Stormwater Management Report

under the
City of Beverly
Stormwater and Construction Site Management Ordinance
(Article XXXII)

Livingstone Avenue Improvements

Assessors Map 9
Lot 370, 371, 372 & 378

7 Porter Terrace
Beverly, MA

March 23, 2018

REVISED: March 28, 2019

Applicant:
7 Porter Terrace, LLC

Submitted to:
City of Beverly Planning Board

Prepared by:
Griffin Engineering
Beverly, MA

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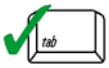
STORMWATER MANAGEMENT CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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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.

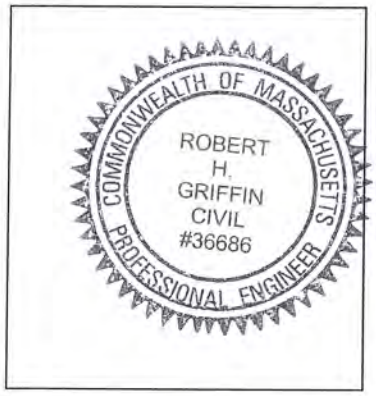
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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



3/28/19

Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

ATTACHMENT A

PROJECT
DESCRIPTION

1.0 INTRODUCTION

This stormwater management report was prepared in support of the proposed residential development at 7 Porter Terrace (Assessors Map 9 Lot 370, 371, 372, & 378) in Beverly, MA. The project consists of improving approximately 400-feet of Livingstone Avenue and constructing three (3) new single-family residences.

According to the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management regulations, the proposed construction is exempt from MassDEP Stormwater Management requirements since the proposed development is a small residential subdivision (four or fewer lots). However, the regulations establish a framework for evaluating stormwater management systems that is used by the City of Beverly in evaluating new development projects. The narrative below compares the proposed construction to the MassDEP Stormwater Management requirements.

1.1 Existing Conditions

The project site consists of four properties totaling approximately 1-acre. The 7 Porter Terrace parcel (Map 9 Lot 378) is currently developed with a single-family residence with associated driveway, landscaping, and utilities, with frontage on Porter Terrace. The three remaining parcels are vacant, containing mature woodlands and scrub vegetation. Livingstone Avenue, an unconstructed private way, exists to the north of these properties. An intermittent stream (drainage channel) and associated Inland Bank wetland resource area exists at the east side of the properties. The project site is predominately surrounded by single-family residential properties. The topography of the site consists of gently sloping terrain, with portions draining toward Porter Terrace, Livingstone Avenue, and the intermittent stream channel.

1.2 Proposed Conditions

The proposed project involves improving approximately 400-feet of Livingstone Avenue with a new 24-foot wide roadway and constructing three (3) new single-family residences with frontage on Livingstone Avenue. The existing residence (#7 Porter Terrace) will remain. The proposed single-family residences consist of modest sized dwellings with associated driveways, utilities, and landscaping. A site plan showing the proposed development and stormwater management features has been separately provided.

The proposed project is considered new development. When complete, there will be an increase of approximately 19,083 square feet of impervious surfaces at the site (an approximately 1,600 square foot reduction in comparison to our December, 2018 plan). The proposed stormwater management system is designed to meet the stormwater management standards to the maximum extent practicable due to site development constraints (i.e. shallow depth to ledge and high groundwater table).

2.0 STORMWATER MANAGEMENT STANDARDS

2.1 Standard 1: No New Untreated Discharges

There is one new drainage discharge associated with the proposed project. Stormwater conveyed to the new outfall will be treated by deep-sump catchbasins and a First Defense vortex separator prior to being discharged to the municipal drainage system in Porter Terrace. The annual average TSS removal for the system was estimated to be 97%.

2.2 Standard 2: Peak Rate Attenuation

Hydrologic modeling was conducted using the HydroCAD computer model. This model uses an approximation of Soil Conservation Service TR-20 methods to calculate runoff rates and volumes based on descriptions of land use, ground characteristics, and size.

The time of concentration (Tc) for each subcatchment was calculated in HydroCAD using a combination of sheet flow and shallow concentrated flow. Sheet flow uses roughness coefficients (Manning's *n*) and watercourse slope to calculate travel time of stormwater runoff for each subcatchment. The site was modeled using a maximum of 100-feet of sheet flow. The shallow concentrated flow method was used to determine the velocity factor along the flow path of the runoff and thereby derive a travel time. The time of concentration of each subcatchment is the combination of these travel times. A minimum time of concentration of 6 minutes was used for all subcatchments, for both existing and proposed conditions.

Stormwater from the proposed development discharges in two directions: 1) south toward Porter Terrace and the intermittent stream and 2) west toward Livingstone Avenue and #121 Livingstone Ave. The intermittent stream location is shown on the project plans.

For calculation purposes, the outfall of the Porter Terrace drain at the Danvers River (behind # 87 & 91 Kernwood Ave) was chosen as the analysis point for the site discharge toward Porter Terrace. The drainage analysis was expanded to include the entire catchment area (approximately 29-acres) tributary to this point in the City's drainage system, which includes portions of Ashton Street, Livingstone Avenue, Harris Street, Leech Street, Porter Terrace, Upland Road, and Kernwood Avenue.

The enclosed drainage calculations indicate that there is a decrease in the post-development peak runoff rates and volumes for the 2-, 10-, 25-, and 100-year, 24-hour storm events from the site towards Livingstone Avenue, and an increase in peak flows and volume at the outfall of the Porter Terrace drain (the HydroCAD drainage calculations for the aforementioned storm events are provided in Attachment C). Comparison of pre- and post-development stormwater runoff calculation results are summarized below in Tables 1 through 4 for the two design points.

Table 1: Comparison of Pre-Development and Post-Development Peak Runoff Rates In Porter Terrace Drain (1)

(at 24" discharge to Danvers River, tidal)

Subcatchment	Storm Frequency			
	2-Year	10-Year	25-Year	100-Year
Pre-Development	3.28	14.59	20.92	28.44
Post-Development	3.71	15.51	22.23	30.29

1. Flow rates measured in cubic feet per second (cfs).

Table 2: Comparison of Pre-Development and Post-Development Peak Runoff Rates Towards Livingstone Ave (1)

Subcatchment	Storm Frequency			
	2-Year	10-Year	25-Year	100-Year
Pre-Development	0.94	1.77	3.22	13.30
Post-Development	0.91	1.50	1.88	9.19

1. Flow rates measured in cubic feet per second (cfs).

Table 3: Comparison of Pre-Development and Post Development Peak Runoff Volume In Porter Terrace Drain (1)

(at 24" discharge to Danvers River, tidal)

Subcatchment	Storm Frequency			
	2-Year	10-Year	25-Year	100-Year
Pre-Development	30,678	91,193	140,355	197,540
Post-Development	34,588	97,718	148,965	208,878

1. Volumes measured in cubic feet (cf).

Table 4: Comparison of Pre-Development and Post Development Peak Runoff Volume Towards Livingstone Ave (1)

Subcatchment	Storm Frequency			
	2-Year	10-Year	25-Year	100-Year
Pre-Development	4,678	8,687	12,241	28,150
Post-Development	2,903	4,865	6,598	20,030

1. Volumes measured in cubic feet (cf).

The increase in post-development peak flow rates and runoff volume shown in Tables 1 and 3, respectively, is due to the increase in tributary area associated with the proposed drainage connection to Porter Terrace, and the inability to install adequate infiltration structures at the site due to on-site soil conditions. There is no municipal drainage system within Livingstone Ave, so runoff from the site was directed to Porter Terrace instead. Directing drainage to Porter Terrace increases stormwater discharges towards Porter Terrace while decreasing discharges towards Livingstone Avenue. The existing drain in Porter Terrace is 18-inch diameter and has a minimum slope of approximately 0.7%. Our expanded drainage analysis shows that this pipe is unable to completely convey peak flows during extreme storm events, as is typical for municipal subdivisions in residential subdivisions. Under existing conditions, catchbasins in Porter Terrace likely surcharge and flow onto the street (instead of flowing from the street into the catchbasin) during the 100-year storm.

Stormwater from the proposed Porter Terrace drainage connection travels through approximately 1,000-feet of drain pipe down Porter Terrace, then southeast along Upland Ave, eventually reaching the Danvers River (tidal). Certain restrictive portions of this drain are proposed to be replaced as part of the proposed project. The drain improvements will increase the capacity of the drainage system by removing existing “bottlenecks” and replacing them with larger diameter pipe. Increasing the capacity of the existing drain in this manner will allow more stormwater to be conveyed to the Ocean during the 100-year storm.

Figure 1 & 2 (Attachment B.9) compare pre- and post-construction conditions of the Porter Terrace drain. The Figures show that existing catchbasin overflows along the roadway are relieved as a result of the proposed pipe improvements. Because the drain pipe ultimately discharges to Land Subject to Coastal Storm Flowage (the tidal Danvers River), and analysis of the Porter Terrace drain (with the proposed improvements) shows that the municipal drainage system can convey the 100-year storm without increasing off-site flooding, Standard 2 is satisfied.

Under pre-construction conditions, during extreme storm events stormwater accumulates around the intermittent stream at the project site, in the Livingstone Avenue right-of way, and on abutting properties. On the project site, ponded water can reach the elevation at which overland flow occurs and thereby carries flow from the intermittent stream to the Livingstone Ave. right of way, eventually reaching Ashton Street. To replicate this condition, which based on the model occurs only during the 25- and 100-year storm events, under post construction conditions, an 18” RCP overflow drain pipe is proposed along the edge of the Livingstone Avenue. This 18” drain will convey stormwater only during the largest storm events when the capacity of the 18” drain in Porter Terrace is exceeded.

2.3 Standard 3: Recharge

Site soils are mapped by the United States Department of Agriculture – Soil Conservation Service (Essex Co. Massachusetts Southern Part Soil Survey, 1984) as being primarily Hollis-Urban Land-Rock Outcrop with a small portion of the property (adjacent to the intermittent stream) being Canton-Urban Land. Based upon observed site conditions and test pits performed at the site, a 'D' hydrologic soil group was assigned to the soils for this analysis.

For D-type soils, the Stormwater Management Guidelines require that a recharge device be provided with a capacity equal to 0.1-inches times the impervious area. The post-development (new) impervious surfaces are approximately 19,083 sf, which yields a minimum design groundwater recharge volume of approximately 159 cf.

Due to soil conditions at the site (i.e. shallow depth to ledge and high groundwater table) only a small portion of the proposed impervious surfaces will be directed towards infiltration devices. Clean roof runoff from the proposed residences on Lots 3 & 4 will each be directed into a 1,000 gallon drywell. The two drywells will infiltrate approximately 400 cf of roof runoff from the proposed residences (see Attachment B.1 for recharge volume calculations). This standard has been met to the maximum extent practicable due to the restrictions inherent in on-site soil conditions.

2.4 Standard 4: Water Quality

The minimum required water quality treatment volume for the proposed residential development is one-half inch times the area of the impervious surfaces. The driveways for the three new lots and a portion of the new roadway will be directed into deep-sump catchbasins and then a First Defense (FD) water quality structure prior to being discharged to the municipal drain in Porter Terrace. The water quality structure was sized to adequately treat the required water quality volume by converting the WQV to the equivalent water quality flow rate. This treatment train has a 97% TSS removal rate. The reader is referred to Water Quality Flow Calculations and TSS Removal Worksheets provided in Attachments B.4, B.6, and B.7.

The first 260 feet of the new roadway (approximately 6,240 sf) adjacent to the existing, improved portion of Livingstone Ave is not proposed to be treated. Capturing and treating runoff from this area was not possible due to topographic constraints and limited land area for installing an appropriate treatment device. The standard has been met to the maximum extent practicable.

As required by the Stormwater Management Standards, a Long-Term Pollution Prevention Plan has been prepared and can be found in Attachment E. In short, the plan identifies suitable practices for source control and pollution prevention measures.

2.5 Standard 5: Land Uses with Higher Potential Pollutant Loads

In accordance with the Stormwater Management Standards, the proposed residential use is not considered a Land Use with Higher Potential Pollutant Loads. Therefore, this

standard does not apply to this project.

2.6 Standard 6: Critical Areas

The site discharge is to the existing municipal drain in Porter Terrace. Therefore, this standard does not apply to this project.

2.7 Standard 7: Redevelopment and Other Projects Subject to the Standards only to the Maximum Extent Practicable

This is not a redevelopment project so this standard does not apply.

2.8 Standard 8: Construction Period Pollution Prevention and Erosion and Sediment Control

The NPDES Construction General Permit requires that a Stormwater Pollution Prevention Plan (SWPPP) be prepared for any project disturbing over 1-acre of land. The proposed project will disturb approximately 1.2-acres of land. In accordance with the Massachusetts Stormwater Management Standards and the General Permit, a SWPPP will be prepared prior to land disturbance commencing. A copy will be provided to the City upon request.

2.9 Standard 9: Operation and Maintenance Plan

An Operations & Maintenance plan has been provided in Attachment F. The owner(s) of the new residences (#100, #106, and #112) are the parties responsible for operation and maintenance of the proposed BMPs.

2.10 Standard 10: Illicit Discharges

The submitted Long-Term Pollution Prevention Plan (Attachment E) specifies measures to prevent illicit discharges from entering the stormwater management system. Source control and response plans are also specified to prevent illicit discharges from being conveyed through the stormwater management system.

Consistent with the Massachusetts Stormwater Handbook, a signed Illicit Discharge Compliance Statement will be finalized prior to discharging stormwater to the post-construction stormwater BMP's. A draft copy of the Illicit Discharge Statement is provided in Attachment G.

3.0 SUMMARY

The proposed drainage system and site development plans for the three-lot residential subdivision conforms to the MassDEP Stormwater Management Regulations to the maximum extent practicable. The proposed replacement of undersized drain pipes in Porter Terrace with larger pipes will alleviate flooding along Porter Terrace and Upland Road. The proposed drainage system will treat and remove TSS and other pollutants throughout the project area and minimize erosion. Proper construction and operation and maintenance of the proposed drainage system are critical to its long-term performance. To that end, an Operations and Maintenance Plan and Long-Term Pollution Prevention Plan have been prepared and will be instituted.

ATTACHMENT B

STORMWATER COMPUTATIONS

B.1 - Recharge Volume & Design Calculations

B.2 - Drawdown Analysis

B.3 - Soil Test Pit Data

B.4 - Water Quality Flow Calculation

B.5 - Structural BMP’s Sizing Calculations

B.6 - TSS Removal Calculation Worksheet

B.7 - TSS Removal Efficiency Curve
(by Hydro International)

B.8 - Rip Rap Discharge Design Calculations

B.9 - Porter Terrace and Upland Rd Drain HGL Profiles

Griffin Engineering Group, LLC
495 Cabot Street, 2nd Floor
Beverly, MA 01915

Phone: 978-927-5111; Fax: 978-927-5103

RECHARGE VOLUME & DESIGN CALCULATIONS

Job Name: 7 Porter Terrace
Job No: 1754
Date 3/27/2019
Designer SSM
Checked By: RHG

IMPERVIOUS AREAS

	Total (sf)
Existing	1,231
Proposed	20,314
Net Increase	19,083

Target Depth Factor:
"D" Type Soils
0.10 inches of runoff

MINIMUM RECHARGE REQUIRED:

For Increase in Impervious Area:
Volume = (19083 sf) x (0.1 in) x (1'/12 in) = 159 cf

For all Impervious Surfaces:
Volume = (20314 sf) x (0.1 in) x (1'/12 in) = 169 cf

DRYWELLS:

Impervious Area Tributary to Drywells =	3,024	sf	
Minimum Volume Req'd (0.1") =	25	cf	
Storage Volume Per 1,000 gal. Drywell*	200	cf	(Static Vol., Incl. Stone) - Per HydroCAD
Provided Recharge Volume (2 Drywells)	400	cf ->	**OK**

**Reference HydroCAD Calcs*

Impervious Area Tributary to Infiltration BMPs:	3,024	sf	
Percentage of Total Impervious Surfaces:	16%		**Required: >65%**
Ratio of Total Impervious Area to Tributary Area:	6.31		
Adjusted Min. Required Recharge Volume:	1068	cf	

TOTAL RECHARGE PROVIDED:
400 = 400 cf **Required: 1068 cf**

Note:

Subject property is comprised primarily of C & D soils and/or shallow depth to bedrock and groundwater.
Standard 3 (recharge) has been met to the maximum extent practicable.

Griffin Engineering Group, LLC
495 Cabot Street, 2nd Floor
Beverly, MA 01915

Phone: 978-927-5111; Fax: 978-927-5103

DRAWDOWN ANALYSIS

Job Name: 7 Porter Terrace
Job No: 1754
Date 3/27/2019
Designer SSM
Checked By: RHG

DRAWDOWN CALCULATION:

Equation: Drawdown = D / IR (hrs)
D = Depth of Water in Structure (in)
IR = Infiltration Rate* (in/hr)

	D	IR*	Drawdown
Drywells	54	1.02	**52.9**

* Rawls Rate for Sandy Loam Used, per soil test data

MassDEP requires drawdown to be less than 72 hours -> **OK**

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-1 **Date:** 4/12/2017 **Time:** 9:45 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 51.3'

Land Use: Lawn **Surface Stones:** None; Exposed Ledge Nearby

Vegetation: Grass **Landform:** Ridges, Hills

Slope(%): 5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	20	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 10	Ap	SL	10 YR 3/2	--	Granular, Friable
10 - 22	Bw	SL	10 YR 4/3	--	Massive, Friable
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 22"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: _____

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: N/A feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-2 **Date:** 4/12/2017 **Time:** 10:00 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 53.5'

Land Use: Lawn **Surface Stones:** None; Exposed Ledge Nearby

Vegetation: Grass **Landform:** Ridges, Hills

Slope(%): 10%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	15	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 6	A	SL	10 YR 3/2	--	Granular, Friable
6 - 12	Bw	SL	10 YR 4/3	--	Massive, Friable
12 - 29	C	FSL	10 YR 4/1	--	Massive, Friable
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 29"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: _____

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: N/A feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-3 **Date:** 4/12/2017 **Time:** 10:15 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 55.4'

Land Use: Woods/Lawn **Surface Stones:** None; Exposed Ledge Nearby

Vegetation: Grass/Woods **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	25	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 6	A	SL	10 YR 3/2	--	Granular, Friable
6 - 16	Bw	SL	10 YR 4/6	--	Massive, Friable
16 - 26	C	LS	10 YR 6/3	--	Massive, Friable
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 26"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: _____

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: N/A feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-4 **Date:** 4/12/2017 **Time:** 10:30 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.1'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 5%

Distance from:

Open Water Body	>100	feet	Drainage Way	90	feet
Possible Wet Area	90	feet	Property Line	50	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 7	A	SL	10 YR 3/2	--	Granular, Friable
7 - 21	Bw	SL	10 YR 4/3	--	Massive, Friable
21 - 34	C1	LS	10 YR 6/3	7.5YR 4/6	Massive, Friable
34 - 44	C2	LS	10 YR 6/3		Heavily Mottled, Dense
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 44"+/-

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 37"

Depth Standing Water in Hole: 37 inches

Estimated Seasonal High Groundwater: 47.9 feet 27"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-5 **Date:** 4/12/2017 **Time:** 10:45 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.0'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	5	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 7	A	SL	10 YR 3/2	--	Granular, Friable
7 - 24	Bw	SL	10 YR 4/3	--	Massive, Friable
24 - 53	C1	LS	10 YR 6/3	7.5YR 4/6	Massive, Friable
53 - 86	C2	LS	10 YR 6/3		Heavily Mottled, Dense
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 86"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: _____

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: 47.4 feet 31"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-6 **Date:** 4/12/2017 **Time:** 11:15 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 47.0'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	45	feet
Drinking Water Well	NA	feet	Other	Dug on side of garbage pit	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders …..)
--	--	--	--	--	--
Test pit dug on side of existing garbage pit; Material consists of organic yard waste and misc. garbage; Bottom of existing pit is ledge (approx. 4' down)					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 48"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: _____

Depth Standing Water in Hole: 48" inches

Estimated Seasonal High Groundwater: _____ feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-7 **Date:** 4/12/2017 **Time:** 11:30 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.1'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	5	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders …..)
0 - 7	Ap	SL	10 YR 3/2	--	Granular, Friable
7 - 16	Bw	SL	10 YR 5/6	--	Massive, Friable
16 - 24	B/C	LS	10 YR 6/3	7.5YR 4/6	Massive, Friable
24 - 35	C1	S	10 YR 6/3		Single Grain, Loose
35 - 46	C2	Gr LS	10 YR 5/2		Heavily Mottled, Dense

Parent Material (geologic): Glacial Till **Depth of Bedrock:** >46"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 46"

Depth Standing Water in Hole: 46" inches

Estimated Seasonal High Groundwater: 47.7 feet 29"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-8 **Date:** 2/23/2018 **Time:** 8:15 **Weather:** 70º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 44.3'

Land Use: Lawn/Woods **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 10	Ap	SL	10 YR 3/2	--	Granular, Friable
10 - 16	Bw	SL	10 YR 5/3	--	Massive, Friable
16 - 48	C1	LS	10 YR 5/3	28"	Massive, Friable
48 - 52	C2	S	10 YR 5/3		Single Grain, Loose
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 38" - 52"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 48"

Depth Standing Water in Hole: 52" inches

Estimated Seasonal High Groundwater: 42.0 feet 28"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-9 **Date:** 2/23/2018 **Time:** 9:00 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 45.2'

Land Use: Lawn/Woods **Surface Stones:** Some Nearby - Fill

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 6	A	SL	10 YR 3/2	--	Granular, Friable
6 - 17	Bw	SL	10 YR 5/3	--	Massive, Friable
17 - 48	C1	LS	11 YR 5/3	--	Massive, Friable
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 50"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 48"

Depth Standing Water in Hole: 48" inches

Estimated Seasonal High Groundwater: >41.2 feet <48"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Attachment B.3

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-10 **Date:** 2/23/2018 **Time:** 9:45 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 49.0'

Land Use: Lawn/Woods **Surface Stones:** Some Nearby - Fill; Exposed Ledge

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 10	A	--	--	--	--
Refusal					Ledge just under topsoil

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 10"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: N/A

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: N/A feet N/A

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-11 **Date:** 2/23/2018 **Time:** 10:30 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 49.7'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-3%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 6	A	SL	10 YR 3/2	--	Granular, Friable
6 - 28	Bw	L		--	Massive, Friable
28 - 40+	C1	LS		30"	Firm in Place, Loose in Hand
No Refusal					B.O.E. @ 72"

Parent Material (geologic): Glacial Till **Depth of Bedrock:** >72"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 72"

Depth Standing Water in Hole: 72" inches

Estimated Seasonal High Groundwater: 47.2 feet 30"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-12 **Date:** 2/23/2018 **Time:** 11:15 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.2'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-3%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 6	A	SL	10 YR 3/2	--	Gran, Fr; Topsoil mostly removed
6 - 20	Bw	SL	10 YR 5/6	--	Massive, Friable
20 - 46	C1	L	10 YR 5/2	24"	Massive, Friable
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 46"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 44"

Depth Standing Water in Hole: 44" inches

Estimated Seasonal High Groundwater: 48.2 feet 24"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-13 **Date:** 2/23/2018 **Time:** 11:45 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.8'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-3%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 10	A	SL	10 YR 3/2	--	Granular, Friable
10 - 17	Bw	SL	10 YR 4/4	--	Massive, Friable
17 - 29	C1	LS	10 YR 5/4	24"	Massive, Friable
29 - 42	C2	S	10 YR 5/4		Loose, Single Grain
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 42"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: N/A

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: 48.8 feet 24"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Attachment B.3

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-14 **Date:** 2/23/2018 **Time:** 12:15 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 51.9'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-3%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 10	A	SL	10 YR 3/2	--	Granular, Friable
10 - 22	Bw	SL	10 YR 5/6	--	Massive, Friable
22 - 32	C1	LS	10 YR 5/3	22"	Massive, Friable
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 32"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: N/A

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: 50.1 feet 22"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-15 **Date:** 2/23/2018 **Time:** 12:45 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 51.7'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-3%

Distance from:

Open Water Body	>100	feet	Drainage Way	45	feet
Possible Wet Area	45	feet	Property Line	in ROW	feet
Drinking Water Well	NA	feet	Other	In 40' R.O.W.	

