging Area – The site supervisor shall designate a materials staging area on site. This area shall be covered with 2" of gravel (this gravel shall be subsequently stripped and can be reused as a base for paving or other construction activities)

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall inspect this area once week to ensure orderly materials storage is confined to the designated area. The site supervisor shall coordinate all materials delivery to ensure proper placement of materials.
- Responsible Staff: Site Supervisor

5.5.1 *Building Products*

- All building products will be stored in contained areas within the construction site away from the elements. Storage containers will shall be used to protect stored materials. Material storage and stockpiling areas will be surrounded by haybales and silt fencing to prevent erosion.

5.5.2 *Pesticides, Herbicides, Insecticides, Fertilizers, and Landscape Materials*

- Pesticides and herbicides shall be used sparingly. Fertilizers should be restricted to the use of organic fertilizers only.

5.5.3 *Diesel Fuel, Oil, Hydraulic Fluids, Other Petroleum Products, and Other Chemicals*

- Vehicle fueling and maintenance shall occur off-site for the duration of the project.

5.5.4 *Hazardous or Toxic Waste*

- All import of hazardous or toxic materials onto the site shall be limited to those necessary for immediate work. No stockpiling of hazardous or toxic materials shall occur.
- All hazardous materials must be clearly labeled and stored in a locked area.
- A spill prevention and response plan shall be created by the site contractor to ensure that pollutants are not distributed into stormwater runoff.
- All hazardous materials shall be disposed of off-site according to MA DEP and Federal EPA regulations.

5.5.5 *Construction and Domestic Waste*

BMP Description: Recycling / Waste Area –The site supervisor shall produce a written document received by all subcontractors and employees that delineates their responsibilities on site. The site supervisor shall document receipt of these instructions by obtaining the signatures of subcontractors and individuals that may enter the site and the date in which they were notified of their responsibilities. This document shall instruct all waste to be properly distributed to a designated area. The general contractor and site supervisor shall assemble a recycling and waste management area on the site, in the location indicated on the plans, after excavation and preliminary site grading have been completed. This area shall include dumpsters and storage areas for materials recycling and construction waste. Waste and recycling shall be removed from the site on a weekly basis as appropriate to the stage of construction.

- Installation Schedule: Prior to start of Work
- Maintenance and Inspection: The site supervisor shall inspect the waste and recycling area on a daily basis to ensure the proper sorting and disposal of materials. This shall also include evaluation that waste/recycling are confined to the designated area. The site supervisor shall maintain a log of individuals receiving these instructions.
- Responsible Staff: Site Supervisor

5.5.6 *Sanitary Waste*

- Portable sanitary waste facilities shall be kept on site for the duration of the project for use by personnel on site.
- Waste facilities shall be cleaned weekly and emptied as necessary by licensed personnel.

5.6 Washing of Applicators and Containers used for Paint, Concrete or Other Materials

- All equipment used for application of hazardous materials shall be washed off-site.

5.7 Fertilizers

- Use of fertilizers shall be limited to organic fertilizers only.

SECTION 6: INSPECTION AND CORRECTIVE ACTION

6.1 Inspection Personnel and Procedures

Weekly Inspections:

A weekly inspection shall be completed for active areas of the site. These inspections shall continue until final stabilization is achieved. The inspections will be conducted each Thursday of the work week to ensure adequate time is reserved to mitigate any deficiencies prior to the weekend. Weekly inspections shall include any portion of site subject to receiving stormwater runoff from disturbed/active areas. The inspections should be conducted only during suitable weather conditions. See exception under "other inspections."

Other Inspections:

Inspections are also required after each heavy rainfall event defined as any rainfall exceeding ½". The weekly inspection schedule may be adjusted to account for weather deviations to minimize the number of inspections during the course of the week as long as a minimum of one inspection is completed during the course of the work week. i.e. a heavy rainfall may occur over the weekend so an inspection would be required the following Monday regardless of whether an inspection was completed the previous Thursday. If no other rain events occur during the work week, the next inspection would not be required until the following Thursday or subsequent rain event. The inspection schedule should be adjusted accordingly.

- Responsible Staff: Site Supervisor

6.2 Corrective Action

Personnel Responsible for Corrective Actions: Site Supervisor

6.3 Delegation of Authority

Maintenance Procedures: The site supervisor shall perform a routine inspection of the BMP's once every seven days and after any precipitation event in excess of ½". The supervisor shall keep accurate and complete records of inspections, dates of BMP installation and removal, any repair actions required and performed and all associated dates, times and individuals performing associated work.

- See Appendix J

SECTION 7: TRAINING

- See Appendix I

SECTION 8: CERTIFICATION AND NOTIFICATION

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

Name: _____ Title: _____

Signature: _____ Date: _____

- See Appendix G for Subcontractor Certifications

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: _____

Project Title: _____

Operator(s): _____

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: _____

Address: _____

Telephone Number: _____

Type of construction service to be provided: _____

_____

_____

Signature: _____

Title: _____

Date: _____

Stormwater Pollution Prevention Training Log

Project Name:

Project Location:

Instructor's Name(s):

Instructor's Title(s):

Course Location: _____ Date: _____

Course Length (hours): _____

Stormwater Training Topic: *(check as appropriate)*

- ☐ **Sediment and Erosion Controls**
- ☐ **Emergency Procedures**
- ☐ **Stabilization Controls**
- ☐ **Inspections/Corrective Actions**
- ☐ **Pollution Prevention Measures**

Specific Training Objective: _____

_____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		

Delegation of Authority

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

_____ (name of person or position)

_____ (company)

_____ (address)

_____ (city, state, zip)

_____ (phone)

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

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

Name: _____

Company: _____

Title: _____

Signature: _____

Date: _____