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
--	--	--	--	--	
Heavily Mottled @ BOE; Gleyed Soil & Peat above					
Refusal @ 54"					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 54"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 36"

Depth Standing Water in Hole: 48" inches

Estimated Seasonal High Groundwater: >48.7 feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-16 **Date:** 2/23/2018 **Time:** 1:15 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.9'

Land Use: Woodland **Surface Stones:** None

Vegetation: N/A; Yard Waste; Garbage **Landform:** Ridges, Hills

Slope(%): 0-3%

Distance from:

Open Water Body	>100	feet	Drainage Way	40	feet
Possible Wet Area	40	feet	Property Line	35	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders …..)
--	--	--	--	--	
Located in pile of yard waste and misc. garbage behind house #5					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 36"+/-

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 36"

Depth Standing Water in Hole: 36" inches

Estimated Seasonal High Groundwater: N/A feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-17 **Date:** 2/23/2018 **Time:** 1:45 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 49.0'

Land Use: Woodland **Surface Stones:** None; Exposed Ledge Nearby

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	70	feet
Possible Wet Area	70	feet	Property Line	10	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 12	A	--	--	--	--
Refusal					Ledge just under topsoil

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 12"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: N/A

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: N/A feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Attachment B.3

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-18 **Date:** 2/23/2018 **Time:** 2:00 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 51.2'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	100	feet
Possible Wet Area	100	feet	Property Line	50	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 8	Ap	SL	10 YR 3/2	--	Granular; Friable
8 - 22	Bw	SL	10 YR 5/6	--	Massive; Friable
22 - 66	C1	LS	10 YR 5/4	24"	Massive; Friable
No Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** >66"

Groundwater Observed: Yes If Yes: Depth of Weeping from Pit: 66"

Depth Standing Water in Hole: 66" inches

Estimated Seasonal High Groundwater: 49.2 feet 24"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-19 **Date:** 2/23/2018 **Time:** 2:30 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 53.0'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	10	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 6	A	--	--	--	--
Refusal					Ledge just under topsoil

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 6"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: N/A

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: N/A feet

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Location Address 7 Porter Terrace

On-site Review

Deep Hole Number: TP-20 **Date:** 2/23/2018 **Time:** 2:45 **Weather:** 30º Clear

Location: (see site plan) **Ground Elevation at Surface of Hole:** 50.8'

Land Use: Woodland **Surface Stones:** None

Vegetation: Mature Trees; Scrub Veg. **Landform:** Ridges, Hills

Slope(%): 0-5%

Distance from:

Open Water Body	>100	feet	Drainage Way	>100	feet
Possible Wet Area	>100	feet	Property Line	40	feet
Drinking Water Well	NA	feet	Other		

DEEP OBSERVATION HOLE LOG

Depth from Surface (inches)	Soil Horizon/ Layer	Soil Texture (USDA)	Soil Color (Munsell)	Redoximorphic Features	Other Other (Structure, Kind & Grade, Consistency, % Gravel, Stones, Boulders .....)
0 - 10	Ap	SL	10 YR 3/2	--	Granular; Friable
10 - 24	Bw	SL		--	Massive; Friable
24 - 60	C1	LS		36"	Massive; Friable; Pockets of Sand
Refusal					

Parent Material (geologic): Glacial Till **Depth of Bedrock:** 60"

Groundwater Observed: No If Yes: Depth of Weeping from Pit: N/A

Depth Standing Water in Hole: N/A inches

Estimated Seasonal High Groundwater: 47.8 feet 36"

Does at least 4-ft of naturally occurring pervious material exist: N/A

Upper Boundary (inches) : N/A Lower Boundary (inches): N/A

Certification

I certify that on ___N/A____ I have passed the soil evaluator examination approved by the Department of Environmental Protection and that the above analysis was performed by me consistent with the required training, expertise, and experience des

Signature _____ Date _____

Griffin Engineering Group, LLC
495 Cabot Street, 2nd Floor
Beverly, MA 01915

Phone: 978-927-5111; Fax: 978-927-5103

WATER QUALITY FLOW CALCULATIONS

Job Name: 7 Porter Terrace
Job No: 1754
Date: 3/27/2019
Designer: SSM
Checked By: RHG

PROPRIETARY SEPARATORS

REQ. WATER QUALITY VOLUME (WQV) DEPTH = 0.5 inch(s) of runoff

Structure Name	Imp. Area (sf)	A ($miles^2$)	t_c (min.)	t_c (hrs.)	qu (csm/in)	Q (cfs)	Proposed Device	Proposed Configuration
WQS#1	7,578	0.00027	9.8	0.163	677	**0.09**	4' FD	Online

Notes:

Q = (qu)(A)(WQV)

where:

Q = flow rate associated with first 0.5-inch(s) of runoff (WQF)
qu = the unit peak discharge in csm/in
A = impervious surface drainage area in square miles
WQV = water quality volume in watershed inches

WQS #1 - FIRST DEFENSE PROPRIETARY SEPARATOR

Internal Bypass Configuration

Bypass Flowrate = 0.70 cfs (Per Manufacturer)
WQF = 0.09 cfs **OK**

Griffin Engineering Group, LLC
495 Cabot Street, 2nd Floor
Beverly, MA 01915

Phone: 978-927-5111; Fax: 978-927-5103

STUCTURAL BMP's SIZING CALCULATIONS

Job Name:	7 Porter Terrace
Job No:	1754
Date	3/27/2019
Designer	SSM
Checked By:	RHG

ROOF DRYWELL

Tributary Imp. Area	1,880	sf	(Proposed Building Roof)
Water Qualtity Volume (WQV)	0.5	inch x impervious area	
Min. Drywell Volume Req'd	78	cf	
Provided Drywell Vol.	200		(Static Vol., Including Stone)
	OK		

INSTRUCTIONS:

Non-automated: Mar. 4, 2008

1. Sheet is nonautomated. Print sheet and complete using hand calculations. Column A and B: See MassDEP Structural BMP Table
2. The calculations must be completed using the Column Headings specified in Chart and Not the Excel Column Headings
3. To complete Chart Column D, multiple Column B value within Row x Column C value within Row
4. To complete Chart Column E value, subtract Column D value within Row from Column C within Row
5. Total TSS Removal = Sum All Values in Column D

Location: Subcatchment P1a

TSS Removal Calculation Worksheet

A BMP[1]	B TSS Removal Rate[1]	C Starting TSS Load*	D Amount Removed (B*C)	E Remaining Load (C-D)
Deep Sump Catchbasin	**25%**	**1.00**	**0.25**	**0.75**
First Defense Proprietary Separator (WQS #1)	**96%**	**0.75**	**0.72**	**0.03**

Total TSS Removal = **97%**

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

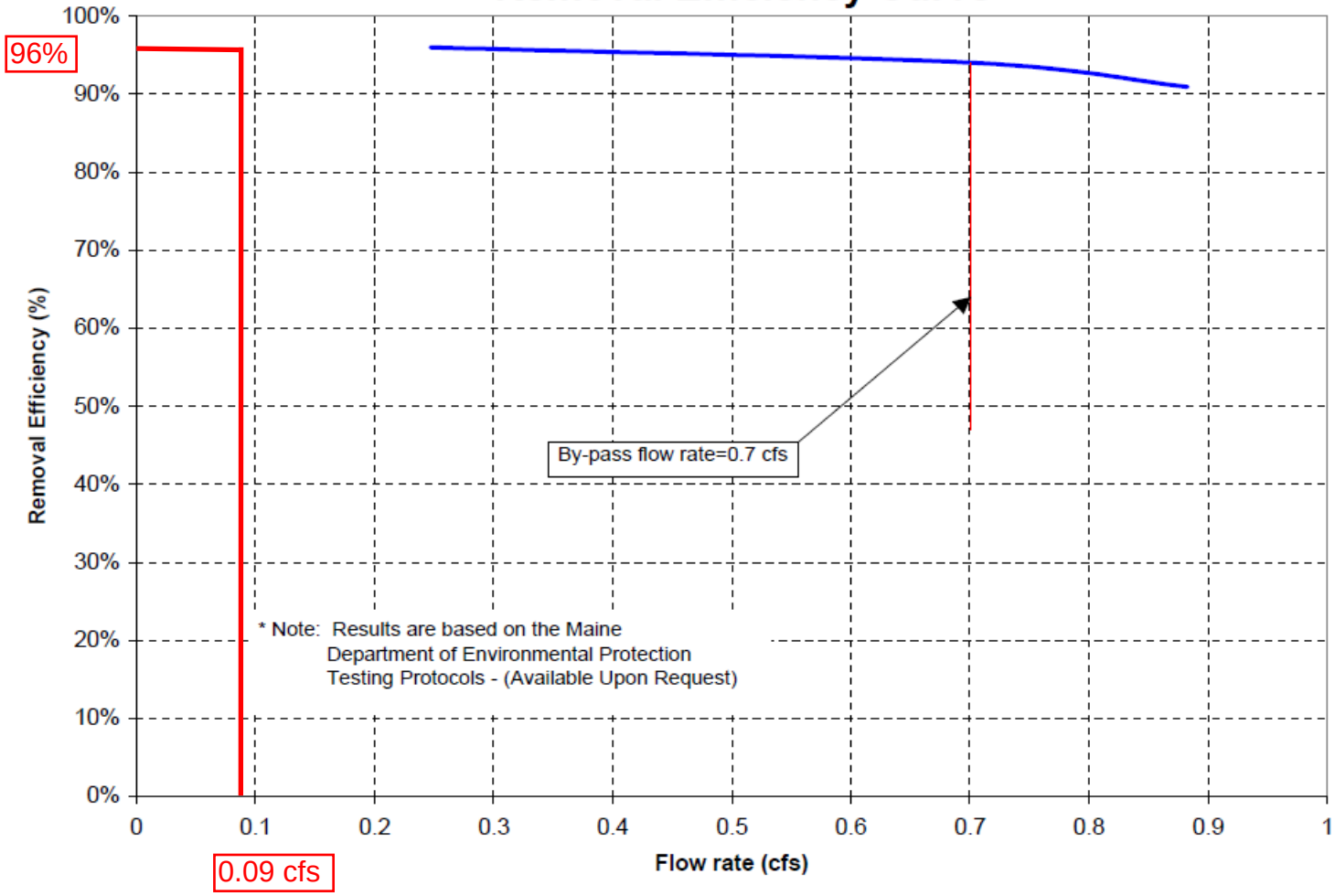
Project: **Livingstone Ave Improvements**

Prepared By: **SSM**

Date: **March, 2019**

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

4-ft Diameter First Defense Removal Efficiency Curve*



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Griffin Engineering Group, LLC
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Beverly, MA 01915

Phone: 978-927-5111; Fax: 978-927-5103

RIP RAP DISCHARGE DESIGN CALCULATIONS

Job Name:	7 Porter Terrace
Job No:	1754
Date	3/27/2019
Designer	SSM
Checked By:	RHG

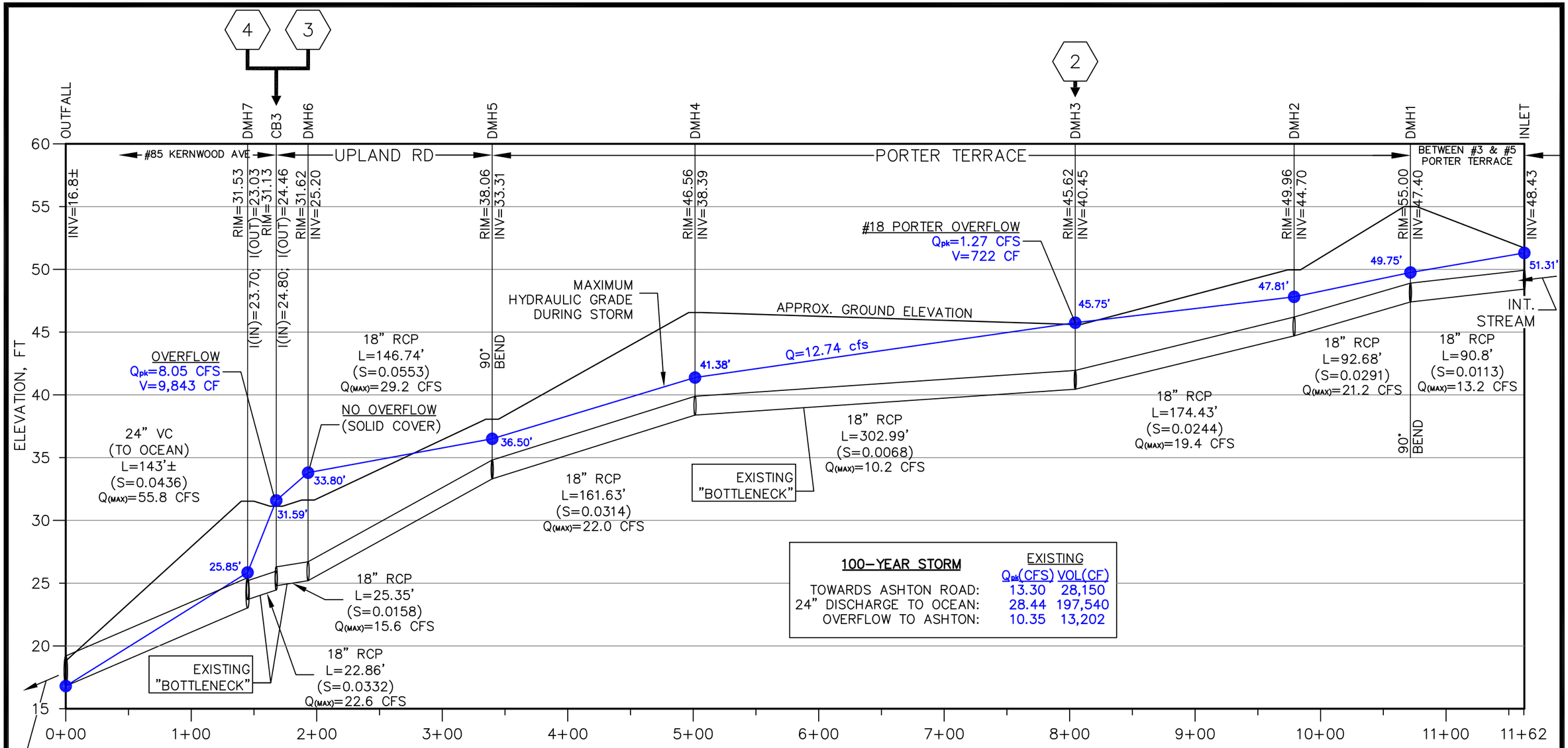
STONE SIZE @ 24" DISCHARGE

Equation d50 = Do x 0.020 x (Do/ TW) x (Q/Do^2.5)^1.33

d50 = Diameter of average Stone Size (ft)
Do = Pipe diameter (ft)
TW = Tailwater depth (ft)
Q= Pipe discharge (cfs)

Do =	2	ft	
TW =	0.8	ft	(use 0.4*Do, min)
Q=	30.3	cfs	(per HydroCAD)
d50=	0.93	ft	
	11.2	in	**(use d50 = 12")**

Max. Stone Size = 1.5 x d50 =	18	in
Min. Thickness = 1.5 x Max =	27	in



100-YEAR STORM	EXISTING Qpk(CFS)	EXISTING VOL(CF)
TOWARDS ASHTON ROAD:	13.30	28,150
24" DISCHARGE TO OCEAN:	28.44	197,540
OVERFLOW TO ASHTON:	10.35	13,202

PORTER TERRACE DRAIN PROFILE

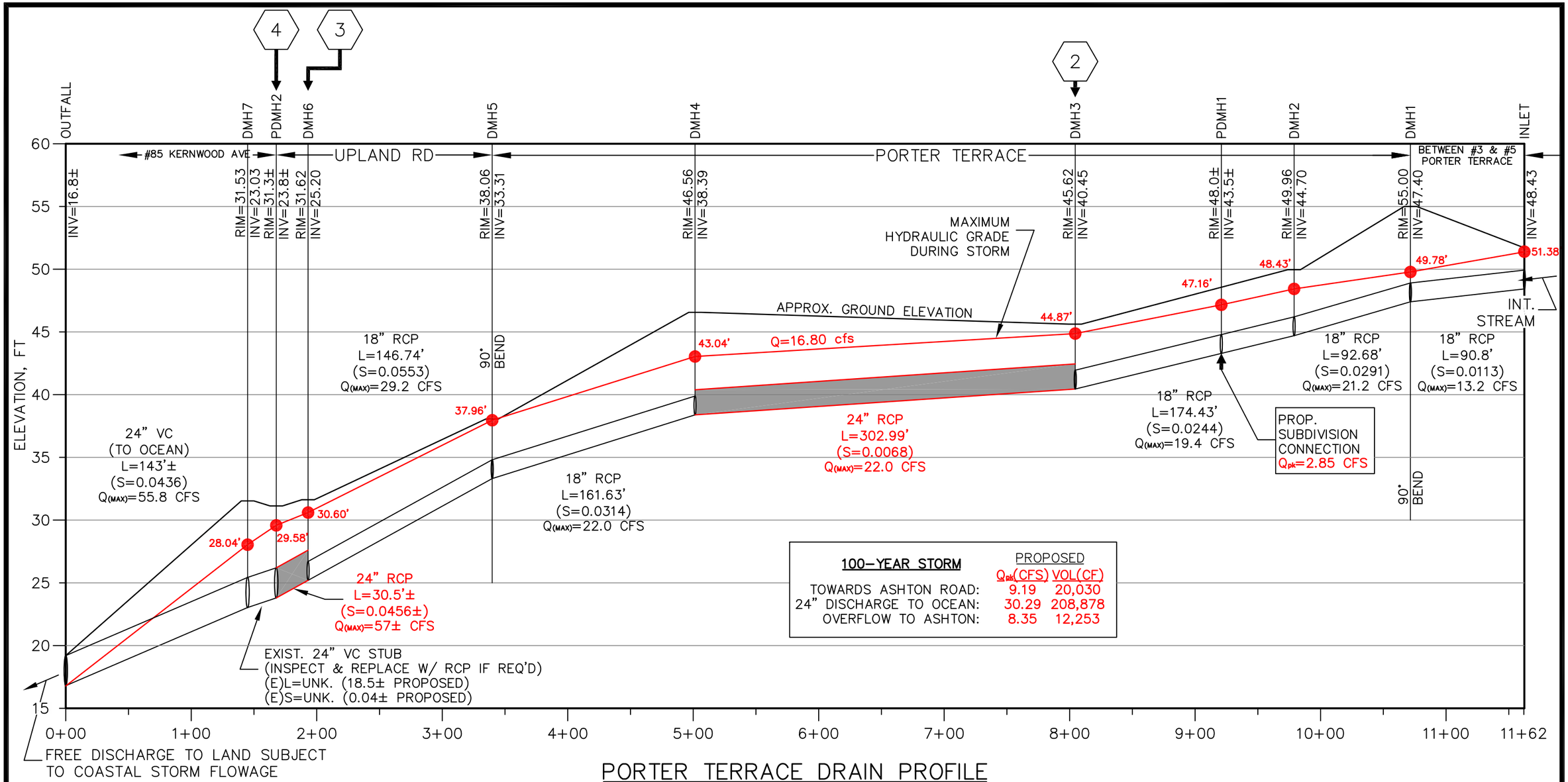
HORIZ.: 1"=80'
VERT.: 1"=8'

4 SUBCATCHMENT (SEE NOTE 2)

EXISTING HYDRAULIC GRADE LINE

NOTE:
1. ELEVATIONS ARE ON THE CITY OF BEVERLY DATUM (BEVERLY DATUM – 6.34' = N.A.V.D. 1988 DATUM).
2. REF. HYDROCAD CALCULATIONS IN STORMWATER REPORT (ATTACHMENT C).

	7 PORTER TERRACE LLC 7 PORTER TERRACE BEVERLY, MA 01915	
Griffin Engineering Group, LLC *Beverly, Massachusetts* *978-927-5111*	PORTER TERRACE – EXISTING DRAIN PROFILE (100-YR STORM) DATE: 3/27/19	Figure 1



PORTER TERRACE DRAIN PROFILE

HORIZ.: 1"=80'
VERT.: 1"=8'

4 SUBCATCHMENT (SEE NOTE 2)

PROPOSED HYDRAULIC GRADE LINE

NOTE:
1. ELEVATIONS ARE ON THE CITY OF BEVERLY DATUM (BEVERLY DATUM – 6.34' = N.A.V.D. 1988 DATUM).
2. REF. HYDROCAD CALCULATIONS IN STORMWATER REPORT (ATTACHMENT C).

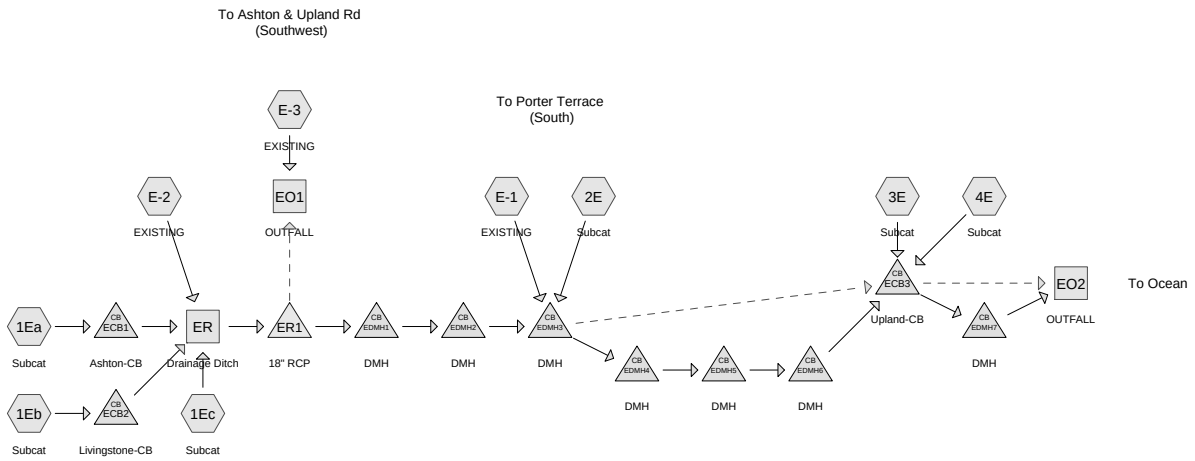
	7 PORTER TERRACE LLC 7 PORTER TERRACE BEVERLY, MA 01915	
Griffin Engineering Group, LLC *Beverly, Massachusetts* *978-927-5111*	PORTER TERRACE – PROPOSED DRAIN PROFILE (100-YR STORM) DATE: 3/27/19	Figure 2

ATTACHMENT C

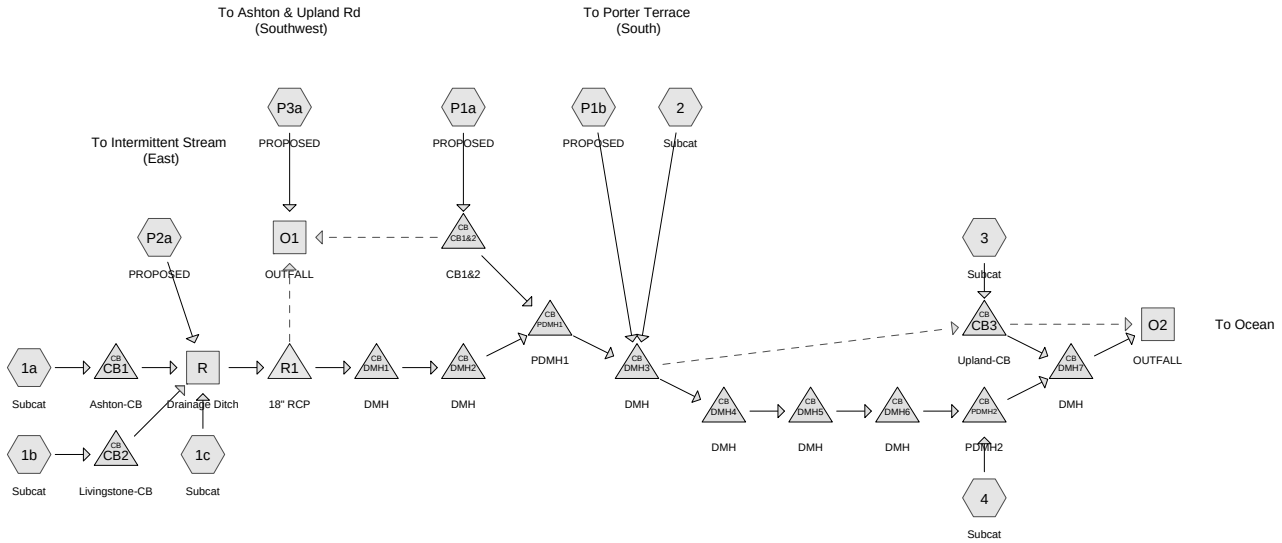
DRAINAGE
CALCULATIONS

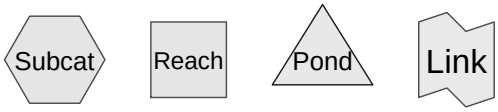
(2-, 10-, 25-, 100-YEAR
STORM EVENTS)

EXISTING



PROPOSED





Routing Diagram for Marks-LivingstoneAve(Rev3)
Prepared by Griffin Engineering Group, LLC
HydroCAD® 10.00 s/n 01316 © 2013 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
2,458,264	57	1/3 acre lots, 30% imp, HSG A (1a, 1b, 1c, 1Ea, 1Eb, 1Ec, 2, 2E, 3, 3E, 4, 4E)
5,174	84	50-75% Grass cover, Fair, HSG D (E-3)
48,134	80	>75% Grass cover, Good, HSG D (E-1, E-2, E-3, P1a, P1b, P2a, P3a)
14,658	98	Pavement (E-1, P1a, P1b, P3a)
933	98	Roofs (E-1)
1,144	98	Roofs - #100 (P1a)
1,880	98	Roofs - #106 (P1a)
1,996	98	Roofs - #112 (P3a)
933	98	Roofs - #7 (P1b)
46,427	79	Woods, Fair, HSG D (E-1, E-2, E-3, P2a)
3,409	82	Woods/grass comb., Fair, HSG D (E-1, E-3)

Summary for Subcatchment 1a: Subcat

Runoff = 0.59 cfs @ 12.43 hrs, Volume= 5,182 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1b: Subcat

Runoff = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1c: Subcat

Runoff = 0.76 cfs @ 12.52 hrs, Volume= 7,134 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 1Ea: Subcat

Runoff = 0.59 cfs @ 12.43 hrs, Volume= 5,182 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1Eb: Subcat

Runoff = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1Ec: Subcat

Runoff = 0.76 cfs @ 12.52 hrs, Volume= 7,134 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 2: Subcat

Runoff = 0.22 cfs @ 12.30 hrs, Volume= 1,747 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

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

Summary for Subcatchment 2E: Subcat

Runoff = 0.22 cfs @ 12.30 hrs, Volume= 1,747 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.6	364	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2					**Direct Entry, (6' Min.)**
6.0	464	Total			

Summary for Subcatchment 3: Subcat

Runoff = 0.57 cfs @ 12.55 hrs, Volume= 5,571 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 3E: Subcat

Runoff = 0.57 cfs @ 12.55 hrs, Volume= 5,571 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 4: Subcat

Runoff = 0.60 cfs @ 12.44 hrs, Volume= 5,244 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment 4E: Subcat

Runoff = 0.60 cfs @ 12.44 hrs, Volume= 5,244 cf, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment E-1: EXISTING

Runoff = 0.32 cfs @ 12.12 hrs, Volume= 1,064 cf, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
	880	79	Woods, Fair, HSG D
*	933	98	Roofs
*	298	98	Pavement
	632	82	Woods/grass comb., Fair, HSG D
	5,616	80	>75% Grass cover, Good, HSG D
	8,359	83	Weighted Average
	7,128		85.27% Pervious Area
	1,231		14.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	86	0.0630	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment E-2: EXISTING

Runoff = 0.27 cfs @ 12.28 hrs, Volume= 1,224 cf, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
10,840	79	Woods, Fair, HSG D
794	80	>75% Grass cover, Good, HSG D
11,634	79	Weighted Average
11,634		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	100	0.0300	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	18	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.9	118	Total			

Summary for Subcatchment E-3: EXISTING

Runoff = 0.94 cfs @ 12.35 hrs, Volume= 4,678 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
5,174	84	50-75% Grass cover, Fair, HSG D
2,777	82	Woods/grass comb., Fair, HSG D
31,951	79	Woods, Fair, HSG D
2,449	80	>75% Grass cover, Good, HSG D
42,351	80	Weighted Average
42,351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.4	163	0.0250	0.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.4	263	Total			

Summary for Subcatchment P1a: PROPOSED

Runoff = 1.10 cfs @ 12.14 hrs, Volume= 3,894 cf, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	7,578	98	Pavement
	13,900	80	>75% Grass cover, Good, HSG D
*	1,880	98	Roofs - #106
	1,144	98	Roofs - #100
	24,502	88	Weighted Average
	13,900		56.73% Pervious Area
	10,602		43.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.8	181	Total			

Summary for Subcatchment P1b: PROPOSED

Runoff = 0.32 cfs @ 12.12 hrs, Volume= 1,079 cf, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	298	98	Pavement
	7,245	80	>75% Grass cover, Good, HSG D
*	933	98	Roofs - #7
	8,476	83	Weighted Average
	7,245		85.48% Pervious Area
	1,231		14.52% Impervious Area

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

Summary for Subcatchment P2a: PROPOSED

Runoff = 0.28 cfs @ 12.26 hrs, Volume= 1,226 cf, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

Area (sf)	CN	Description
8,343	80	>75% Grass cover, Good, HSG D
2,756	79	Woods, Fair, HSG D
11,099	80	Weighted Average
11,099		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	40	0.0450	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
12.3	60	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	11	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.6	111	Total			

Summary for Subcatchment P3a: PROPOSED

Runoff = 0.91 cfs @ 12.10 hrs, Volume= 2,903 cf, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.10"

	Area (sf)	CN	Description
*	6,484	98	Pavement
	9,787	80	>75% Grass cover, Good, HSG D
	1,996	98	Roofs - #112
	18,267	88	Weighted Average
	9,787		53.58% Pervious Area
	8,480		46.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"

Summary for Reach EO1: OUTFALL

Inflow Area = 42,351 sf, 0.00% Impervious, Inflow Depth = 1.33" for 2-Year event
Inflow = 0.94 cfs @ 12.35 hrs, Volume= 4,678 cf
Outflow = 0.94 cfs @ 12.35 hrs, Volume= 4,678 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach EO2: OUTFALL

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 3.28 cfs @ 12.47 hrs, Volume= 30,678 cf
Outflow = 3.28 cfs @ 12.47 hrs, Volume= 30,678 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach ER: Drainage Ditch

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 1.90 cfs @ 12.43 hrs, Volume= 17,051 cf
Outflow = 1.88 cfs @ 12.47 hrs, Volume= 17,051 cf, Atten= 1%, Lag= 2.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.71 fps, Avg. Travel Time= 8.5 min

Peak Storage= 400 cf @ 12.47 hrs
Average Depth at Peak Storage= 0.33'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Reach O1: OUTFALL

Inflow Area = 18,267 sf, 46.42% Impervious, Inflow Depth = 1.91" for 2-Year event
Inflow = 0.91 cfs @ 12.10 hrs, Volume= 2,903 cf
Outflow = 0.91 cfs @ 12.10 hrs, Volume= 2,903 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach O2: OUTFALL

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 0.33" for 2-Year event
Inflow = 3.71 cfs @ 12.44 hrs, Volume= 34,588 cf
Outflow = 3.71 cfs @ 12.44 hrs, Volume= 34,588 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach R: Drainage Ditch

Inflow Area = 696,340 sf, 29.52% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 1.89 cfs @ 12.42 hrs, Volume= 17,054 cf
Outflow = 1.87 cfs @ 12.47 hrs, Volume= 17,054 cf, Atten= 1%, Lag= 2.5 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 1.69 fps, Min. Travel Time= 3.6 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 8.6 min

Peak Storage= 399 cf @ 12.47 hrs
Average Depth at Peak Storage= 0.33'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Pond CB1: Ashton-CB

Inflow Area =	224,344 sf, 30.00% Impervious, Inflow Depth = 0.28" for 2-Year event				
Inflow =	0.59 cfs @	12.43 hrs, Volume=	5,182 cf		
Outflow =	0.59 cfs @	12.43 hrs, Volume=	5,182 cf, Atten= 0%, Lag= 0.0 min		
Primary =	0.59 cfs @	12.43 hrs, Volume=	5,182 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 56.34' @ 12.43 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.59 cfs @ 12.43 hrs HW=56.34' TW=50.33' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.59 cfs @ 1.98 fps)

Summary for Pond CB1&2: CB1&2

Inflow Area =	24,502 sf, 43.27% Impervious, Inflow Depth = 1.91" for 2-Year event				
Inflow =	1.10 cfs @	12.14 hrs, Volume=	3,894 cf		
Outflow =	1.10 cfs @	12.14 hrs, Volume=	3,894 cf, Atten= 0%, Lag= 0.0 min		
Primary =	1.10 cfs @	12.14 hrs, Volume=	3,894 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 45.24' @ 12.14 hrs
Flood Elev= 49.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 230.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 43.50' S= 0.0039 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.10 cfs @ 12.14 hrs HW=45.24' TW=44.04' (Dynamic Tailwater)
└─**1=Culvert** (Barrel Controls 1.10 cfs @ 2.12 fps)

Summary for Pond CB2: Livingstone-CB

Inflow Area = 152,058 sf, 30.00% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf
Outflow = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 53.33' @ 12.30 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.44 cfs @ 12.30 hrs HW=53.33' TW=50.29' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.44 cfs @ 1.95 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.00' TW=50.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond CB3: Upland-CB

Inflow Area = 241,195 sf, 30.00% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 0.57 cfs @ 12.55 hrs, Volume= 5,571 cf
Outflow = 0.57 cfs @ 12.55 hrs, Volume= 5,571 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.57 cfs @ 12.55 hrs, Volume= 5,571 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.79' @ 12.55 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.03' S= 0.0715 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.57 cfs @ 12.55 hrs HW=24.79' TW=23.81' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 0.57 cfs @ 1.96 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.46' TW=0.00' (Dynamic Tailwater)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH1: DMH

Inflow Area =	696,340 sf, 29.52% Impervious, Inflow Depth = 0.29" for 2-Year event				
Inflow	=	1.87 cfs @	12.47 hrs, Volume=	17,052 cf	
Outflow	=	1.87 cfs @	12.47 hrs, Volume=	17,052 cf, Atten= 0%, Lag= 0.0 min	
Primary	=	1.87 cfs @	12.47 hrs, Volume=	17,052 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 48.02' @ 12.47 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round Culvert** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=1.87 cfs @ 12.47 hrs HW=48.02' TW=45.32' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 1.87 cfs @ 2.69 fps)

Summary for Pond DMH2: DMH

Inflow Area =	696,340 sf, 29.52% Impervious, Inflow Depth = 0.29" for 2-Year event				
Inflow	=	1.87 cfs @	12.47 hrs, Volume=	17,052 cf	
Outflow	=	1.87 cfs @	12.47 hrs, Volume=	17,052 cf, Atten= 0%, Lag= 0.0 min	
Primary	=	1.87 cfs @	12.47 hrs, Volume=	17,052 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 45.32' @ 12.47 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round Culvert** L= 53.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 43.50' S= 0.0223 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=1.87 cfs @ 12.47 hrs HW=45.32' TW=44.19' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 1.87 cfs @ 2.69 fps)

Summary for Pond DMH3: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.35" for 2-Year event
Inflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf
Outflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.13' @ 12.40 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**24.0" Round Prop. RCP_Round 24"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.63 cfs @ 12.40 hrs HW=41.13' TW=39.14' (Dynamic Tailwater)
└─**1=Prop. RCP_Round 24"** (Inlet Controls 2.63 cfs @ 2.80 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH4: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.35" for 2-Year event
Inflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf
Outflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 39.14' @ 12.40 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round Culvert** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.63 cfs @ 12.40 hrs HW=39.14' TW=34.06' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.63 cfs @ 2.96 fps)

Summary for Pond DMH5: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.35" for 2-Year event
Inflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf
Outflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 34.06' @ 12.40 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round Culvert** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.63 cfs @ 12.40 hrs HW=34.06' TW=25.88' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 2.63 cfs @ 2.96 fps)

Summary for Pond DMH6: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.35" for 2-Year event
Inflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf
Outflow = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.63 cfs @ 12.40 hrs, Volume= 23,773 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.88' @ 12.40 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**24.0" Round Culvert (Prop. 24")** L= 30.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 23.80' S= 0.0456 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=2.63 cfs @ 12.40 hrs HW=25.88' TW=24.47' (Dynamic Tailwater)
└**1=Culvert (Prop. 24")** (Inlet Controls 2.63 cfs @ 2.80 fps)

Summary for Pond DMH7: DMH

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 0.33" for 2-Year event
Inflow = 3.71 cfs @ 12.44 hrs, Volume= 34,588 cf
Outflow = 3.71 cfs @ 12.44 hrs, Volume= 34,588 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.71 cfs @ 12.44 hrs, Volume= 34,588 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 23.85' @ 12.44 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=3.71 cfs @ 12.44 hrs HW=23.85' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.71 cfs @ 3.08 fps)

Summary for Pond ECB1: Ashton-CB

Inflow Area = 224,344 sf, 30.00% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 0.59 cfs @ 12.43 hrs, Volume= 5,182 cf
Outflow = 0.59 cfs @ 12.43 hrs, Volume= 5,182 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.59 cfs @ 12.43 hrs, Volume= 5,182 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 56.34' @ 12.43 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.59 cfs @ 12.43 hrs HW=56.34' TW=50.33' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.59 cfs @ 1.98 fps)

Summary for Pond ECB2: Livingstone-CB

Inflow Area = 152,058 sf, 30.00% Impervious, Inflow Depth = 0.28" for 2-Year event
Inflow = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf
Outflow = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.44 cfs @ 12.30 hrs, Volume= 3,512 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 53.33' @ 12.30 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.44 cfs @ 12.30 hrs HW=53.33' TW=50.28' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.44 cfs @ 1.95 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.00' TW=50.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond ECB3: Upland-CB

Inflow Area =	1,249,125 sf,	29.62% Impervious,	Inflow Depth =	0.29"	for 2-Year event
Inflow =	3.28 cfs @	12.47 hrs,	Volume=	30,678 cf	
Outflow =	3.28 cfs @	12.47 hrs,	Volume=	30,678 cf,	Atten= 0%, Lag= 0.0 min
Primary =	3.28 cfs @	12.47 hrs,	Volume=	30,678 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.32' @ 12.47 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round RCP_Round 18"** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.70' S= 0.0380 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=3.28 cfs @ 12.47 hrs HW=25.32' TW=23.79' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 3.28 cfs @ 3.15 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.46' TW=0.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond EDMH1: DMH

Inflow Area =	696,875 sf,	29.50% Impervious,	Inflow Depth =	0.29"	for 2-Year event
Inflow =	1.87 cfs @	12.48 hrs,	Volume=	17,051 cf	
Outflow =	1.87 cfs @	12.48 hrs,	Volume=	17,051 cf,	Atten= 0%, Lag= 0.0 min
Primary =	1.87 cfs @	12.48 hrs,	Volume=	17,051 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 48.02' @ 12.48 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round RCP_Round 18"** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=1.87 cfs @ 12.48 hrs HW=48.02' TW=45.32' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 1.87 cfs @ 2.69 fps)

Summary for Pond EDMH2: DMH

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 1.87 cfs @ 12.48 hrs, Volume= 17,051 cf
Outflow = 1.87 cfs @ 12.48 hrs, Volume= 17,051 cf, Atten= 0%, Lag= 0.0 min
Primary = 1.87 cfs @ 12.48 hrs, Volume= 17,051 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 45.32' @ 12.48 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round RCP_Round 18"** L= 171.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 40.45' S= 0.0248 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=1.87 cfs @ 12.48 hrs HW=45.32' TW=41.12' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 1.87 cfs @ 2.69 fps)

Summary for Pond EDMH3: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf
Outflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.12' @ 12.45 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**18.0" Round RCP_Round 18"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.15 cfs @ 12.45 hrs HW=41.12' TW=39.06' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 2.15 cfs @ 2.80 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond EDMH4: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf
Outflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 39.06' @ 12.45 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round RCP_Round 18"** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.15 cfs @ 12.45 hrs HW=39.06' TW=33.98' (Dynamic Tailwater)
└**1=RCP_Round 18"** (Inlet Controls 2.15 cfs @ 2.80 fps)

Summary for Pond EDMH5: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf
Outflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 33.98' @ 12.45 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round RCP_Round 18"** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.15 cfs @ 12.45 hrs HW=33.98' TW=25.87' (Dynamic Tailwater)
└**1=RCP_Round 18"** (Inlet Controls 2.15 cfs @ 2.80 fps)

Summary for Pond EDMH6: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.31" for 2-Year event
Inflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf
Outflow = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.15 cfs @ 12.45 hrs, Volume= 19,862 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.87' @ 12.45 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**18.0" Round RCP_Round 18"** L= 22.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 24.80' S= 0.0178 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.15 cfs @ 12.45 hrs HW=25.87' TW=25.31' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 2.15 cfs @ 2.80 fps)

Summary for Pond EDMH7: DMH

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 3.28 cfs @ 12.47 hrs, Volume= 30,678 cf
Outflow = 3.28 cfs @ 12.47 hrs, Volume= 30,678 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.28 cfs @ 12.47 hrs, Volume= 30,678 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 23.79' @ 12.47 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=3.28 cfs @ 12.47 hrs HW=23.79' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.28 cfs @ 2.97 fps)

Summary for Pond ER1: 18" RCP

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 0.29" for 2-Year event
Inflow = 1.88 cfs @ 12.47 hrs, Volume= 17,051 cf
Outflow = 1.87 cfs @ 12.48 hrs, Volume= 17,051 cf, Atten= 0%, Lag= 0.9 min
Primary = 1.87 cfs @ 12.48 hrs, Volume= 17,051 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.05' @ 12.48 hrs Surf.Area= 303 sf Storage= 15 cf
Flood Elev= 50.00' Surf.Area= 1,453 sf Storage= 845 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (953.3 - 953.3)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	18,875 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	237	0	0
50.00	1,453	845	845
51.00	7,939	4,696	5,541
52.00	18,728	13,334	18,875

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	50.90'	**15.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=1.87 cfs @ 12.48 hrs HW=49.05' TW=48.02' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.87 cfs @ 2.69 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=49.00' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PDMH1: PDMH1

Inflow Area = 720,842 sf, 29.99% Impervious, Inflow Depth = 0.35" for 2-Year event
Inflow = 2.30 cfs @ 12.42 hrs, Volume= 20,946 cf
Outflow = 2.30 cfs @ 12.42 hrs, Volume= 20,946 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.30 cfs @ 12.42 hrs, Volume= 20,946 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 44.20' @ 12.42 hrs
Flood Elev= 48.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**18.0" Round Culvert** L= 112.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 43.50' / 40.45' S= 0.0272 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=2.30 cfs @ 12.42 hrs HW=44.20' TW=41.13' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.30 cfs @ 2.85 fps)

Summary for Pond PDMH2: PDMH2

Inflow Area = 1,032,014 sf, 29.87% Impervious, Inflow Depth = 0.34" for 2-Year event
Inflow = 3.22 cfs @ 12.41 hrs, Volume= 29,017 cf
Outflow = 3.22 cfs @ 12.41 hrs, Volume= 29,017 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.22 cfs @ 12.41 hrs, Volume= 29,017 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.47' @ 12.42 hrs
Flood Elev= 31.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.80'	**24.0" Round Culvert** L= 18.8' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 23.80' / 23.03' S= 0.0410 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=3.21 cfs @ 12.41 hrs HW=24.47' TW=23.84' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 3.21 cfs @ 5.14 fps)

Summary for Pond R1: 18" RCP

Inflow Area =	696,340 sf,	29.52% Impervious,	Inflow Depth =	0.29"	for 2-Year event
Inflow =	1.87 cfs @	12.47 hrs,	Volume=	17,054 cf	
Outflow =	1.87 cfs @	12.47 hrs,	Volume=	17,052 cf,	Atten= 0%, Lag= 0.3 min
Primary =	1.87 cfs @	12.47 hrs,	Volume=	17,052 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.05' @ 12.47 hrs Surf.Area= 91 sf Storage= 9 cf
Flood Elev= 50.00' Surf.Area= 1,500 sf Storage= 761 cf

Plug-Flow detention time= 0.3 min calculated for 17,052 cf (100% of inflow)
Center-of-Mass det. time= 0.1 min (953.1 - 953.0)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	18,931 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	2	0	0
49.00	10	6	6
50.00	1,500	755	761
51.00	8,800	5,150	5,911
52.00	17,240	13,020	18,931

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	49.50'	**18.0" Round Culvert** L= 235.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 49.50' / 48.50' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	50.90'	**10.0' 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=1.87 cfs @ 12.47 hrs HW=49.05' TW=48.02' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 1.87 cfs @ 2.69 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Subcatchment 1a: Subcat

Runoff = 3.05 cfs @ 12.24 hrs, Volume= 15,878 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1b: Subcat

Runoff = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1c: Subcat

Runoff = 3.71 cfs @ 12.35 hrs, Volume= 21,858 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 1Ea: Subcat

Runoff = 3.05 cfs @ 12.24 hrs, Volume= 15,878 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1Eb: Subcat

Runoff = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1Ec: Subcat

Runoff = 3.71 cfs @ 12.35 hrs, Volume= 21,858 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 2: Subcat

Runoff = 1.35 cfs @ 12.11 hrs, Volume= 5,354 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

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

Summary for Subcatchment 2E: Subcat

Runoff = 1.35 cfs @ 12.11 hrs, Volume= 5,354 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.6	364	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2					**Direct Entry, (6' Min.)**
6.0	464	Total			

Summary for Subcatchment 3: Subcat

Runoff = 2.76 cfs @ 12.40 hrs, Volume= 17,071 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 3E: Subcat

Runoff = 2.76 cfs @ 12.40 hrs, Volume= 17,071 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 4: Subcat

Runoff = 3.03 cfs @ 12.26 hrs, Volume= 16,069 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment 4E: Subcat

Runoff = 3.03 cfs @ 12.26 hrs, Volume= 16,069 cf, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment E-1: EXISTING

Runoff = 0.57 cfs @ 12.12 hrs, Volume= 1,899 cf, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
	880	79	Woods, Fair, HSG D
*	933	98	Roofs
*	298	98	Pavement
	632	82	Woods/grass comb., Fair, HSG D
	5,616	80	>75% Grass cover, Good, HSG D
	8,359	83	Weighted Average
	7,128		85.27% Pervious Area
	1,231		14.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	86	0.0630	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment E-2: EXISTING

Runoff = 0.51 cfs @ 12.26 hrs, Volume= 2,304 cf, Depth= 2.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
10,840	79	Woods, Fair, HSG D
794	80	>75% Grass cover, Good, HSG D
11,634	79	Weighted Average
11,634		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	100	0.0300	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	18	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.9	118	Total			

Summary for Subcatchment E-3: EXISTING

Runoff = 1.77 cfs @ 12.32 hrs, Volume= 8,687 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
5,174	84	50-75% Grass cover, Fair, HSG D
2,777	82	Woods/grass comb., Fair, HSG D
31,951	79	Woods, Fair, HSG D
2,449	80	>75% Grass cover, Good, HSG D
42,351	80	Weighted Average
42,351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.4	163	0.0250	0.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.4	263	Total			

Summary for Subcatchment P1a: PROPOSED

Runoff = 1.82 cfs @ 12.14 hrs, Volume= 6,526 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	7,578	98	Pavement
	13,900	80	>75% Grass cover, Good, HSG D
*	1,880	98	Roofs - #106
	1,144	98	Roofs - #100
	24,502	88	Weighted Average
	13,900		56.73% Pervious Area
	10,602		43.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.8	181	Total			

Summary for Subcatchment P1b: PROPOSED

Runoff = 0.58 cfs @ 12.12 hrs, Volume= 1,925 cf, Depth= 2.73"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	298	98	Pavement
	7,245	80	>75% Grass cover, Good, HSG D
*	933	98	Roofs - #7
	8,476	83	Weighted Average
	7,245		85.48% Pervious Area
	1,231		14.52% Impervious Area

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

Summary for Subcatchment P2a: PROPOSED

Runoff = 0.52 cfs @ 12.24 hrs, Volume= 2,277 cf, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

Area (sf)	CN	Description
8,343	80	>75% Grass cover, Good, HSG D
2,756	79	Woods, Fair, HSG D
11,099	80	Weighted Average
11,099		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	40	0.0450	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
12.3	60	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	11	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.6	111	Total			

Summary for Subcatchment P3a: PROPOSED

Runoff = 1.50 cfs @ 12.10 hrs, Volume= 4,865 cf, Depth= 3.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.50"

	Area (sf)	CN	Description
*	6,484	98	Pavement
	9,787	80	>75% Grass cover, Good, HSG D
	1,996	98	Roofs - #112
	18,267	88	Weighted Average
	9,787		53.58% Pervious Area
	8,480		46.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"

Summary for Reach EO1: OUTFALL

Inflow Area = 42,351 sf, 0.00% Impervious, Inflow Depth = 2.46" for 10-Year event
Inflow = 1.77 cfs @ 12.32 hrs, Volume= 8,687 cf
Outflow = 1.77 cfs @ 12.32 hrs, Volume= 8,687 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach EO2: OUTFALL

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 0.88" for 10-Year event
Inflow = 14.59 cfs @ 12.35 hrs, Volume= 91,193 cf
Outflow = 14.59 cfs @ 12.35 hrs, Volume= 91,193 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach ER: Drainage Ditch

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 0.87" for 10-Year event
Inflow = 8.71 cfs @ 12.28 hrs, Volume= 50,802 cf
Outflow = 8.65 cfs @ 12.31 hrs, Volume= 50,802 cf, Atten= 1%, Lag= 1.8 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.76 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 6.5 min

Peak Storage= 1,128 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.82'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Reach O1: OUTFALL

Inflow Area = 18,267 sf, 46.42% Impervious, Inflow Depth = 3.20" for 10-Year event
Inflow = 1.50 cfs @ 12.10 hrs, Volume= 4,865 cf
Outflow = 1.50 cfs @ 12.10 hrs, Volume= 4,865 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach O2: OUTFALL

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 0.92" for 10-Year event
Inflow = 15.51 cfs @ 12.33 hrs, Volume= 97,718 cf
Outflow = 15.51 cfs @ 12.33 hrs, Volume= 97,718 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach R: Drainage Ditch

Inflow Area = 696,340 sf, 29.52% Impervious, Inflow Depth = 0.87" for 10-Year event
Inflow = 8.71 cfs @ 12.28 hrs, Volume= 50,775 cf
Outflow = 8.65 cfs @ 12.31 hrs, Volume= 50,775 cf, Atten= 1%, Lag= 1.7 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.76 fps, Min. Travel Time= 2.2 min
Avg. Velocity = 0.91 fps, Avg. Travel Time= 6.6 min

Peak Storage= 1,128 cf @ 12.31 hrs
Average Depth at Peak Storage= 0.82'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Pond CB1: Ashton-CB

Inflow Area =	224,344 sf, 30.00% Impervious, Inflow Depth = 0.85" for 10-Year event				
Inflow =	3.05 cfs @	12.24 hrs, Volume=	15,878 cf		
Outflow =	3.05 cfs @	12.24 hrs, Volume=	15,878 cf, Atten= 0%, Lag= 0.0 min		
Primary =	3.05 cfs @	12.24 hrs, Volume=	15,878 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 56.82' @ 12.24 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=3.05 cfs @ 12.24 hrs HW=56.82' TW=50.80' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.05 cfs @ 3.08 fps)

Summary for Pond CB1&2: CB1&2

Inflow Area =	24,502 sf, 43.27% Impervious, Inflow Depth = 3.20" for 10-Year event				
Inflow =	1.82 cfs @	12.14 hrs, Volume=	6,526 cf		
Outflow =	1.82 cfs @	12.14 hrs, Volume=	6,526 cf, Atten= 0%, Lag= 0.0 min		
Primary =	1.82 cfs @	12.14 hrs, Volume=	6,526 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 46.42' @ 12.15 hrs
Flood Elev= 49.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 230.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 43.50' S= 0.0039 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.79 cfs @ 12.14 hrs HW=46.37' TW=44.87' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 1.79 cfs @ 2.28 fps)

Summary for Pond CB2: Livingstone-CB

Inflow Area = 152,058 sf, 30.00% Impervious, Inflow Depth = 0.85" for 10-Year event
Inflow = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf
Outflow = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 54.02' @ 12.11 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.72 cfs @ 12.11 hrs HW=54.02' TW=50.59' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.72 cfs @ 3.46 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.00' TW=50.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond CB3: Upland-CB

Inflow Area = 241,195 sf, 30.00% Impervious, Inflow Depth = 0.85" for 10-Year event
Inflow = 2.76 cfs @ 12.40 hrs, Volume= 17,071 cf
Outflow = 2.76 cfs @ 12.40 hrs, Volume= 17,071 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.76 cfs @ 12.40 hrs, Volume= 17,071 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.39' @ 12.36 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.03' S= 0.0715 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.80 cfs @ 12.40 hrs HW=25.38' TW=25.04' (Dynamic Tailwater)
└**1=Culvert** (Outlet Controls 2.80 cfs @ 3.51 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.46' TW=0.00' (Dynamic Tailwater)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH1: DMH

Inflow Area =	696,340 sf, 29.52% Impervious, Inflow Depth = 0.87" for 10-Year event				
Inflow =	8.18 cfs @	12.40 hrs, Volume=	50,773 cf		
Outflow =	8.18 cfs @	12.40 hrs, Volume=	50,773 cf, Atten= 0%, Lag= 0.0 min		
Primary =	8.18 cfs @	12.40 hrs, Volume=	50,773 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.07' @ 12.40 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round Culvert** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=8.18 cfs @ 12.40 hrs HW=49.07' TW=46.37' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 8.18 cfs @ 4.63 fps)

Summary for Pond DMH2: DMH

Inflow Area =	696,340 sf, 29.52% Impervious, Inflow Depth = 0.87" for 10-Year event				
Inflow =	8.18 cfs @	12.40 hrs, Volume=	50,773 cf		
Outflow =	8.18 cfs @	12.40 hrs, Volume=	50,773 cf, Atten= 0%, Lag= 0.0 min		
Primary =	8.18 cfs @	12.40 hrs, Volume=	50,773 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 46.37' @ 12.40 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round Culvert** L= 53.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 43.50' S= 0.0223 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=8.18 cfs @ 12.40 hrs HW=46.37' TW=45.36' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 8.18 cfs @ 4.63 fps)

Summary for Pond DMH3: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.96" for 10-Year event
Inflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf
Outflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.06' @ 12.33 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**24.0" Round Prop. RCP_Round 24"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=10.04 cfs @ 12.33 hrs HW=42.06' TW=40.53' (Dynamic Tailwater)
└─**1=Prop. RCP_Round 24"** (Outlet Controls 10.04 cfs @ 5.07 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH4: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.96" for 10-Year event
Inflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf
Outflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 40.53' @ 12.33 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round Culvert** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.04 cfs @ 12.33 hrs HW=40.53' TW=35.45' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 10.04 cfs @ 5.68 fps)

Summary for Pond DMH5: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.96" for 10-Year event
Inflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf
Outflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 35.45' @ 12.33 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round Culvert** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.04 cfs @ 12.33 hrs HW=35.45' TW=26.65' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.04 cfs @ 5.68 fps)

Summary for Pond DMH6: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 0.96" for 10-Year event
Inflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf
Outflow = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.04 cfs @ 12.33 hrs, Volume= 64,578 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 26.65' @ 12.33 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**24.0" Round Culvert (Prop. 24")** L= 30.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 23.80' S= 0.0456 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=10.04 cfs @ 12.33 hrs HW=26.65' TW=25.69' (Dynamic Tailwater)
└**1=Culvert (Prop. 24")** (Inlet Controls 10.04 cfs @ 4.10 fps)

Summary for Pond DMH7: DMH

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 0.92" for 10-Year event
Inflow = 15.51 cfs @ 12.33 hrs, Volume= 97,718 cf
Outflow = 15.51 cfs @ 12.33 hrs, Volume= 97,718 cf, Atten= 0%, Lag= 0.0 min
Primary = 15.51 cfs @ 12.33 hrs, Volume= 97,718 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.08' @ 12.33 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=15.51 cfs @ 12.33 hrs HW=25.08' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 15.51 cfs @ 4.94 fps)

Summary for Pond ECB1: Ashton-CB

Inflow Area = 224,344 sf, 30.00% Impervious, Inflow Depth = 0.85" for 10-Year event
Inflow = 3.05 cfs @ 12.24 hrs, Volume= 15,878 cf
Outflow = 3.05 cfs @ 12.24 hrs, Volume= 15,878 cf, Atten= 0%, Lag= 0.0 min
Primary = 3.05 cfs @ 12.24 hrs, Volume= 15,878 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 56.82' @ 12.24 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=3.05 cfs @ 12.24 hrs HW=56.82' TW=50.80' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 3.05 cfs @ 3.08 fps)

Summary for Pond ECB2: Livingstone-CB

Inflow Area = 152,058 sf, 30.00% Impervious, Inflow Depth = 0.85" for 10-Year event
Inflow = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf
Outflow = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf, Atten= 0%, Lag= 0.0 min
Primary = 2.72 cfs @ 12.11 hrs, Volume= 10,762 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 54.02' @ 12.11 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.72 cfs @ 12.11 hrs HW=54.02' TW=50.58' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 2.72 cfs @ 3.46 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.00' TW=50.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond ECB3: Upland-CB

Inflow Area =	1,249,125 sf,	29.62% Impervious,	Inflow Depth =	0.88"	for 10-Year event
Inflow =	14.59 cfs @	12.35 hrs,	Volume=	91,193 cf	
Outflow =	14.59 cfs @	12.35 hrs,	Volume=	91,193 cf,	Atten= 0%, Lag= 0.0 min
Primary =	14.59 cfs @	12.35 hrs,	Volume=	91,193 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 28.15' @ 12.35 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round RCP_Round 18"** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.70' S= 0.0380 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=14.59 cfs @ 12.35 hrs HW=28.15' TW=24.95' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 14.59 cfs @ 8.25 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.46' TW=0.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond EDMH1: DMH

Inflow Area =	696,875 sf,	29.50% Impervious,	Inflow Depth =	0.87"	for 10-Year event
Inflow =	8.19 cfs @	12.40 hrs,	Volume=	50,801 cf	
Outflow =	8.19 cfs @	12.40 hrs,	Volume=	50,801 cf,	Atten= 0%, Lag= 0.0 min
Primary =	8.19 cfs @	12.40 hrs,	Volume=	50,801 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.08' @ 12.40 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round RCP_Round 18"** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=8.19 cfs @ 12.40 hrs HW=49.08' TW=46.38' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 8.19 cfs @ 4.63 fps)

Summary for Pond EDMH2: DMH

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 0.87" for 10-Year event
Inflow = 8.19 cfs @ 12.40 hrs, Volume= 50,801 cf
Outflow = 8.19 cfs @ 12.40 hrs, Volume= 50,801 cf, Atten= 0%, Lag= 0.0 min
Primary = 8.19 cfs @ 12.40 hrs, Volume= 50,801 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 46.38' @ 12.40 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round RCP_Round 18"** L= 171.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 40.45' S= 0.0248 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=8.19 cfs @ 12.40 hrs HW=46.38' TW=42.34' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 8.19 cfs @ 4.63 fps)

Summary for Pond EDMH3: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.89" for 10-Year event
Inflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf
Outflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf, Atten= 0%, Lag= 0.0 min
Primary = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.35' @ 12.37 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**18.0" Round RCP_Round 18"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=9.13 cfs @ 12.37 hrs HW=42.35' TW=40.29' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 9.13 cfs @ 5.17 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond EDMH4: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.89" for 10-Year event
Inflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf
Outflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf, Atten= 0%, Lag= 0.0 min
Primary = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 40.29' @ 12.37 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round RCP_Round 18"** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=9.13 cfs @ 12.37 hrs HW=40.29' TW=35.21' (Dynamic Tailwater)
└**1=RCP_Round 18"** (Inlet Controls 9.13 cfs @ 5.17 fps)

Summary for Pond EDMH5: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.89" for 10-Year event
Inflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf
Outflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf, Atten= 0%, Lag= 0.0 min
Primary = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 35.21' @ 12.37 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round RCP_Round 18"** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=9.13 cfs @ 12.37 hrs HW=35.21' TW=29.30' (Dynamic Tailwater)
└**1=RCP_Round 18"** (Inlet Controls 9.13 cfs @ 5.17 fps)

Summary for Pond EDMH6: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 0.89" for 10-Year event
Inflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf
Outflow = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf, Atten= 0%, Lag= 0.0 min
Primary = 9.13 cfs @ 12.37 hrs, Volume= 58,054 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 29.30' @ 12.36 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**18.0" Round RCP_Round 18"** L= 22.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 24.80' S= 0.0178 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=9.15 cfs @ 12.37 hrs HW=29.30' TW=28.14' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 9.15 cfs @ 5.18 fps)

Summary for Pond EDMH7: DMH

Inflow Area =	1,249,125 sf,	29.62% Impervious,	Inflow Depth =	0.88"	for 10-Year event
Inflow =	14.59 cfs @	12.35 hrs,	Volume=	91,193 cf	
Outflow =	14.59 cfs @	12.35 hrs,	Volume=	91,193 cf,	Atten= 0%, Lag= 0.0 min
Primary =	14.59 cfs @	12.35 hrs,	Volume=	91,193 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 24.95' @ 12.35 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=14.59 cfs @ 12.35 hrs HW=24.95' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 14.59 cfs @ 4.71 fps)

Summary for Pond ER1: 18" RCP

Inflow Area =	696,875 sf,	29.50% Impervious,	Inflow Depth =	0.87"	for 10-Year event
Inflow =	8.65 cfs @	12.31 hrs,	Volume=	50,802 cf	
Outflow =	8.19 cfs @	12.40 hrs,	Volume=	50,801 cf,	Atten= 5%, Lag= 5.3 min
Primary =	8.19 cfs @	12.40 hrs,	Volume=	50,801 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 50.11' @ 12.40 hrs Surf.Area= 2,143 sf Storage= 1,036 cf
Flood Elev= 50.00' Surf.Area= 1,453 sf Storage= 845 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.6 min (905.1 - 904.6)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	18,875 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	237	0	0
50.00	1,453	845	845
51.00	7,939	4,696	5,541
52.00	18,728	13,334	18,875

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	50.90'	**15.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=8.19 cfs @ 12.40 hrs HW=50.11' TW=49.08' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 8.19 cfs @ 4.63 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=49.00' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Pond PDMH1: PDMH1

Inflow Area = 720,842 sf, 29.99% Impervious, Inflow Depth = 0.95" for 10-Year event
Inflow = 9.01 cfs @ 12.36 hrs, Volume= 57,299 cf
Outflow = 9.01 cfs @ 12.36 hrs, Volume= 57,299 cf, Atten= 0%, Lag= 0.0 min
Primary = 9.01 cfs @ 12.36 hrs, Volume= 57,299 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 45.37' @ 12.36 hrs
Flood Elev= 48.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**18.0" Round Culvert** L= 112.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 43.50' / 40.45' S= 0.0272 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=9.01 cfs @ 12.36 hrs HW=45.37' TW=42.05' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 9.01 cfs @ 5.10 fps)

Summary for Pond PDMH2: PDMH2

Inflow Area = 1,032,014 sf, 29.87% Impervious, Inflow Depth = 0.94" for 10-Year event
Inflow = 12.95 cfs @ 12.30 hrs, Volume= 80,648 cf
Outflow = 12.95 cfs @ 12.30 hrs, Volume= 80,648 cf, Atten= 0%, Lag= 0.0 min
Primary = 12.95 cfs @ 12.30 hrs, Volume= 80,648 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.69' @ 12.33 hrs
Flood Elev= 31.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.80'	**24.0" Round Culvert** L= 18.8' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 23.80' / 23.03' S= 0.0410 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=12.85 cfs @ 12.30 hrs HW=25.68' TW=25.07' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 12.85 cfs @ 5.43 fps)

Summary for Pond R1: 18" RCP

Inflow Area =	696,340 sf,	29.52% Impervious,	Inflow Depth =	0.87"	for 10-Year event
Inflow =	8.65 cfs @	12.31 hrs,	Volume=	50,775 cf	
Outflow =	8.18 cfs @	12.40 hrs,	Volume=	50,773 cf,	Atten= 5%, Lag= 5.4 min
Primary =	8.18 cfs @	12.40 hrs,	Volume=	50,773 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 50.10' @ 12.40 hrs Surf.Area= 2,255 sf Storage= 955 cf
Flood Elev= 50.00' Surf.Area= 1,500 sf Storage= 761 cf

Plug-Flow detention time= 0.6 min calculated for 50,773 cf (100% of inflow)
Center-of-Mass det. time= 0.5 min (905.0 - 904.4)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	18,931 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	2	0	0
49.00	10	6	6
50.00	1,500	755	761
51.00	8,800	5,150	5,911
52.00	17,240	13,020	18,931

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	49.50'	**18.0" Round Culvert** L= 235.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 49.50' / 48.50' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	50.90'	**10.0' 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=8.18 cfs @ 12.40 hrs HW=50.10' TW=49.07' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 8.18 cfs @ 4.63 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=48.00' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Controls 0.00 cfs)
  └─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Subcatchment 1a: Subcat

Runoff = 5.33 cfs @ 12.22 hrs, Volume= 24,755 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1b: Subcat

Runoff = 4.76 cfs @ 12.10 hrs, Volume= 16,779 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1c: Subcat

Runoff = 6.45 cfs @ 12.32 hrs, Volume= 34,079 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 1Ea: Subcat

Runoff = 5.33 cfs @ 12.22 hrs, Volume= 24,755 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1Eb: Subcat

Runoff = 4.76 cfs @ 12.10 hrs, Volume= 16,779 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1Ec: Subcat

Runoff = 6.45 cfs @ 12.32 hrs, Volume= 34,079 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 2: Subcat

Runoff = 2.37 cfs @ 12.10 hrs, Volume= 8,347 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

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

Summary for Subcatchment 2E: Subcat

Runoff = 2.37 cfs @ 12.10 hrs, Volume= 8,347 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.6	364	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2					**Direct Entry, (6' Min.)**
6.0	464	Total			

Summary for Subcatchment 3: Subcat

Runoff = 4.77 cfs @ 12.37 hrs, Volume= 26,615 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 3E: Subcat

Runoff = 4.77 cfs @ 12.37 hrs, Volume= 26,615 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 4: Subcat

Runoff = 5.31 cfs @ 12.23 hrs, Volume= 25,053 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment 4E: Subcat

Runoff = 5.31 cfs @ 12.23 hrs, Volume= 25,053 cf, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment E-1: EXISTING

Runoff = 0.74 cfs @ 12.11 hrs, Volume= 2,465 cf, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

	Area (sf)	CN	Description
	880	79	Woods, Fair, HSG D
*	933	98	Roofs
*	298	98	Pavement
	632	82	Woods/grass comb., Fair, HSG D
	5,616	80	>75% Grass cover, Good, HSG D
	8,359	83	Weighted Average
	7,128		85.27% Pervious Area
	1,231		14.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	86	0.0630	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment E-2: EXISTING

Runoff = 0.68 cfs @ 12.26 hrs, Volume= 3,053 cf, Depth= 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
10,840	79	Woods, Fair, HSG D
794	80	>75% Grass cover, Good, HSG D
11,634	79	Weighted Average
11,634		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	100	0.0300	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	18	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.9	118	Total			

Summary for Subcatchment E-3: EXISTING

Runoff = 2.33 cfs @ 12.32 hrs, Volume= 11,451 cf, Depth= 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
5,174	84	50-75% Grass cover, Fair, HSG D
2,777	82	Woods/grass comb., Fair, HSG D
31,951	79	Woods, Fair, HSG D
2,449	80	>75% Grass cover, Good, HSG D
42,351	80	Weighted Average
42,351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.4	163	0.0250	0.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.4	263	Total			

Summary for Subcatchment P1a: PROPOSED

Runoff = 2.29 cfs @ 12.13 hrs, Volume= 8,270 cf, Depth= 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

	Area (sf)	CN	Description
*	7,578	98	Pavement
	13,900	80	>75% Grass cover, Good, HSG D
*	1,880	98	Roofs - #106
	1,144	98	Roofs - #100
	24,502	88	Weighted Average
	13,900		56.73% Pervious Area
	10,602		43.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.8	181	Total			

Summary for Subcatchment P1b: PROPOSED

Runoff = 0.75 cfs @ 12.11 hrs, Volume= 2,499 cf, Depth= 3.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

	Area (sf)	CN	Description
*	298	98	Pavement
	7,245	80	>75% Grass cover, Good, HSG D
*	933	98	Roofs - #7
	8,476	83	Weighted Average
	7,245		85.48% Pervious Area
	1,231		14.52% Impervious Area

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

Summary for Subcatchment P2a: PROPOSED

Runoff = 0.69 cfs @ 12.24 hrs, Volume= 3,001 cf, Depth= 3.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

Area (sf)	CN	Description
8,343	80	>75% Grass cover, Good, HSG D
2,756	79	Woods, Fair, HSG D
11,099	80	Weighted Average
11,099		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	40	0.0450	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
12.3	60	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	11	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.6	111	Total			

Summary for Subcatchment P3a: PROPOSED

Runoff = 1.88 cfs @ 12.10 hrs, Volume= 6,165 cf, Depth= 4.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 25-Year Rainfall=5.40"

	Area (sf)	CN	Description
*	6,484	98	Pavement
	9,787	80	>75% Grass cover, Good, HSG D
	1,996	98	Roofs - #112
	18,267	88	Weighted Average
	9,787		53.58% Pervious Area
	8,480		46.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"

Summary for Reach EO1: OUTFALL

Inflow Area = 42,351 sf, 0.00% Impervious, Inflow Depth = 3.47" for 25-Year event
Inflow = 3.22 cfs @ 12.46 hrs, Volume= 12,241 cf
Outflow = 3.22 cfs @ 12.46 hrs, Volume= 12,241 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach EO2: OUTFALL

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 1.35" for 25-Year event
Inflow = 20.92 cfs @ 12.31 hrs, Volume= 140,355 cf
Outflow = 20.92 cfs @ 12.31 hrs, Volume= 140,355 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach ER: Drainage Ditch

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 1.35" for 25-Year event
Inflow = 14.82 cfs @ 12.26 hrs, Volume= 78,666 cf
Outflow = 14.75 cfs @ 12.28 hrs, Volume= 78,666 cf, Atten= 0%, Lag= 1.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.22 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 5.9 min

Peak Storage= 1,647 cf @ 12.28 hrs
Average Depth at Peak Storage= 1.11'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Reach O1: OUTFALL

Inflow Area = 18,267 sf, 46.42% Impervious, Inflow Depth = 4.33" for 25-Year event
Inflow = 1.88 cfs @ 12.10 hrs, Volume= 6,598 cf
Outflow = 1.88 cfs @ 12.10 hrs, Volume= 6,598 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach O2: OUTFALL

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 1.40" for 25-Year event
Inflow = 22.23 cfs @ 12.27 hrs, Volume= 148,965 cf
Outflow = 22.23 cfs @ 12.27 hrs, Volume= 148,965 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach R: Drainage Ditch

Inflow Area = 696,340 sf, 29.52% Impervious, Inflow Depth = 1.35" for 25-Year event
Inflow = 14.83 cfs @ 12.25 hrs, Volume= 78,614 cf
Outflow = 14.76 cfs @ 12.28 hrs, Volume= 78,614 cf, Atten= 0%, Lag= 1.4 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.22 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 5.9 min

Peak Storage= 1,647 cf @ 12.28 hrs
Average Depth at Peak Storage= 1.11'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Pond CB1: Ashton-CB

Inflow Area =	224,344 sf, 30.00% Impervious, Inflow Depth = 1.32" for 25-Year event				
Inflow =	5.33 cfs @	12.22 hrs, Volume=	24,755 cf		
Outflow =	5.33 cfs @	12.22 hrs, Volume=	24,755 cf, Atten= 0%, Lag= 0.0 min		
Primary =	5.33 cfs @	12.22 hrs, Volume=	24,755 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 57.15' @ 12.22 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=5.33 cfs @ 12.22 hrs HW=57.15' TW=51.09' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 5.33 cfs @ 3.66 fps)

Summary for Pond CB1&2: CB1&2

Inflow Area =	24,502 sf, 43.27% Impervious, Inflow Depth = 4.05" for 25-Year event				
Inflow =	2.29 cfs @	12.13 hrs, Volume=	8,270 cf		
Outflow =	2.29 cfs @	12.13 hrs, Volume=	8,270 cf, Atten= 0%, Lag= 0.0 min		
Primary =	2.29 cfs @	12.13 hrs, Volume=	8,270 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 48.18' @ 12.15 hrs
Flood Elev= 49.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 230.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 43.50' S= 0.0039 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.25 cfs @ 12.13 hrs HW=48.12' TW=45.75' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 2.25 cfs @ 2.86 fps)

Summary for Pond CB2: Livingstone-CB

Inflow Area =	152,058 sf,	30.00% Impervious,	Inflow Depth =	1.32"	for 25-Year event
Inflow =	4.76 cfs @	12.10 hrs,	Volume=	16,779 cf	
Outflow =	4.76 cfs @	12.10 hrs,	Volume=	16,779 cf,	Atten= 0%, Lag= 0.0 min
Primary =	4.76 cfs @	12.10 hrs,	Volume=	16,779 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 55.09' @ 12.10 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.76 cfs @ 12.10 hrs HW=55.09' TW=50.88' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 4.76 cfs @ 6.06 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.00' TW=50.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond CB3: Upland-CB

Inflow Area =	241,195 sf,	30.00% Impervious,	Inflow Depth =	1.32"	for 25-Year event
Inflow =	4.77 cfs @	12.37 hrs,	Volume=	26,615 cf	
Outflow =	4.77 cfs @	12.37 hrs,	Volume=	26,615 cf,	Atten= 0%, Lag= 0.0 min
Primary =	4.77 cfs @	12.37 hrs,	Volume=	26,615 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 26.47' @ 12.30 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.03' S= 0.0715 '/' Cc= 0.900

n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2 Secondary 31.13' **24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600
Limited to weir flow at low heads

Primary OutFlow Max=4.88 cfs @ 12.37 hrs HW=26.41' TW=26.08' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 4.88 cfs @ 2.76 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.46' TW=0.00' (Dynamic Tailwater)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH1: DMH

Inflow Area = 696,340 sf, 29.52% Impervious, Inflow Depth = 1.35" for 25-Year event
Inflow = 10.15 cfs @ 12.51 hrs, Volume= 78,180 cf
Outflow = 10.15 cfs @ 12.51 hrs, Volume= 78,180 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.15 cfs @ 12.51 hrs, Volume= 78,180 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.57' @ 12.51 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round Culvert** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.15 cfs @ 12.51 hrs HW=49.57' TW=47.30' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.15 cfs @ 5.75 fps)

Summary for Pond DMH2: DMH

Inflow Area = 696,340 sf, 29.52% Impervious, Inflow Depth = 1.35" for 25-Year event
Inflow = 10.15 cfs @ 12.51 hrs, Volume= 78,180 cf
Outflow = 10.15 cfs @ 12.51 hrs, Volume= 78,180 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.15 cfs @ 12.51 hrs, Volume= 78,180 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 47.33' @ 12.44 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round Culvert** L= 53.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 43.50' S= 0.0223 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.15 cfs @ 12.51 hrs HW=47.30' TW=45.87' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.15 cfs @ 5.74 fps)

Summary for Pond DMH3: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.45" for 25-Year event
Inflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf
Outflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf, Atten= 0%, Lag= 0.0 min
Primary = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 42.83' @ 12.17 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**24.0" Round Prop. RCP_Round 24"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=13.44 cfs @ 12.16 hrs HW=42.82' TW=41.66' (Dynamic Tailwater)
└─**1=Prop. RCP_Round 24"** (Outlet Controls 13.44 cfs @ 4.55 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH4: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.45" for 25-Year event
Inflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf
Outflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf, Atten= 0%, Lag= 0.0 min
Primary = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.67' @ 12.16 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round Culvert** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=13.52 cfs @ 12.16 hrs HW=41.66' TW=36.58' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 13.52 cfs @ 7.65 fps)

Summary for Pond DMH5: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.45" for 25-Year event
Inflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf
Outflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf, Atten= 0%, Lag= 0.0 min
Primary = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 36.59' @ 12.16 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round Culvert** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=13.52 cfs @ 12.16 hrs HW=36.58' TW=27.41' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 13.52 cfs @ 7.65 fps)

Summary for Pond DMH6: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.45" for 25-Year event
Inflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf
Outflow = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf, Atten= 0%, Lag= 0.0 min
Primary = 13.52 cfs @ 12.16 hrs, Volume= 97,296 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 27.80' @ 12.27 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**24.0" Round Culvert (Prop. 24")** L= 30.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 23.80' S= 0.0456 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=12.56 cfs @ 12.16 hrs HW=27.41' TW=26.72' (Dynamic Tailwater)
└**1=Culvert (Prop. 24")** (Inlet Controls 12.56 cfs @ 4.00 fps)

Summary for Pond DMH7: DMH

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 1.40" for 25-Year event
Inflow = 22.23 cfs @ 12.27 hrs, Volume= 148,965 cf
Outflow = 22.23 cfs @ 12.27 hrs, Volume= 148,965 cf, Atten= 0%, Lag= 0.0 min
Primary = 22.23 cfs @ 12.27 hrs, Volume= 148,965 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 26.19' @ 12.27 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=22.23 cfs @ 12.27 hrs HW=26.19' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 22.23 cfs @ 7.07 fps)

Summary for Pond ECB1: Ashton-CB

Inflow Area =	224,344 sf,	30.00% Impervious,	Inflow Depth =	1.32"	for 25-Year event
Inflow =	5.33 cfs @	12.22 hrs,	Volume=	24,755 cf	
Outflow =	5.33 cfs @	12.22 hrs,	Volume=	24,755 cf,	Atten= 0%, Lag= 0.0 min
Primary =	5.33 cfs @	12.22 hrs,	Volume=	24,755 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 57.15' @ 12.22 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=5.33 cfs @ 12.22 hrs HW=57.15' TW=51.09' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 5.33 cfs @ 3.66 fps)

Summary for Pond ECB2: Livingstone-CB

Inflow Area =	152,058 sf,	30.00% Impervious,	Inflow Depth =	1.32"	for 25-Year event
Inflow =	4.76 cfs @	12.10 hrs,	Volume=	16,779 cf	
Outflow =	4.76 cfs @	12.10 hrs,	Volume=	16,779 cf,	Atten= 0%, Lag= 0.0 min
Primary =	4.76 cfs @	12.10 hrs,	Volume=	16,779 cf	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 55.09' @ 12.10 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=4.76 cfs @ 12.10 hrs HW=55.09' TW=50.87' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 4.76 cfs @ 6.06 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=53.00' TW=50.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond ECB3: Upland-CB

Inflow Area =	1,249,125 sf,	29.62% Impervious,	Inflow Depth =	1.35"	for 25-Year event
Inflow =	20.92 cfs @	12.31 hrs,	Volume=	140,355 cf	
Outflow =	20.92 cfs @	12.31 hrs,	Volume=	140,355 cf,	Atten= 0%, Lag= 0.0 min
Primary =	19.92 cfs @	12.29 hrs,	Volume=	139,789 cf	
Secondary =	1.00 cfs @	12.31 hrs,	Volume=	566 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 31.24' @ 12.31 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round RCP_Round 18"** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.70' S= 0.0380 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=19.92 cfs @ 12.29 hrs HW=31.24' TW=25.76' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 19.92 cfs @ 11.27 fps)

Secondary OutFlow Max=1.00 cfs @ 12.31 hrs HW=31.24' TW=0.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Weir Controls 1.00 cfs @ 1.10 fps)

Summary for Pond EDMH1: DMH

Inflow Area =	696,875 sf,	29.50% Impervious,	Inflow Depth =	1.34"	for 25-Year event
Inflow =	10.18 cfs @	12.47 hrs,	Volume=	77,875 cf	
Outflow =	10.18 cfs @	12.47 hrs,	Volume=	77,875 cf,	Atten= 0%, Lag= 0.0 min
Primary =	10.18 cfs @	12.47 hrs,	Volume=	77,875 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.58' @ 12.47 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round RCP_Round 18"** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.18 cfs @ 12.47 hrs HW=49.58' TW=46.88' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 10.18 cfs @ 5.76 fps)

Summary for Pond EDMH2: DMH

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 1.34" for 25-Year event
Inflow = 10.18 cfs @ 12.47 hrs, Volume= 77,875 cf
Outflow = 10.18 cfs @ 12.47 hrs, Volume= 77,875 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.18 cfs @ 12.47 hrs, Volume= 77,875 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 46.88' @ 12.47 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round RCP_Round 18"** L= 171.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 40.45' S= 0.0248 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.18 cfs @ 12.47 hrs HW=46.88' TW=44.31' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 10.18 cfs @ 5.76 fps)

Summary for Pond EDMH3: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.36" for 25-Year event
Inflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf
Outflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf, Atten= 0%, Lag= 0.0 min
Primary = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 44.49' @ 12.37 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**18.0" Round RCP_Round 18"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=11.45 cfs @ 12.37 hrs HW=44.49' TW=40.95' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Outlet Controls 11.45 cfs @ 6.48 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond EDMH4: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.36" for 25-Year event
Inflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf
Outflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf, Atten= 0%, Lag= 0.0 min
Primary = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 40.95' @ 12.37 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round RCP_Round 18"** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=11.46 cfs @ 12.37 hrs HW=40.95' TW=35.87' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 11.46 cfs @ 6.48 fps)

Summary for Pond EDMH5: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.36" for 25-Year event
Inflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf
Outflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf, Atten= 0%, Lag= 0.0 min
Primary = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 35.87' @ 12.37 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round RCP_Round 18"** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=11.46 cfs @ 12.37 hrs HW=35.87' TW=33.04' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 11.46 cfs @ 6.48 fps)

Summary for Pond EDMH6: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.36" for 25-Year event
Inflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf
Outflow = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf, Atten= 0%, Lag= 0.0 min
Primary = 11.46 cfs @ 12.37 hrs, Volume= 88,687 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 33.05' @ 12.33 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**18.0" Round RCP_Round 18"** L= 22.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 24.80' S= 0.0178 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=11.47 cfs @ 12.37 hrs HW=33.04' TW=31.22' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 11.47 cfs @ 6.49 fps)

Summary for Pond EDMH7: DMH

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 1.34" for 25-Year event
Inflow = 19.92 cfs @ 12.29 hrs, Volume= 139,789 cf
Outflow = 19.92 cfs @ 12.29 hrs, Volume= 139,789 cf, Atten= 0%, Lag= 0.0 min
Primary = 19.92 cfs @ 12.29 hrs, Volume= 139,789 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.76' @ 12.29 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=19.92 cfs @ 12.29 hrs HW=25.76' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 19.92 cfs @ 6.34 fps)

Summary for Pond ER1: 18" RCP

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 1.35" for 25-Year event
Inflow = 14.75 cfs @ 12.28 hrs, Volume= 78,666 cf
Outflow = 11.46 cfs @ 12.49 hrs, Volume= 78,665 cf, Atten= 22%, Lag= 12.5 min
Primary = 10.18 cfs @ 12.47 hrs, Volume= 77,875 cf
Secondary = 1.28 cfs @ 12.48 hrs, Volume= 790 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 51.01' @ 12.48 hrs Surf.Area= 8,015 sf Storage= 5,597 cf
Flood Elev= 50.00' Surf.Area= 1,453 sf Storage= 845 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 2.5 min (891.2 - 888.7)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	18,875 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	237	0	0
50.00	1,453	845	845
51.00	7,939	4,696	5,541
52.00	18,728	13,334	18,875

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	50.90'	**15.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=10.16 cfs @ 12.47 hrs HW=51.01' TW=49.58' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.16 cfs @ 5.75 fps)

Secondary OutFlow Max=1.28 cfs @ 12.48 hrs HW=51.01' TW=0.00' (Dynamic Tailwater)
└**2=Broad-Crested Rectangular Weir** (Weir Controls 1.28 cfs @ 0.80 fps)

Summary for Pond PDMH1: PDMH1

Inflow Area = 720,842 sf, 29.99% Impervious, Inflow Depth = 1.44" for 25-Year event
Inflow = 11.03 cfs @ 12.37 hrs, Volume= 86,450 cf
Outflow = 11.03 cfs @ 12.37 hrs, Volume= 86,450 cf, Atten= 0%, Lag= 0.0 min
Primary = 11.03 cfs @ 12.37 hrs, Volume= 86,450 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 45.93' @ 12.37 hrs
Flood Elev= 48.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**18.0" Round Culvert** L= 112.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 43.50' / 40.45' S= 0.0272 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=11.03 cfs @ 12.37 hrs HW=45.93' TW=42.53' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 11.03 cfs @ 6.24 fps)

Summary for Pond PDMH2: PDMH2

Inflow Area = 1,032,014 sf, 29.87% Impervious, Inflow Depth = 1.42" for 25-Year event
Inflow = 18.32 cfs @ 12.19 hrs, Volume= 122,350 cf
Outflow = 18.32 cfs @ 12.19 hrs, Volume= 122,350 cf, Atten= 0%, Lag= 0.0 min
Primary = 18.32 cfs @ 12.19 hrs, Volume= 122,350 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 27.08' @ 12.26 hrs
Flood Elev= 31.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.80'	**24.0" Round Culvert** L= 18.8' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 23.80' / 23.03' S= 0.0410 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=17.86 cfs @ 12.19 hrs HW=26.93' TW=26.04' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 17.86 cfs @ 5.69 fps)

Summary for Pond R1: 18" RCP

Inflow Area =	696,340 sf,	29.52% Impervious,	Inflow Depth =	1.35"	for 25-Year event
Inflow =	14.76 cfs @	12.28 hrs,	Volume=	78,614 cf	
Outflow =	10.90 cfs @	12.51 hrs,	Volume=	78,612 cf,	Atten= 26%, Lag= 13.9 min
Primary =	10.15 cfs @	12.51 hrs,	Volume=	78,180 cf	
Secondary =	0.75 cfs @	12.51 hrs,	Volume=	432 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 50.99' @ 12.51 hrs Surf.Area= 8,721 sf Storage= 5,817 cf
Flood Elev= 50.00' Surf.Area= 1,500 sf Storage= 761 cf

Plug-Flow detention time= 2.7 min calculated for 78,612 cf (100% of inflow)
Center-of-Mass det. time= 2.6 min (891.2 - 888.6)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	18,931 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	2	0	0
49.00	10	6	6
50.00	1,500	755	761
51.00	8,800	5,150	5,911
52.00	17,240	13,020	18,931

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	49.50'	**18.0" Round Culvert** L= 235.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 49.50' / 48.50' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	50.90'	**10.0' 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=10.12 cfs @ 12.51 hrs HW=50.99' TW=49.57' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 10.12 cfs @ 5.73 fps)

Secondary OutFlow Max=0.74 cfs @ 12.51 hrs HW=50.99' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Passes 0.74 cfs of 6.72 cfs potential flow)
└─**3=Broad-Crested Rectangular Weir** (Weir Controls 0.74 cfs @ 0.84 fps)

Summary for Subcatchment 1a: Subcat

Runoff = 8.56 cfs @ 12.21 hrs, Volume= 37,155 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1b: Subcat

Runoff = 7.61 cfs @ 12.10 hrs, Volume= 25,183 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1c: Subcat

Runoff = 10.29 cfs @ 12.30 hrs, Volume= 51,149 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 1Ea: Subcat

Runoff = 8.56 cfs @ 12.21 hrs, Volume= 37,155 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
224,344	57	1/3 acre lots, 30% imp, HSG A
157,041		70.00% Pervious Area
67,303		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0	100	0.0200	0.17		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
3.3	214	0.0234	1.07		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.6	95	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.5	180	0.0050	5.46	9.66	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.010 PVC, smooth interior
14.4	589	Total			

Summary for Subcatchment 1Eb: Subcat

Runoff = 7.61 cfs @ 12.10 hrs, Volume= 25,183 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
152,058	57	1/3 acre lots, 30% imp, HSG A
106,441		70.00% Pervious Area
45,617		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.5	260	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.9	400	0.0150	7.22	5.67	**Pipe Channel,** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.010 PVC, smooth interior
2.4					**Direct Entry, 6' min.**
6.0	760	Total			

Summary for Subcatchment 1Ec: Subcat

Runoff = 10.29 cfs @ 12.30 hrs, Volume= 51,149 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
308,839	57	1/3 acre lots, 30% imp, HSG A
216,187		70.00% Pervious Area
92,652		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.1	100	0.0100	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
7.1	500	0.0280	1.17		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
20.2	600	Total			

Summary for Subcatchment 2: Subcat

Runoff = 3.79 cfs @ 12.10 hrs, Volume= 12,529 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

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

Summary for Subcatchment 2E: Subcat

Runoff = 3.79 cfs @ 12.10 hrs, Volume= 12,529 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
75,649	57	1/3 acre lots, 30% imp, HSG A
52,954		70.00% Pervious Area
22,695		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.2	100	0.0200	1.35		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.10"
1.6	364	0.0330	3.69		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
3.2					**Direct Entry, (6' Min.)**
6.0	464	Total			

Summary for Subcatchment 3: Subcat

Runoff = 7.62 cfs @ 12.35 hrs, Volume= 39,946 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 3E: Subcat

Runoff = 7.62 cfs @ 12.35 hrs, Volume= 39,946 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
241,195	57	1/3 acre lots, 30% imp, HSG A
168,837		70.00% Pervious Area
72,359		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.3	100	0.0240	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
13.8	900	0.0240	1.08		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
23.1	1,000	Total			

Summary for Subcatchment 4: Subcat

Runoff = 8.50 cfs @ 12.23 hrs, Volume= 37,603 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment 4E: Subcat

Runoff = 8.50 cfs @ 12.23 hrs, Volume= 37,603 cf, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
227,047	57	1/3 acre lots, 30% imp, HSG A
158,933		70.00% Pervious Area
68,114		30.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	100	0.0260	0.19		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
6.1	1,200	0.0260	3.27		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
15.1	1,300	Total			

Summary for Subcatchment E-1: EXISTING

Runoff = 0.94 cfs @ 12.11 hrs, Volume= 3,175 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
	880	79	Woods, Fair, HSG D
*	933	98	Roofs
*	298	98	Pavement
	632	82	Woods/grass comb., Fair, HSG D
	5,616	80	>75% Grass cover, Good, HSG D
	8,359	83	Weighted Average
	7,128		85.27% Pervious Area
	1,231		14.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.1	86	0.0630	0.18		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"

Summary for Subcatchment E-2: EXISTING

Runoff = 0.89 cfs @ 12.25 hrs, Volume= 4,003 cf, Depth= 4.13"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
10,840	79	Woods, Fair, HSG D
794	80	>75% Grass cover, Good, HSG D
11,634	79	Weighted Average
11,634		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	100	0.0300	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	18	0.0300	0.87		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
18.9	118	Total			

Summary for Subcatchment E-3: EXISTING

Runoff = 3.03 cfs @ 12.32 hrs, Volume= 14,947 cf, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
5,174	84	50-75% Grass cover, Fair, HSG D
2,777	82	Woods/grass comb., Fair, HSG D
31,951	79	Woods, Fair, HSG D
2,449	80	>75% Grass cover, Good, HSG D
42,351	80	Weighted Average
42,351		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	100	0.0250	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
3.4	163	0.0250	0.79		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.4	263	Total			

Summary for Subcatchment P1a: PROPOSED

Runoff = 2.85 cfs @ 12.13 hrs, Volume= 10,431 cf, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	7,578	98	Pavement
	13,900	80	>75% Grass cover, Good, HSG D
*	1,880	98	Roofs - #106
	1,144	98	Roofs - #100
	24,502	88	Weighted Average
	13,900		56.73% Pervious Area
	10,602		43.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	100	0.0250	0.18		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"
0.3	45	0.0200	2.87		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
0.4	36	0.0500	1.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.8	181	Total			

Summary for Subcatchment P1b: PROPOSED

Runoff = 0.95 cfs @ 12.11 hrs, Volume= 3,219 cf, Depth= 4.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	298	98	Pavement
	7,245	80	>75% Grass cover, Good, HSG D
*	933	98	Roofs - #7
	8,476	83	Weighted Average
	7,245		85.48% Pervious Area
	1,231		14.52% Impervious Area

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

Summary for Subcatchment P2a: PROPOSED

Runoff = 0.89 cfs @ 12.24 hrs, Volume= 3,917 cf, Depth= 4.24"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

Area (sf)	CN	Description
8,343	80	>75% Grass cover, Good, HSG D
2,756	79	Woods, Fair, HSG D
11,099	80	Weighted Average
11,099		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0	40	0.0450	0.13		**Sheet Flow,** Grass: Dense n= 0.240 P2= 3.10"
12.3	60	0.0300	0.08		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.10"
0.3	11	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
17.6	111	Total			

Summary for Subcatchment P3a: PROPOSED

Runoff = 2.34 cfs @ 12.10 hrs, Volume= 7,777 cf, Depth= 5.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=6.50"

	Area (sf)	CN	Description
*	6,484	98	Pavement
	9,787	80	>75% Grass cover, Good, HSG D
	1,996	98	Roofs - #112
	18,267	88	Weighted Average
	9,787		53.58% Pervious Area
	8,480		46.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	100	0.0500	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.10"

Summary for Reach EO1: OUTFALL

Inflow Area = 42,351 sf, 0.00% Impervious, Inflow Depth = 7.98" for 100-Year event
Inflow = 13.30 cfs @ 12.37 hrs, Volume= 28,150 cf
Outflow = 13.30 cfs @ 12.37 hrs, Volume= 28,150 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach EO2: OUTFALL

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 1.90" for 100-Year event
Inflow = 28.44 cfs @ 12.26 hrs, Volume= 197,540 cf
Outflow = 28.44 cfs @ 12.26 hrs, Volume= 197,540 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach ER: Drainage Ditch

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 2.02" for 100-Year event
Inflow = 23.42 cfs @ 12.24 hrs, Volume= 117,491 cf
Outflow = 23.31 cfs @ 12.26 hrs, Volume= 117,491 cf, Atten= 0%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.66 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 5.3 min

Peak Storage= 2,291 cf @ 12.26 hrs
Average Depth at Peak Storage= 1.43'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Reach O1: OUTFALL

Inflow Area = 18,267 sf, 46.42% Impervious, Inflow Depth = 13.16" for 100-Year event
Inflow = 9.19 cfs @ 12.33 hrs, Volume= 20,030 cf
Outflow = 9.19 cfs @ 12.33 hrs, Volume= 20,030 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach O2: OUTFALL

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 1.97" for 100-Year event
Inflow = 30.29 cfs @ 12.24 hrs, Volume= 208,878 cf
Outflow = 30.29 cfs @ 12.24 hrs, Volume= 208,878 cf, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Summary for Reach R: Drainage Ditch

Inflow Area = 696,340 sf, 29.52% Impervious, Inflow Depth = 2.02" for 100-Year event
Inflow = 23.43 cfs @ 12.24 hrs, Volume= 117,405 cf
Outflow = 23.32 cfs @ 12.26 hrs, Volume= 117,405 cf, Atten= 0%, Lag= 1.3 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.66 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.11 fps, Avg. Travel Time= 5.4 min

Peak Storage= 2,291 cf @ 12.26 hrs
Average Depth at Peak Storage= 1.44'
Defined Flood Depth= 1.00' Flow Area= 4.0 sf, Capacity= 12.22 cfs
Bank-Full Depth= 1.50' Flow Area= 6.8 sf, Capacity= 25.28 cfs

3.00' x 1.50' deep channel, n= 0.025 Earth, clean & winding
Side Slope Z-value= 1.0 '/' Top Width= 6.00'
Length= 360.0' Slope= 0.0044 '/'
Inlet Invert= 50.00', Outlet Invert= 48.43'

Summary for Pond CB1: Ashton-CB

Inflow Area =	224,344 sf,	30.00% Impervious,	Inflow Depth =	1.99"	for 100-Year event
Inflow =	8.56 cfs @	12.21 hrs, Volume=	37,155 cf		
Outflow =	8.56 cfs @	12.21 hrs, Volume=	37,155 cf,	Atten= 0%,	Lag= 0.0 min
Primary =	8.56 cfs @	12.21 hrs, Volume=	37,155 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 57.76' @ 12.21 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=8.55 cfs @ 12.21 hrs HW=57.76' TW=51.42' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 8.55 cfs @ 4.84 fps)

Summary for Pond CB1&2: CB1&2

Inflow Area =	24,502 sf,	43.27% Impervious,	Inflow Depth =	5.11"	for 100-Year event
Inflow =	2.85 cfs @	12.13 hrs, Volume=	10,431 cf		
Outflow =	2.85 cfs @	12.13 hrs, Volume=	10,431 cf,	Atten= 0%,	Lag= 0.0 min
Primary =	2.85 cfs @	12.13 hrs, Volume=	10,431 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 50.89' @ 12.15 hrs
Flood Elev= 49.10'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.40'	**12.0" Round Culvert** L= 230.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.40' / 43.50' S= 0.0039 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.79 sf

Primary OutFlow Max=2.81 cfs @ 12.13 hrs HW=50.78' TW=47.07' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 2.81 cfs @ 3.58 fps)

Summary for Pond CB2: Livingstone-CB

Inflow Area = 152,058 sf, 30.00% Impervious, Inflow Depth = 1.99" for 100-Year event
Inflow = 7.61 cfs @ 12.10 hrs, Volume= 25,183 cf
Outflow = 7.61 cfs @ 12.10 hrs, Volume= 25,183 cf, Atten= 0%, Lag= 0.0 min
Primary = 6.15 cfs @ 12.10 hrs, Volume= 24,791 cf
Secondary = 1.46 cfs @ 12.10 hrs, Volume= 392 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 56.15' @ 12.10 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.15 cfs @ 12.10 hrs HW=56.15' TW=51.19' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 6.15 cfs @ 7.83 fps)

Secondary OutFlow Max=1.45 cfs @ 12.10 hrs HW=56.15' TW=51.19' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Weir Controls 1.45 cfs @ 1.25 fps)

Summary for Pond CB3: Upland-CB

Inflow Area = 241,195 sf, 30.00% Impervious, Inflow Depth = 1.99" for 100-Year event
Inflow = 7.62 cfs @ 12.35 hrs, Volume= 39,946 cf
Outflow = 7.62 cfs @ 12.35 hrs, Volume= 39,946 cf, Atten= 0%, Lag= 0.0 min
Primary = 7.62 cfs @ 12.35 hrs, Volume= 39,946 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 28.74' @ 12.29 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round Culvert** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.03' S= 0.0715 '/' Cc= 0.900

			n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.94 cfs @ 12.35 hrs HW=28.56' TW=27.69' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 7.94 cfs @ 4.49 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=24.46' TW=0.00' (Dynamic Tailwater)
└**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH1: DMH

Inflow Area =	696,340 sf, 29.52% Impervious, Inflow Depth = 1.81" for 100-Year event				
Inflow =	10.85 cfs @	12.42 hrs, Volume=	105,150 cf		
Outflow =	10.85 cfs @	12.42 hrs, Volume=	105,150 cf, Atten= 0%, Lag= 0.0 min		
Primary =	10.85 cfs @	12.42 hrs, Volume=	105,150 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.78' @ 12.42 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round Culvert** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.85 cfs @ 12.42 hrs HW=49.78' TW=47.85' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.85 cfs @ 6.14 fps)

Summary for Pond DMH2: DMH

Inflow Area =	696,340 sf, 29.52% Impervious, Inflow Depth = 1.81" for 100-Year event				
Inflow =	10.85 cfs @	12.42 hrs, Volume=	105,150 cf		
Outflow =	10.85 cfs @	12.42 hrs, Volume=	105,150 cf, Atten= 0%, Lag= 0.0 min		
Primary =	10.85 cfs @	12.42 hrs, Volume=	105,150 cf		

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 48.43' @ 12.15 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round Culvert** L= 53.9' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 43.50' S= 0.0223 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.81 cfs @ 12.42 hrs HW=47.85' TW=46.23' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 10.81 cfs @ 6.12 fps)

Summary for Pond DMH3: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.96" for 100-Year event
Inflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf
Outflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf, Atten= 0%, Lag= 0.0 min
Primary = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 44.87' @ 12.13 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**24.0" Round Prop. RCP_Round 24"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=16.51 cfs @ 12.12 hrs HW=44.82' TW=43.03' (Dynamic Tailwater)
└─**1=Prop. RCP_Round 24"** (Outlet Controls 16.51 cfs @ 5.25 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=40.45' TW=24.46' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond DMH4: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.96" for 100-Year event
Inflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf
Outflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf, Atten= 0%, Lag= 0.0 min
Primary = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 43.04' @ 12.12 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round Culvert** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=16.78 cfs @ 12.12 hrs HW=43.03' TW=37.95' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 16.78 cfs @ 9.50 fps)

Summary for Pond DMH5: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.96" for 100-Year event
Inflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf
Outflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf, Atten= 0%, Lag= 0.0 min
Primary = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 37.96' @ 12.12 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round Culvert** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=16.78 cfs @ 12.12 hrs HW=37.95' TW=29.46' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 16.78 cfs @ 9.50 fps)

Summary for Pond DMH6: DMH

Inflow Area = 804,967 sf, 29.83% Impervious, Inflow Depth = 1.96" for 100-Year event
Inflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf
Outflow = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf, Atten= 0%, Lag= 0.0 min
Primary = 16.80 cfs @ 12.12 hrs, Volume= 131,329 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 30.60' @ 12.24 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**24.0" Round Culvert (Prop. 24")** L= 30.7' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 23.80' S= 0.0456 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=15.19 cfs @ 12.12 hrs HW=29.46' TW=28.45' (Dynamic Tailwater)
└**1=Culvert (Prop. 24")** (Inlet Controls 15.19 cfs @ 4.84 fps)

Summary for Pond DMH7: DMH

Inflow Area = 1,273,209 sf, 29.89% Impervious, Inflow Depth = 1.97" for 100-Year event
Inflow = 30.29 cfs @ 12.24 hrs, Volume= 208,878 cf
Outflow = 30.29 cfs @ 12.24 hrs, Volume= 208,878 cf, Atten= 0%, Lag= 0.0 min
Primary = 30.29 cfs @ 12.24 hrs, Volume= 208,878 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 28.04' @ 12.24 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=30.28 cfs @ 12.24 hrs HW=28.04' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 30.28 cfs @ 9.64 fps)

Summary for Pond ECB1: Ashton-CB

Inflow Area = 224,344 sf, 30.00% Impervious, Inflow Depth = 1.99" for 100-Year event
Inflow = 8.56 cfs @ 12.21 hrs, Volume= 37,155 cf
Outflow = 8.56 cfs @ 12.21 hrs, Volume= 37,155 cf, Atten= 0%, Lag= 0.0 min
Primary = 8.56 cfs @ 12.21 hrs, Volume= 37,155 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 57.76' @ 12.21 hrs
Flood Elev= 59.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	56.00'	**18.0" Round Culvert** L= 222.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 56.00' / 50.00' S= 0.0270 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=8.55 cfs @ 12.21 hrs HW=57.76' TW=51.42' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 8.55 cfs @ 4.84 fps)

Summary for Pond ECB2: Livingstone-CB

Inflow Area = 152,058 sf, 30.00% Impervious, Inflow Depth = 1.99" for 100-Year event
Inflow = 7.61 cfs @ 12.10 hrs, Volume= 25,183 cf
Outflow = 7.61 cfs @ 12.10 hrs, Volume= 25,183 cf, Atten= 0%, Lag= 0.0 min
Primary = 6.15 cfs @ 12.10 hrs, Volume= 24,791 cf
Secondary = 1.46 cfs @ 12.10 hrs, Volume= 392 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 56.15' @ 12.10 hrs
Flood Elev= 56.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	53.00'	**12.0" Round Culvert** L= 93.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 53.00' / 50.00' S= 0.0323 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.79 sf
#2	Secondary	56.00'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.15 cfs @ 12.10 hrs HW=56.15' TW=51.19' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 6.15 cfs @ 7.83 fps)

Secondary OutFlow Max=1.45 cfs @ 12.10 hrs HW=56.15' TW=51.19' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Weir Controls 1.45 cfs @ 1.25 fps)

Summary for Pond ECB3: Upland-CB

Inflow Area =	1,249,125 sf,	29.62% Impervious,	Inflow Depth =	1.90"	for 100-Year event
Inflow =	28.44 cfs @	12.26 hrs,	Volume=	197,540 cf	
Outflow =	28.44 cfs @	12.26 hrs,	Volume=	197,540 cf,	Atten= 0%, Lag= 0.0 min
Primary =	20.39 cfs @	12.26 hrs,	Volume=	187,697 cf	
Secondary =	8.05 cfs @	12.26 hrs,	Volume=	9,843 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 31.59' @ 12.26 hrs
Flood Elev= 31.13'

Device	Routing	Invert	Outlet Devices
#1	Primary	24.46'	**18.0" Round RCP_Round 18"** L= 20.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 24.46' / 23.70' S= 0.0380 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	31.13'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=20.38 cfs @ 12.26 hrs HW=31.59' TW=25.85' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 20.38 cfs @ 11.54 fps)

Secondary OutFlow Max=8.04 cfs @ 12.26 hrs HW=31.59' TW=0.00' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Weir Controls 8.04 cfs @ 2.21 fps)

Summary for Pond EDMH1: DMH

Inflow Area =	696,875 sf,	29.50% Impervious,	Inflow Depth =	1.80"	for 100-Year event
Inflow =	10.75 cfs @	12.36 hrs,	Volume=	104,287 cf	
Outflow =	10.75 cfs @	12.36 hrs,	Volume=	104,287 cf,	Atten= 0%, Lag= 0.0 min
Primary =	10.75 cfs @	12.36 hrs,	Volume=	104,287 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 49.75' @ 12.36 hrs
Flood Elev= 55.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	47.40'	**18.0" Round RCP_Round 18"** L= 89.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 47.40' / 44.70' S= 0.0302 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.75 cfs @ 12.36 hrs HW=49.75' TW=47.80' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 10.75 cfs @ 6.09 fps)

Summary for Pond EDMH2: DMH

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 1.80" for 100-Year event
Inflow = 10.75 cfs @ 12.36 hrs, Volume= 104,287 cf
Outflow = 10.75 cfs @ 12.36 hrs, Volume= 104,287 cf, Atten= 0%, Lag= 0.0 min
Primary = 10.75 cfs @ 12.36 hrs, Volume= 104,287 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 47.81' @ 12.32 hrs
Flood Elev= 49.96'

Device	Routing	Invert	Outlet Devices
#1	Primary	44.70'	**18.0" Round RCP_Round 18"** L= 171.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 44.70' / 40.45' S= 0.0248 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=10.74 cfs @ 12.36 hrs HW=47.80' TW=45.66' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Outlet Controls 10.74 cfs @ 6.08 fps)

Summary for Pond EDMH3: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.84" for 100-Year event
Inflow = 14.01 cfs @ 12.12 hrs, Volume= 119,991 cf
Outflow = 14.01 cfs @ 12.12 hrs, Volume= 119,991 cf, Atten= 0%, Lag= 0.0 min
Primary = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf
Secondary = 1.27 cfs @ 12.12 hrs, Volume= 722 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 45.75' @ 12.12 hrs
Flood Elev= 45.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	40.45'	**18.0" Round RCP_Round 18"** L= 299.6' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 40.45' / 38.39' S= 0.0069 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	45.62'	**24.0" x 24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=12.73 cfs @ 12.12 hrs HW=45.75' TW=41.38' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Outlet Controls 12.73 cfs @ 7.20 fps)

Secondary OutFlow Max=1.27 cfs @ 12.12 hrs HW=45.75' TW=31.40' (Dynamic Tailwater)
└─**2=Orifice/Grate** (Weir Controls 1.27 cfs @ 1.19 fps)

Summary for Pond EDMH4: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.83" for 100-Year event
Inflow = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf
Outflow = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf, Atten= 0%, Lag= 0.0 min
Primary = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 41.38' @ 12.12 hrs
Flood Elev= 46.56'

Device	Routing	Invert	Outlet Devices
#1	Primary	38.39'	**18.0" Round RCP_Round 18"** L= 158.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 38.39' / 33.31' S= 0.0321 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=12.74 cfs @ 12.12 hrs HW=41.38' TW=36.30' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 12.74 cfs @ 7.21 fps)

Summary for Pond EDMH5: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.83" for 100-Year event
Inflow = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf
Outflow = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf, Atten= 0%, Lag= 0.0 min
Primary = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 36.50' @ 12.28 hrs
Flood Elev= 38.06'

Device	Routing	Invert	Outlet Devices
#1	Primary	33.31'	**18.0" Round RCP_Round 18"** L= 143.4' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 33.31' / 31.62' S= 0.0118 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=12.67 cfs @ 12.12 hrs HW=36.30' TW=33.60' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Outlet Controls 12.67 cfs @ 7.17 fps)

Summary for Pond EDMH6: DMH

Inflow Area = 780,883 sf, 29.39% Impervious, Inflow Depth = 1.83" for 100-Year event
Inflow = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf
Outflow = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf, Atten= 0%, Lag= 0.0 min
Primary = 12.74 cfs @ 12.12 hrs, Volume= 119,269 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 33.80' @ 12.28 hrs
Flood Elev= 31.62'

Device	Routing	Invert	Outlet Devices
#1	Primary	25.20'	**18.0" Round RCP_Round 18"** L= 22.5' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 25.20' / 24.80' S= 0.0178 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=12.64 cfs @ 12.12 hrs HW=33.60' TW=31.40' (Dynamic Tailwater)
└─**1=RCP_Round 18"** (Inlet Controls 12.64 cfs @ 7.15 fps)

Summary for Pond EDMH7: DMH

Inflow Area = 1,249,125 sf, 29.62% Impervious, Inflow Depth = 1.80" for 100-Year event
Inflow = 20.39 cfs @ 12.26 hrs, Volume= 187,697 cf
Outflow = 20.39 cfs @ 12.26 hrs, Volume= 187,697 cf, Atten= 0%, Lag= 0.0 min
Primary = 20.39 cfs @ 12.26 hrs, Volume= 187,697 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 25.85' @ 12.26 hrs
Flood Elev= 31.53'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.03'	**24.0" Round Culvert** L= 143.2' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 23.03' / 16.80' S= 0.0435 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=20.39 cfs @ 12.26 hrs HW=25.85' TW=0.00' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 20.39 cfs @ 6.49 fps)

Summary for Pond ER1: 18" RCP

Inflow Area = 696,875 sf, 29.50% Impervious, Inflow Depth = 2.02" for 100-Year event
Inflow = 23.31 cfs @ 12.26 hrs, Volume= 117,491 cf
Outflow = 21.09 cfs @ 12.38 hrs, Volume= 117,490 cf, Atten= 10%, Lag= 7.1 min
Primary = 10.75 cfs @ 12.36 hrs, Volume= 104,287 cf
Secondary = 10.35 cfs @ 12.37 hrs, Volume= 13,202 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 51.31' @ 12.37 hrs Surf.Area= 11,329 sf Storage= 8,568 cf
Flood Elev= 50.00' Surf.Area= 1,453 sf Storage= 845 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 3.2 min (878.6 - 875.4)

Volume	Invert	Avail.Storage	Storage Description
#1	49.00'	18,875 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
49.00	237	0	0
50.00	1,453	845	845
51.00	7,939	4,696	5,541
52.00	18,728	13,334	18,875

Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	50.90'	**15.0' long x 3.0' 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 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32

Primary OutFlow Max=10.65 cfs @ 12.36 hrs HW=51.31' TW=49.75' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 10.65 cfs @ 6.03 fps)

Secondary OutFlow Max=10.34 cfs @ 12.37 hrs HW=51.31' TW=0.00' (Dynamic Tailwater)
└─**2=Broad-Crested Rectangular Weir** (Weir Controls 10.34 cfs @ 1.66 fps)

Summary for Pond PDMH1: PDMH1

Inflow Area = 720,842 sf, 29.99% Impervious, Inflow Depth = 1.92" for 100-Year event
Inflow = 12.61 cfs @ 12.18 hrs, Volume= 115,581 cf
Outflow = 12.61 cfs @ 12.18 hrs, Volume= 115,581 cf, Atten= 0%, Lag= 0.0 min
Primary = 12.61 cfs @ 12.18 hrs, Volume= 115,581 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 47.16' @ 12.14 hrs
Flood Elev= 48.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	43.50'	**18.0" Round Culvert** L= 112.3' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 43.50' / 40.45' S= 0.0272 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf

Primary OutFlow Max=12.65 cfs @ 12.18 hrs HW=46.60' TW=44.24' (Dynamic Tailwater)
└─**1=Culvert** (Outlet Controls 12.65 cfs @ 7.16 fps)

Summary for Pond PDMH2: PDMH2

Inflow Area = 1,032,014 sf, 29.87% Impervious, Inflow Depth = 1.96" for 100-Year event
Inflow = 24.16 cfs @ 12.18 hrs, Volume= 168,932 cf
Outflow = 24.16 cfs @ 12.18 hrs, Volume= 168,932 cf, Atten= 0%, Lag= 0.0 min
Primary = 24.16 cfs @ 12.18 hrs, Volume= 168,932 cf

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 29.58' @ 12.25 hrs
Flood Elev= 31.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	23.80'	**24.0" Round Culvert** L= 18.8' RCP, groove end projecting, Ke= 0.200 Inlet / Outlet Invert= 23.80' / 23.03' S= 0.0410 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 3.14 sf

Primary OutFlow Max=22.45 cfs @ 12.18 hrs HW=29.19' TW=27.78' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 22.45 cfs @ 7.15 fps)

Summary for Pond R1: 18" RCP

Inflow Area =	696,340 sf,	29.52% Impervious,	Inflow Depth =	2.02"	for 100-Year event
Inflow =	23.32 cfs @	12.26 hrs,	Volume=	117,405 cf	
Outflow =	19.20 cfs @	12.42 hrs,	Volume=	117,404 cf,	Atten= 18%, Lag= 9.7 min
Primary =	10.85 cfs @	12.42 hrs,	Volume=	105,150 cf	
Secondary =	8.35 cfs @	12.43 hrs,	Volume=	12,253 cf	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 51.38' @ 12.43 hrs Surf.Area= 12,008 sf Storage= 9,865 cf
Flood Elev= 50.00' Surf.Area= 1,500 sf Storage= 761 cf

Plug-Flow detention time= 3.7 min calculated for 117,404 cf (100% of inflow)
Center-of-Mass det. time= 3.6 min (878.9 - 875.3)

Volume	Invert	Avail.Storage	Storage Description
#1	48.00'	18,931 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
48.00	2	0	0
49.00	10	6	6
50.00	1,500	755	761
51.00	8,800	5,150	5,911
52.00	17,240	13,020	18,931

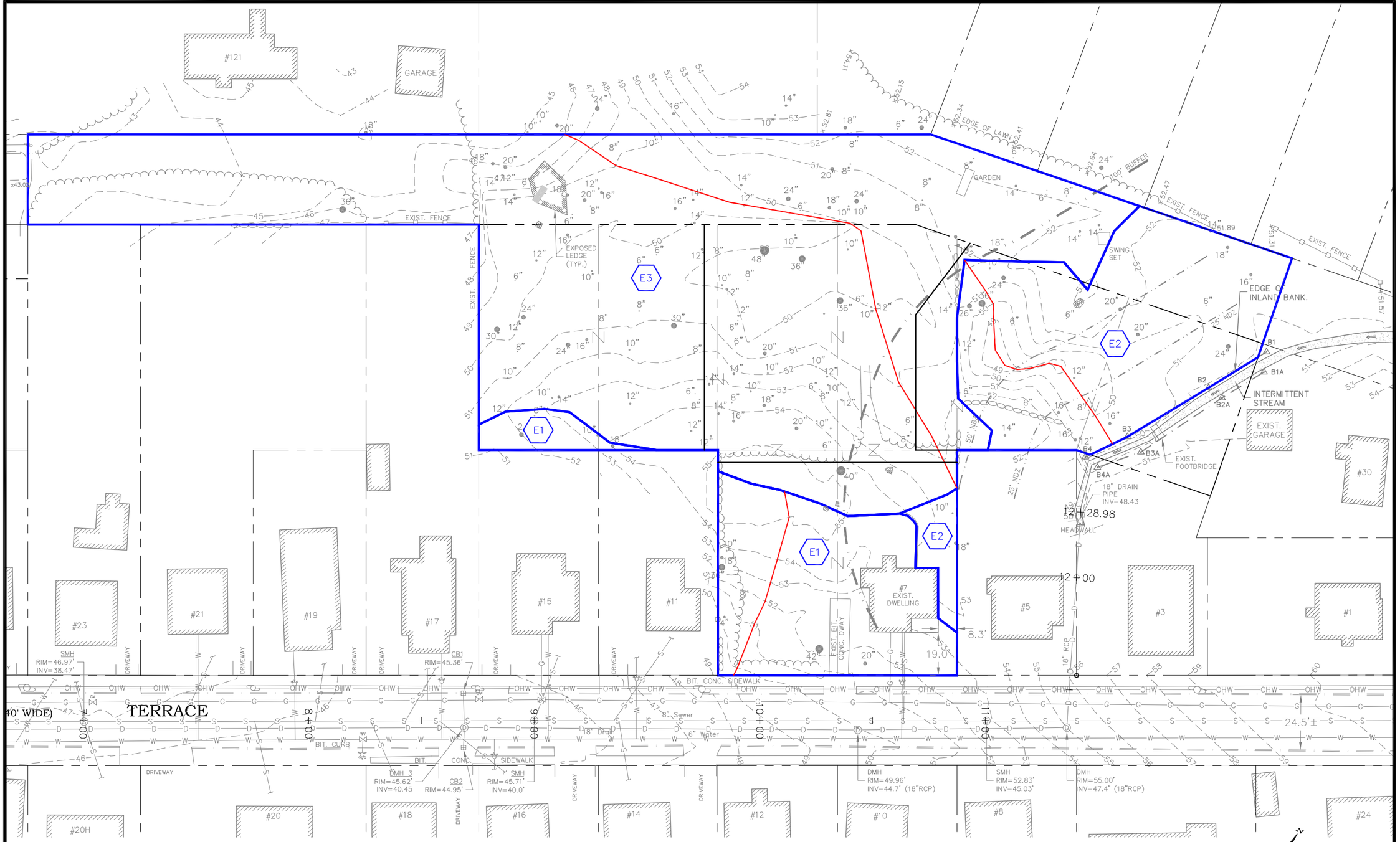
Device	Routing	Invert	Outlet Devices
#1	Primary	48.43'	**18.0" Round Culvert** L= 89.1' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 48.43' / 47.40' S= 0.0116 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#2	Secondary	49.50'	**18.0" Round Culvert** L= 235.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 49.50' / 48.50' S= 0.0043 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 1.77 sf
#3	Device 2	50.90'	**10.0' 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=10.78 cfs @ 12.42 hrs HW=51.38' TW=49.78' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 10.78 cfs @ 6.10 fps)

Secondary OutFlow Max=8.35 cfs @ 12.43 hrs HW=51.38' TW=0.00' (Dynamic Tailwater)
└─**2=Culvert** (Barrel Controls 8.35 cfs @ 4.85 fps)
└─**3=Broad-Crested Rectangular Weir** (Passes 8.35 cfs of 9.92 cfs potential flow)

ATTACHMENT D

SUBCATCHMENT PLANS



SUBCATCHMENT E1	SUBCATCHMENT E2	SUBCATCHMENT E3
BUILDING(S) = 933 SF	WOODS = 10,840 SF	WOODS = 31,951 SF
BIT. CONC. = 298 SF	GRASS (>75%) = 794 SF	GRASS (>75%) = 2,449 SF
WOODS = 880 SF	TOTAL = 11,634 SF	GRASS (50–75%) = 5,174 SF
GRASS (>75%) = 5,616 SF		WOODS/GRASS = 2,777 SF
WOODS/GRASS = 632 SF		TOTAL = 42,351 SF
TOTAL = 8,359 SF		

GRAPHIC SCALE

20 0 10 20 40 80

(IN FEET)
1 inch = 20 ft.

No.	Date	Description

Revisions

Griffin Engineering Group, LLC

495 Cabot Street, 2nd Floor
Beverly, MA 01915

Tel: 978-927-5111
Fax: 978-927-5103

LIVINGSTONE AVENUE IMPROVEMENTS BEVERLY, MA

EXISTING SUBCATCHMENT PLAN

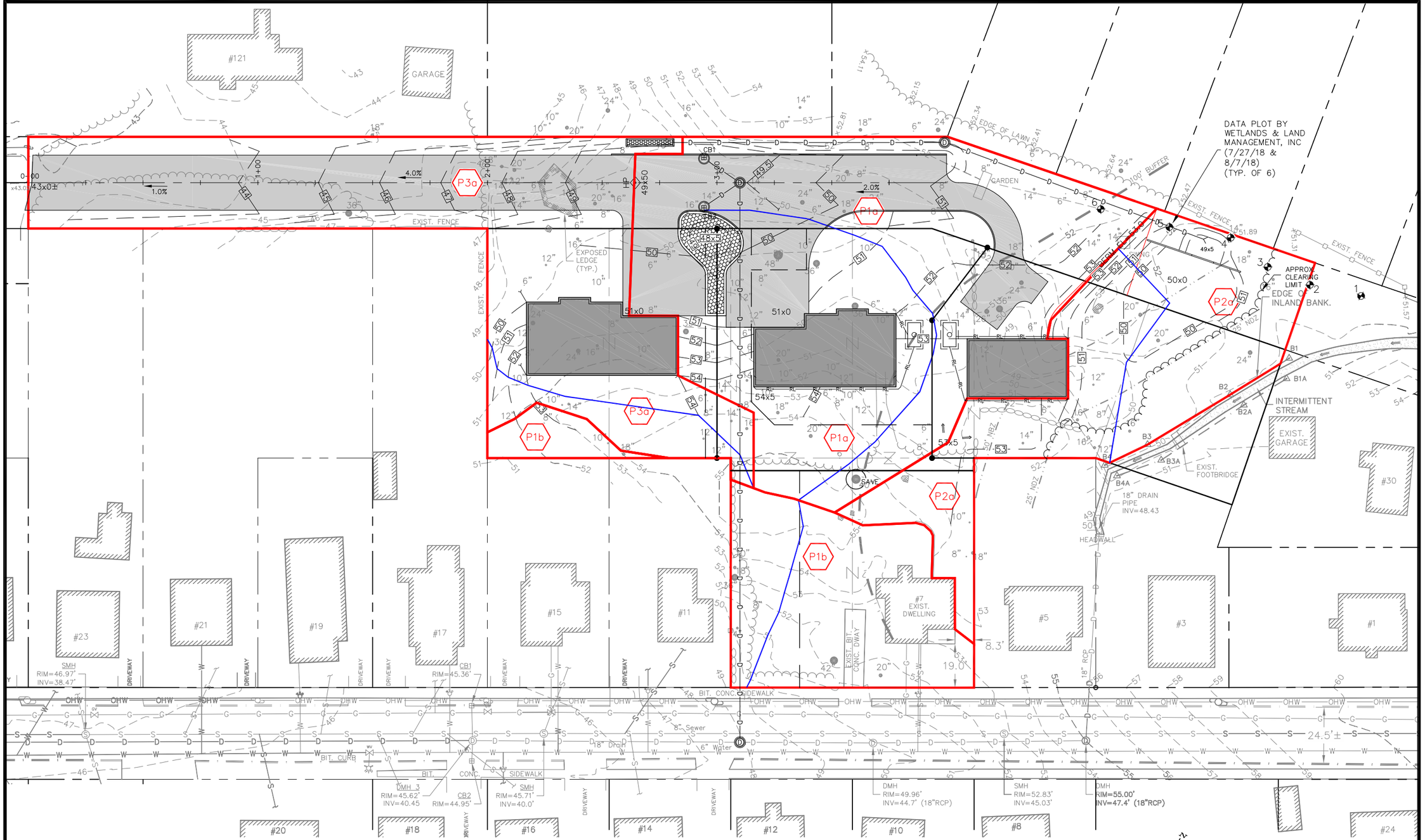
Scale: 1"=20'

Job No.: 1754

File Name: p/p/b/c

Date: 2/23/18

DR-1



SUBCATCHMENT P1a	SUBCATCHMENT P1b	SUBCATCHMENT P2a	SUBCATCHMENT P3a
BUILDING(S) = 3,024 SF	BUILDING(S) = 933 SF	WOODS = 2,756 SF	BUILDING(S) = 1,996 SF
BIT. CONC. = 7,578 SF	BIT. CONC. = 298 SF	GRASS (>75%) = 8,343 SF	BIT. CONC. = 6,484 SF
GRASS (>75%) = 13,900 SF	GRASS (>75%) = 7,245 SF	TOTAL = 11,099 SF	GRASS (>75%) = 9,787 SF
TOTAL = 24,502 SF	TOTAL = 8,476 SF		TOTAL = 18,267 SF

No.	Date	Description
3	3/27/19	REVISED TO REFLECT SITE PLAN CHANGES
2	12/27/18	REVISED TO REFLECT SITE PLAN CHANGES
1	12/17/18	REVISED TO REFLECT SITE PLAN CHANGES

Revisions

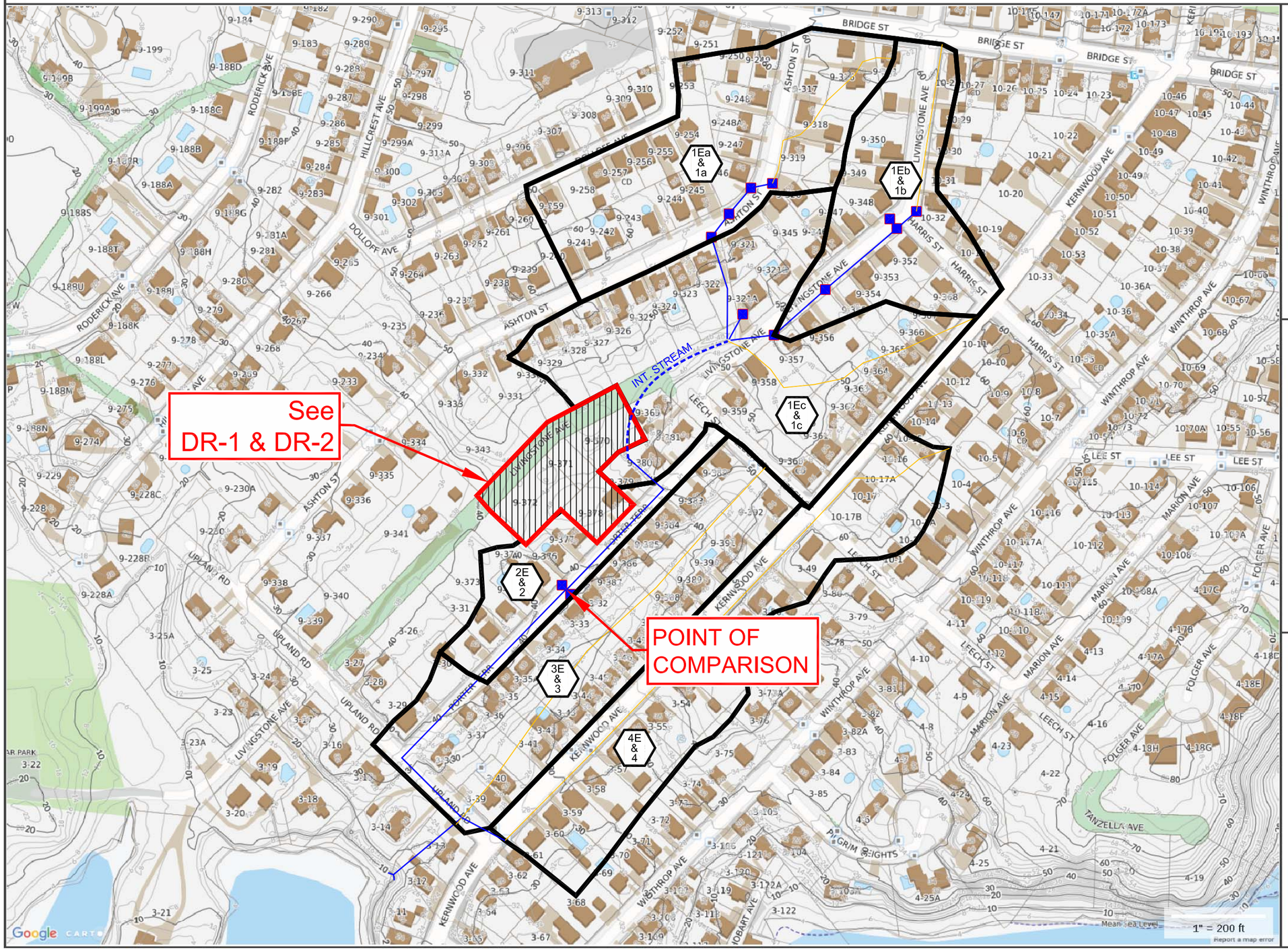
Griffin Engineering Group, LLC
495 Cabot Street, 2nd Floor
Beverly, MA 01915
Tel: 978-927-5111
Fax: 978-927-5103

LIVINGSTONE AVENUE IMPROVEMENTS
BEVERLY, MA

PROPOSED SUBCATCHMENT PLAN

Scale: 1"=20'
Job No.: 1754
File Name: p/p/b/m
Date: 2/23/18

DR-2



7 Porter Terrace

Expanded Drainage Area
Towards Porter Terrace Drain

MAP FOR REFERENCE ONLY
NOT A LEGAL DOCUMENT

City of Beverly, MA makes no claims and no warranties, expressed or implied, concerning the validity or accuracy of the GIS data presented on this map.

Parcels updated 8/1/2018
Properties updated 8/1/2018

SUBCATCHMENT 1Ea & 1a
1/3 ACRE LOTS = 224,344 SF

SUBCATCHMENT 1Eb & 1b
1/3 ACRE LOTS = 152,058 SF

SUBCATCHMENT 1Ec & 1c
1/3 ACRE LOTS = 308,839 SF

SUBCATCHMENT 2E & 2
1/3 ACRE LOTS = 75,649 SF

SUBCATCHMENT 3E & 3
1/3 ACRE LOTS = 241,195 SF

SUBCATCHMENT 4E & 4
1/3 ACRE LOTS = 227,047 SF

MARCH 27, 2019

DR-3

ATTACHMENT E

LONG TERM POLLUTION PREVENTION PLAN

Long Term Pollution Prevention Plan

Standard #4 of the MA DEP Stormwater Management Handbook requires that a Long Term Pollution Prevention Plan (LTPPP) be prepared and incorporated into the long term operation and maintenance plan of the projects stormwater management system. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges and to describe suggested practices to reduce pollutants in stormwater discharges.

Good housekeeping practices - The subject property owners are to keep the site in a neat and orderly condition so that pollutants are not conveyed to the storm drainage system. Materials swept, blown or washed into the storm drains can decrease the system's effectiveness and could eventually be conveyed into the adjacent wetland resource area. Some examples of good housekeeping practices are pavement sweeping, litter control, contained outdoor waste and proper cigarette disposal, and protected material storage areas. The property owners should assign responsibilities to personnel to keep the site in a neat and orderly condition.

Provisions for storing materials and waste products inside or under cover – There are no exterior (un-covered) storage areas associated with the project site. The trash and waste program include a weekly curbside trash pickup. A trash disposal company hired by the homeowners' association will pick up waste materials and properly dispose at a state approved disposal facility.

Requirements for routine inspections and maintenance of stormwater BMP's - Consistent with Standard 9 of the Massachusetts Stormwater Management Regulations, an Operation and Maintenance Plan has been provided in the Stormwater Management Report. The plan details routine inspection and maintenance of the stormwater BMP's along with associated record keeping forms.

Spill prevention and response plans – Sources of potential spill hazards include vehicle fluids and fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids and fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

1) Spill hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
2) Vehicle fluid and fuel spills shall be remediated according to local and state regulations governing fuel spills.
3) The property owners shall have the following equipment and materials on hand

to address a spill clean-up: brooms, dust-pans, mops, rags, gloves, trash bags, trash containers, and absorptive materials such as sand, sawdust, or kitty litter.

4) Spills of toxic or hazardous materials shall be reported to the Massachusetts Department of Environmental Protection at 1-888-304-1133.

Provisions for maintenance of lawns, garden, and other landscaped areas - It should be a general goal of the subject property owners to achieve a high quality of well-groomed and stable landscape that evolves throughout the changing seasons and overall condition of the property. All landscaped areas are to be maintained with dense vegetative growth or a layer of mulch so as to minimize sediment transport. Litter and waste is to be removed weekly from the landscaped areas and adjoining parking lots and disposed of properly.

Requirements for storage and use of fertilizer, herbicides, and pesticides - Fertilizers, herbicides, and pesticides are not to be stored on site or within the buildings. Should use of same become necessary, application should be performed by a state licensed contractor in accordance with the manufacturer's label instruction and when environmental conditions are conducive to product application. Chemical controls should be used as a last resort to organic and biological control methods.

Pet waste management provisions - All pet waste is to be scooped up, sealed in a plastic bag, and disposed of properly in the garbage. Never deposit pet waste in the stormwater management system for it contains high level of fecal coliform bacteria.

Provisions for operation and management of septic systems – There are no septic systems associated with the project site. The sanitary sewer is proposed to be connected to the town sewer main in Porter Terrace.

Snow disposal and deicing chemicals – The common driveway is designed with 24 feet of pavement. This should provide ample width to maintain reasonable travel lanes with snow cast along the edge of the roadway and shoulders. Snow removal has generally not been necessary in newly-constructed residential subdivisions in Beverly in recent years, with the exception of limited clearing of snow banks at intersections to provide a path for adjoining sidewalks and to increase visibility. In these instances snow is usually moved less than 100 feet to a more convenient location. No snow is to be moved to within 100 feet of a wetland resource area.

The individual property owners will be responsible for the clearing of their individual driveways and building entrances. The owners may be required to use a de-icing agent such as salt or potassium chloride to maintain a safe walking surface. The de-icing agent for the walkways and building entrances should be kept on site within a building (i.e. garage).

ATTACHMENT F

OPERATION &
MAINTENANCE
PLAN

Operation & Maintenance Plan.

System Owner: 7 Porter Terrace, LLC (or Successor)

Party Responsible for O&M:	Drainage structures will be maintained by individual lot owners. This includes the drywells, catchbasins, water quality structure, subsurface detention field, drain manholes and piping.
Access / Easements:	Post-Construction: Drainage easements will be granted as indicated on the Definitive Subdivision Plan.

Note: The inspector should note that drainage pipes, treatment tanks and catchbasins often are considered "confined spaces" subject to strict OSHA standards regarding safe entry. Confined spaces present inherent hazards to workers. Only appropriately trained staff with appropriate safety equipment and monitors may enter confined spaces, and then only with a specific entry permit. Also, this work may pose hazards to workers, such as soft ground, flowing or standing water, snakes and rodents. Again, only appropriately trained staff with the necessary safety equipment should undertake such work.

The drainage system is to be operated and maintained in accordance with the following:

Part I: Construction Phase Controls

Roadway Construction Phasing: Construction shall proceed in the following sequence:

1. Install Erosion Controls downhill of work areas. Inspection and maintenance of these Erosion Controls is required throughout the project as detailed below.

2. Clear & Grub areas only as needed.

3. Bring road alignments to rough subgrade.

4. Install underground utilities and subsurface detention field.

5. Fine grade road and install binder course of bituminous pavement.

6. Install final paving.

Throughout construction, haybales and siltation controls are to be placed around drain inlets and low points in the excavation to prevent silt from entering the drainage system. These controls are to be inspected daily and maintained throughout the duration of the construction phase. Whenever sediment depths accumulate to a depth of six-inches next to the barrier, the sediment is to be removed.

The contractor shall install non-woven geotextile fabric between the frame and grate of catchbasins during construction to capture sediment. The fabric shall be maintained and sediment removed as needed throughout construction.

Home Construction Phasing: Construction shall proceed in the following sequence.

1. Install Erosion Controls downhill of work areas. Inspection and maintenance of these Erosion Controls is required throughout the project as detailed below.

2. Clear & Grub lots only as needed.

3. Install construction entrance (rip rap apron) along street line. Install gravel drive for construction vehicles.

4. Excavate foundation hole and install foundation.

5. Backfill around the foundation, install building utilities, and rough grade site. Construct structure.

6. Install driveway and landscaping.

Part II: Post-Development Controls

1). Inspections. Inspection of the drainage system components are to be performed by the System Owner during the first year of operation on a quarterly basis. The inspection frequency can be reduced after the first year to annual inspections provided that the quarterly inspections do not indicate the need for more frequent inspections. If more frequent inspections become appropriate at any time, they should be implemented. Inspections should be documented by taking necessary notes, measurements, photographs, and retaining service receipts. The following inspections are required of the system owner.

Roadway. Remove debris from the roadway as it accumulates, as part of normal site clean-up. Weekly patrolling for litter is recommended. Sand from ice control should be removed monthly via a street sweeper during the winter season. Significant oil leaks should be swept up and disposed of using oil-absorbent material as they are discovered. Any oil spills or leaks that reach the

catchbasins must be reported to the Massachusetts DEP oil spill hotline.

Catchbasins & Drain Manholes - Remove the grate or cover and visually inspect for corrosion and structural damage. Inspect pipe inlets and bottoms for signs of infiltration or inflow. The grate or cover and hoods on the catchbasins should be inspected on a quarterly basis during the first and year and semi-annual thereafter. Cleaning of the catchbasins should be done on a yearly basis and by a vacuum truck or clamshell. While cleaning, if a layer of oil is observed floating on the water surface, place an oil-absorbent pillow on the surface, allow to soak and remove. Repeat this process until the oil layer is removed. Alternatively, have the oil layer pumped out by a licensed disposal contractor and appropriately disposed of. The oil absorbent pillows must be drummed for disposal by a licensed disposal contractor.

First Defense Stormwater Treatment Device – A copy of the manufacturer's Operation & Maintenance Manual is provided at the end of this section which contains the required operation and maintenance procedures for the treatment devices. The devices should be inspected for corrosion and structural damage on a quarterly basis during the first year and semi-annually thereafter. The device also should be cleaned on a yearly basis and in accordance with the manufacturer's procedural recommendations.

Recharge Structures (Drywells). Initially, inspect the recharge structures after major storms to ensure proper function and stabilization. Record water levels over several days to check for the infiltration performance. After the first year, inspect the recharge structures annually for silt buildup or clogging.

2). Snow Storage. The new roadway is designed with 24 feet of pavement and shoulder throughout. This should provide ample width to maintain reasonable travel lanes with snow cast along the edge of the roadway and reserve strip. Snow removal has not proven necessary in newly-constructed residential subdivisions in Beverly in recent years, with the possible exception of very limited clearing of snow banks at intersections to provide a path for adjoining sidewalks and to increased visibility. In these instances snow is usually moved less than 100 feet to a more convenient location.

TABLE 1: Construction Phase Inspection and Maintenance Procedures

Control	Inspection Frequency (1)	Maintenance Procedure
Construction Entrance	Weekly	a
Silt Fence	Weekly	a
Rip Rap	Weekly	a
Dust Control	Daily	b
Permanent Stabilization	Weekly	c

1. Inspection frequencies are a minimum. Site conditions may warrant more frequent review. All control shall be inspected after each storm event which exceeds 0.5 inches in 24-hours.

2. Maintenance Procedures shall be reviewed and revised as necessary to protect the environment.

   a. Remove accumulated debris and replace as necessary.
   b. Water or calcium chloride shall be utilized to prevent the generation of dust.
   c. Disturbed areas shall either be paved or stabilized by permanent seeding.

Inspection forms are to be completed weekly and retained with project files.

INSPECTION AND MAINTENANCE REPORT FORM

TO BE COMPLETED EVERY 7 DAYS AND WITHIN 24 HOURS OF
A RAINFALL EVENT OF 0.5 INCHES OR MORE

INSPECTOR:_____
DATE:_____
INSPECTOR'S QUALIFICATIONS:
_____
_____
DAYS SINCE LAST RAINFALL:_____

AMOUNT OF LAST RAINFALL:_____ INCHES

STABILIZATION MEASURES

Project Area	Date Since Last Disturbed	Date of Next Disturbance	Stabilized? (Yes/No)	Stabilized With	Condition
North East South West					

STABILIZATION REQUIRED:
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE_____

INSPECTION AND MAINTENANCE REPORT FORM

STABILIZED CONSTRUCTION ENTRANCE

Does Sediment Get Tracked onto the Road?	Is the Gravel Clean or is it Filled with Sediment?	Does All Traffic Use the Stabilized Exit to Leave the Site?

MAINTENANCE REQUIRED FOR ENTRANCE:

_____
_____
_____
_____
_____

TO BE PERFORMED BY:_____ ON OR BEFORE_____

INSPECTION AND MAINTENANCE REPORT FORM

SILT FENCE or HAYBALES

Location	Depth of Sediment Build-Up	Sediment Need Removal?	Need Replacement?
Eastern Side			
Southern Side			
Western Side			
Northern Side			

MAINTENANCE REQUIRED:

_____

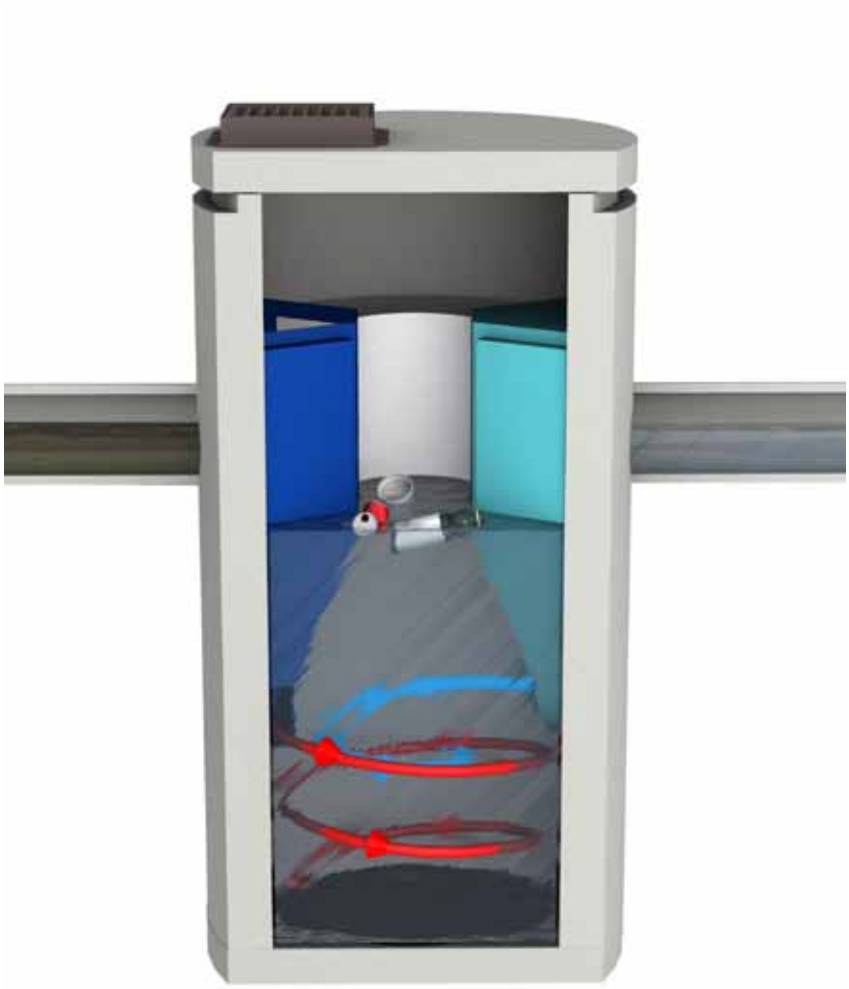
_____

TO BE PERFORMED BY:_____ ON OR BEFORE_____

OPERATION & MAINTENANCE PLAN SCHEDULE

Project: Livingstone Avenue Improvements
Project Address: 7 Porter Terrace
Date: 3/27/2019
Party Responsible: 7 Porter Terrace, LLC
Annual Maint. Budget: $1,700

Task	Description/Schedule	Maintenance Activity	Est. Annual Maint. Cost	Inspection	
				Date:	Inspector:
Street Sweeping	Perform sweeping of paved roadway after spring thaw to remove any traction sand applied during the winter months. Also, perform sweeping during late fall to remove any leaf litter and debris.	Sweep, power broom, or vacuum paved areas	$850		
Catchbasins & Drain Manholes	Inspect grates, covers, and hoods quarterly for the first year and semi-annual thereafter. Also, inspect pipe inlets and precast structures for infiltration and inflow.	Vacuum Deep Sump Annually	$500		
First Defense Water Quality Treatment Devices	Inspect covers, inlets, and plastic insert quarterly for the first year and semi-annual thereafter. Clean yearly per Manufacturers' recommendations	Vacuum Deep Sump Annually	$350		
Drywell Infiltration Structures	Inspect after each major storm even (>1 inch) for the first year and semi annually thereafter. Record water level over several hours.	None unless Insp. Warrants Otherwise	--		



Operation and Maintenance Manual

First® Defense

Vortex Separator for Stormwater Treatment

Stormwater Solutions

Turning Water Around ...®

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DISCLAIMER: Information and data contained in this manual is exclusively for the purpose of assisting in the operation and maintenance of Hydro International plc's First Defense®. No warranty is given nor can liability be accepted for use of this information for any other purpose. Hydro International plc has a policy of continuous product development and reserves the right to amend specifications without notice.

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

First Defense® by Hydro International

Capturing more than 25 years of separation design experience, the First Defense® is Hydro International's latest addition to its family of hydrodynamic vortex separators intended for stormwater applications. It has been developed with ease of installation and maintenance at the forefront without sacrificing performance or design flexibility.

All internal components are housed in either a 4-ft or 6-ft diameter precast manhole that is designed to withstand traffic loads. Each model can be used as a catch basin inlet or standard manhole with solid cover so that runoff can enter from an overhead grate, inlet pipe or both without diminishing performance.

The First Defense® has internal components that are designed to generate rotational flow within the device without requiring a tangential inlet. Flow within the precast chamber is controlled to prevent turbulence and its unique reverse-flow outlet intake ensures a longer retention time by preventing short-circuiting. An internal bypass prevents high flow re-suspension and washout and eliminates the need for additional bypass structures. The internals can easily be adjusted to change the angle between the inlet and outlet for storm drain directional changes and dual inlets can be accomodated in most cases. This simplifies grading and site design so that flow can be conveyed from isolated locations within the same site without increasing the number of structures.

For removal of fine sediment and associated pollutants, oil spills, trash and debris, the first choice in stormwater treatment systems is the First Defense®.

First Defense® Components

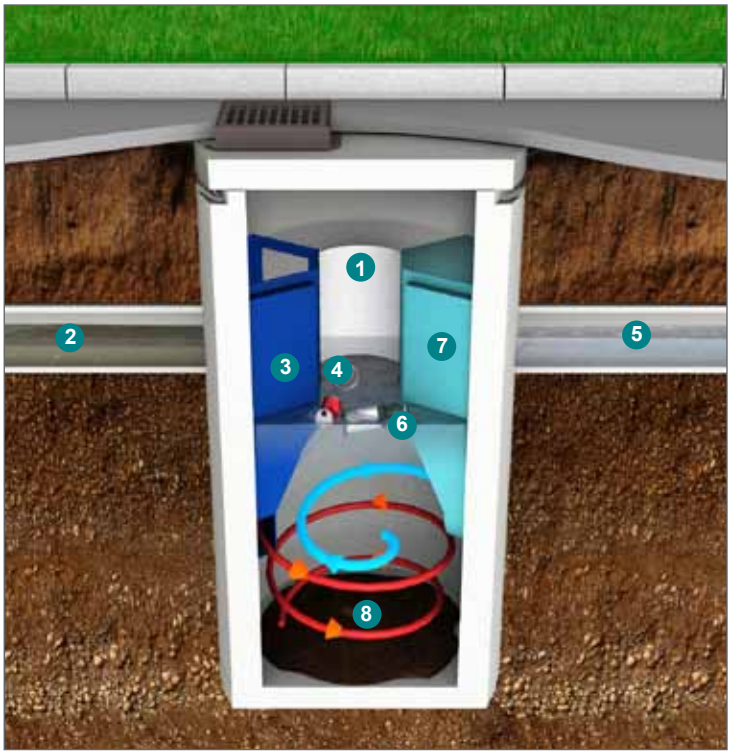
1. **Built-In Bypass**
2. **Inlet Pipe**
3. **Inlet Chute**
4. **Floatables Draw-off Port (not pictured)**
5. **Outlet Pipe**
6. **Floatables Storage**
7. **Outlet Chute**
8. **Sediment Storage**

Benefits of the First Defense®

- Compact and flexible design
  - Can be used as a catch basin inlet and directional change manhole
  - Optional one or two inlets
  - Does not require a bypass structure
- Hydrodynamic Vortex Separation
  - Extended and structured flow path
  - Minimal headloss
  - Reduces turbulence and re-suspension
  - Reverse-flow outlet intake prevents short-circuiting
  - Improved efficiency for all flows
- Delivered Pre-assembled for easy and fast installation
- Simple to inspect and maintain
- Independently verified

Applications

- New developments and retrofits
- Utility yards
- Streets and roadways
- Parking lots
- Pre-treatment for filters, infiltration and storage
- Industrial and commercial facilities
- Wetlands protection



Operation

Introduction

The First Defense® operates on simple fluid hydraulics. It is self-activating, has no moving parts, no external power requirement and is fabricated with durable non-corrosive components. No manual procedures are required to operate the unit and maintenance is limited to monitoring accumulations of stored pollutants and periodic clean-outs. The First Defense® has been designed to allow for easy and safe access for inspection, monitoring and clean-out procedures. Neither entry into the unit nor removal of the internal components is necessary for maintenance, thus safety concerns related to confined-space-entry are avoided.

Pollutant Capture and Retention

The internal components of the First Defense® have been designed to optimize pollutant capture. Sediment is captured and retained in the base of the unit, while oil and floatables are stored on the water surface in the inner volume. The pollutant storage volumes are isolated from the built-in bypass chamber to prevent washout during high-flow internally-bypassed storm events. Accessories such as oil absorbant pads are available for enhanced oil removal and storage. Due to the separation of the oil and floatable storage volume from the outlet, the potential for washout of stored pollutants between clean-outs is minimized.

Wet Sump

The sump of the First Defense® retains a standing water level between storm events. The water in the sump prevents stored sediment from solidifying in the base of the unit. The clean-out procedure becomes more difficult and labor intensive if the system allows fine sediment to dry-out and consolidate. Dried sediment must be manually removed by maintenance crews. This is a labor intensive operation in a hazardous environment.

Maintenance

Overview

The First Defense® protects the environment by removing a wide range of pollutants from stormwater runoff. Periodic removal of these captured pollutants is essential to the continuous, long-term functioning of the First Defense®. The First Defense® will capture and retain sediment and oil until the sediment and oil storage volumes are full to capacity. When sediment and oil storage capacities are reached, the First Defense® will no longer be able to store removed sediment and oil. Maximum pollutant storage capacities are provided in Table 1.

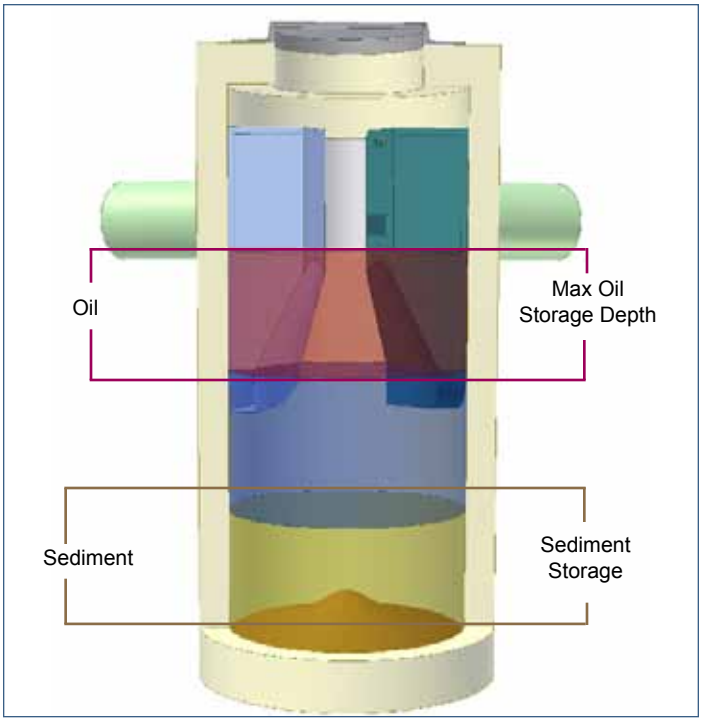


Fig.1 Pollutant storage volumes in the First Defense®.

The First Defense® allows for easy and safe inspection, monitoring and clean-out procedures. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables. Access ports are located in the top of the manhole.

Maintenance events may include Inspection, Oil & Floatables Removal, and Sediment Removal. Maintenance events do not require entry into the First Defense®, nor do they require the internal components of the First Defense® to be removed. In the case of inspection and floatables removal, a vactor truck is not required. However, a vactor truck is required if the maintenance event is to include oil removal and/or sediment removal.

Determining Your Maintenance Schedule

The frequency of cleanout is determined in the field after installation. During the first year of operation, the unit should be inspected every six months to determine the rate of sediment and floatables accumulation. A simple probe such as a Sludge Judge® can be used to determine the level of accumulated solids stored in the sump. This information can be recorded in the maintenance log (see page 9) to establish a routine maintenance schedule.

The vactor procedure, including both sediment and oil/flotables removal, for a 6-ft First Defense® typically takes less than 30 minutes and removes a combined water/oil volume of about 800 gallons.

Inspection

Inspection is a simple process that does not involve entry into the First Defense®. Maintenance crews should be familiar with the First Defense® and its components prior to inspection.

Scheduling

- It is important to inspect your First Defense® every six months during the first year of operation to determine your site-specific rate of pollutant accumulation.
- Typically, inspection may be conducted during any season of the year.

Recommended Equipment

- Safety Equipment and Personal Protective Equipment (traffic cones, work gloves, etc.)
- Crow bar or other tool to remove grate or lid
- Pole with skimmer or net
- Sediment probe (such as a Sludge Judge®)
- Trash bag for removed floatables
- First Defense® Maintenance Log

Table 1. First Defense® Pollutant Storage Capacities and Maximum Cleanout Depths

Unit Diameter	Total Oil Storage	Oil Clean-out Depth	Total Sediment Storage	Sediment Clean-out Depth	Max. Liquid Volume Removed
(ft)	(gal)	(in)	(gal)	(in)	(gal)
4	180	<23.5	202	26	202-342
6	420	<23.5	626	36	626-1,046

NOTE

The total volume removed will depend on the oil accumulation level. Oil accumulation is typically much less than sediment, however removal of oil and sediment during the same service is recommended.

Inspection Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities. Fig.2 shows the standing water level that should be observed.

4. Without entering the vessel, use the pole with the skimmer net to remove floatables and loose debris from the outer annulus of the chamber.

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel.

6. On the Maintenance Log (see page 9), record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components or blockages.

7. Securely replace the grate or lid.

8. Take down safety equipment.

9. Notify Hydro International of any irregularities noted during inspection.

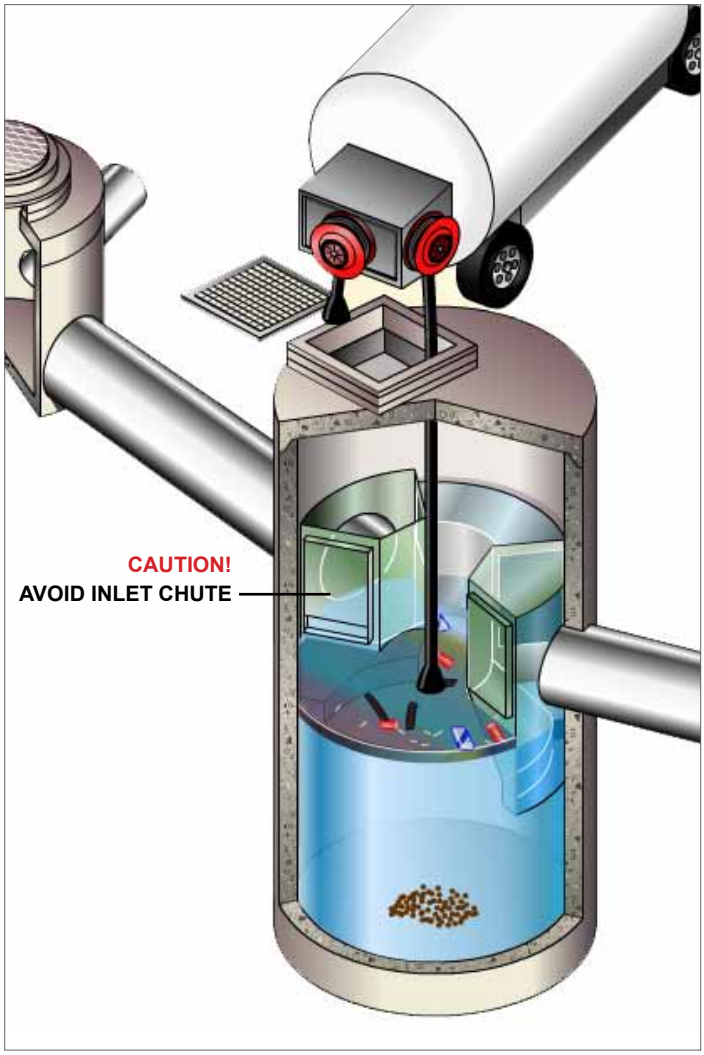


Fig.2 Floatables are removed with a vactor hose.

Floatables and Sediment Cleanout

Floatables cleanout is typically done in conjunction with sediment removal. A commercially or municipally owned sump-vac is used to remove captured sediment and floatables (Fig.2).

Floatables and loose debris can also be netted with a skimmer and pole. The access port located at the top of the manhole provides unobstructed access for a vactor hose and skimmer pole to be lowered to the base of the sump.

Scheduling

- Floatables and sump cleanout are typically conducted once a year during any season.

- Floatables and sump cleanout should occur as soon as possible following a spill in the contributing drainage area.

Recommended Equipment

- Safety Equipment (traffic cones, etc)

- Crow bar or other tool to remove grate or lid

- Pole with skimmer or net (if only floatables are being removed)

- Sediment probe (such as a Sludge Judge®)

- Vactor truck (flexible hose recommended)

- First Defense® Maintenance Log

Floatables and sediment Clean Out Procedures

1. Set up any necessary safety equipment around the access port or grate of the First Defense® as stipulated by local ordinances. Safety equipment should notify passing pedestrian and road traffic that work is being done.

2. Remove the grate or lid to the manhole.

3. Without entering the vessel, look down into the chamber to inspect the inside. Make note of any irregularities.

4. Remove oil and floatables stored on the surface of the water with the vactor hose (Fig.2) or with the skimmer or net (not pictured).

5. Using a sediment probe such as a Sludge Judge®, measure the depth of sediment that has collected in the sump of the vessel and record it in the Maintenance Log (page 9).

6. Once all floatables have been removed, drop the vactor hose to the base of the sump. Vactor out the sediment and gross debris off the sump floor (Fig.3).

7. Retract the vactor hose from the vessel.

8. On the Maintenance Log provided by Hydro International, record the date, unit location, estimated volume of floatables and gross debris removed, and the depth of sediment measured. Also note any apparent irregularities such as damaged components, blockages, or irregularly high or low water levels.

9. Securely replace the grate or lid.

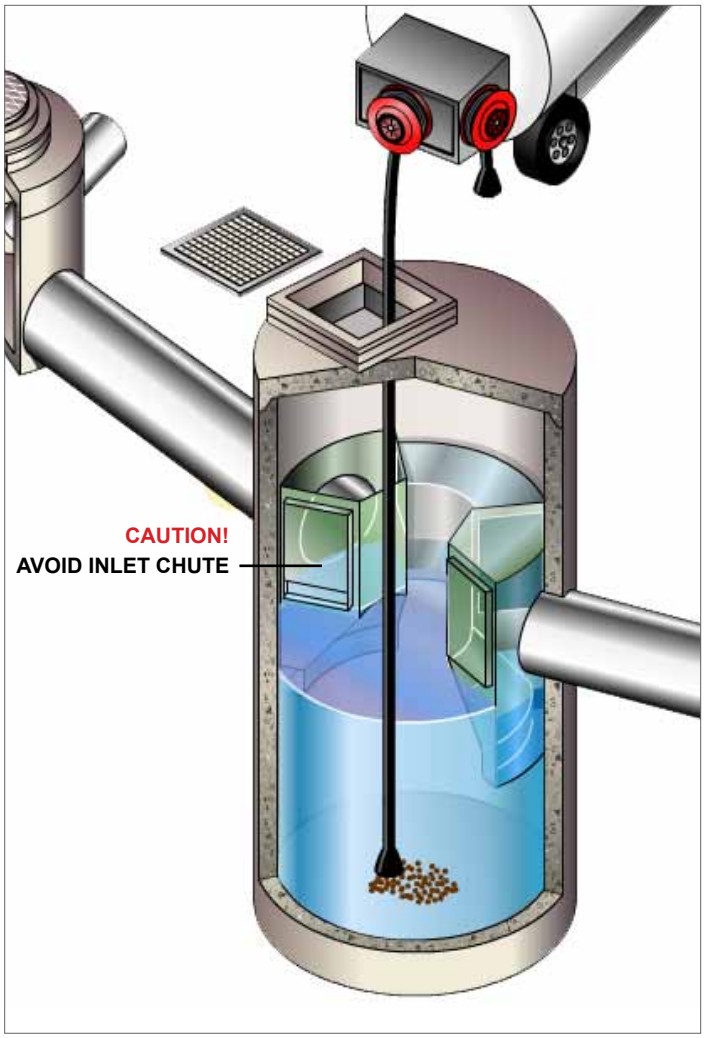


Fig.3 Sediment is removed with a vactor hose

Maintenance at a Glance

Activity	Frequency
Inspection	- Regularly during first year of installation - Every 6 months after the first year of installation
Oil and Floatables Removal	- Once per year, with sediment removal - Following a spill in the drainage area
Sediment Removal	- Once per year or as needed - Following a spill in the drainage area
NOTE: For most cleanouts it is not necessary to remove the entire volume of liquid in the vessel. Only removing the first few inches of oils/floatables and the sediment storage volume is required.	

First Defense® Installation Log

HYDRO INTERNATIONAL REFERENCE NUMBER:	
SITE NAME:	
SITE LOCATION:	
OWNER:	CONTRACTOR:
CONTACT NAME:	CONTACT NAME:
COMPANY NAME:	COMPANY NAME:
ADDRESS:	ADDRESS:
TELEPHONE:	TELEPHONE:
FAX:	FAX:

INSTALLATION DATE: / /

MODEL SIZE (CIRCLE ONE): **4-FT** **6-FT**

INLET (CIRCLE ALL THAT APPLY): **GRATE INLET (CATCH BASIN)** **INLET PIPE (FLOW THROUGH)**

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

First Defense® Inspection and Maintenance Log

Date	Initials	Depth of Floatables and Oils	Sediment Depth Measured	Volume of Sediment Removed	Site Activity and Comments

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Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

Hydro International (Stormwater), 94 Hutchins Drive, Portland ME 04102
Tel: (207) 756-6200 Fax: (207) 756-6212 Web: www.hydro-int.com

What is HX?

HX is Hydro Experience, it is the essence of Hydro. It's interwoven into every strand of Hydro's story, from our products to our people, our engineering pedigree to our approach to business and problem-solving.

HX is a stamp of quality and a mark of our commitment to optimum process performance. A Hydro solution is tried, tested and proven.

There is no equivalent to Hydro HX.

Stormwater Solutions

94 Hutchins Drive
Portland, ME 04102

Tel: (207) 756-6200
Fax: (207) 756-6212
stormwaterinquiry@hydro-int.com

www.hydro-int.com

Turning Water Around...®

FD_O+M_B1209

ATTACHMENT G

ILLICIT DISCHARGE
STATEMENT

ILLICIT DISCHARGE COMPLIANCE STATEMENT

I verify that no illicit discharges exist from the 7 Porter Terrace residential subdivision. Through the implementation of Long Term Pollution Prevention Plan and Operation and Maintenance Plan, measures are set forth to prevent illicit discharges from entering the stormwater management drainage system.

Signature	**Print Name**	**Date**
Title	**Company**	
Signature	**Print Name**	**Date**
Title	**Company**	

Note: This certification must be signed before stormwater is conveyed to the proposed stormwater drainage system in accordance with Standard 10 of the Massachusetts Stormwater Management Standards.

ATTACHMENT H

PROPRIETARY
SEPARATOR
THIRD-PARTY
EVALUATION

Hydro International stormwater

stormwater

www.hydro-international.biz

First Defense®
Performance Evaluation

For submission to the Massachusetts Stormwater Technology Evaluation Project (MASTEP)
Stormwater Technology Clearinghouse

February, 2011

First Defense® Performance Evaluation

Summary

Hydro International successfully completed First Defense® laboratory testing to assess washout retention and SSC/TSS removal efficiency. Test procedures were based on NJDEP and WI DNR protocols. Performance evaluation included varying flow rates up to 200% of the Maximum Treatment Flow Rate (MTFR) and varying influent concentrations using OK-110 silica sand, with 50% pre-loaded sediment sump.

Positive removals were achieved for all flows and concentrations, with greater than 70% SSC/TSS efficiency based on the NJDEP weighted removal efficiency calculation method. Non-detectable (<4 mg/L) SSC and TSS effluent concentrations and over 90% sediment retention indicated that no detectable washout had occurred.

These findings indicate that washout would be minimal even with a larger MTFR or a shallower sump design. Alternatively, it is reasonable to expect that finer particle sizes with lower settling velocities would be retained and not washed out at the tested flow rates.

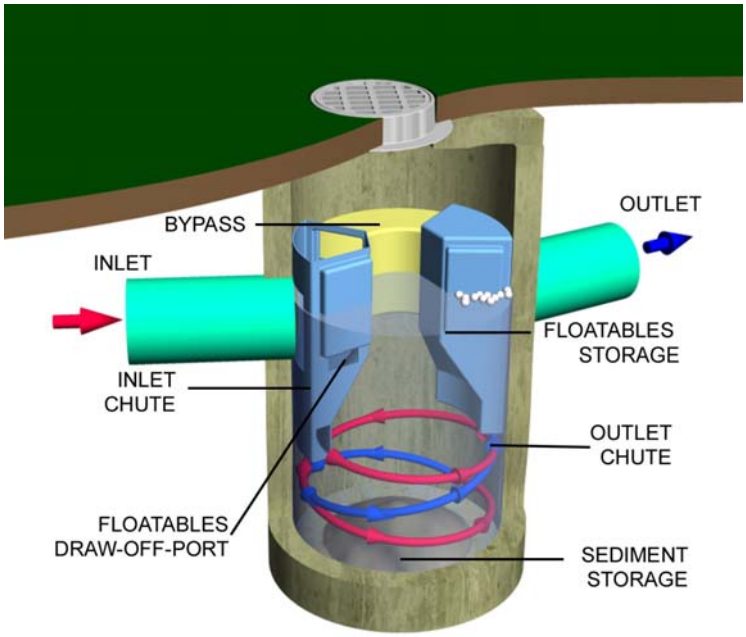

Figure 1: First Defense® - Internal components and flow path

Introduction

The First Defense® is an enhanced vortex separator designed to remove floating and settleable pollutants commonly found in stormwater runoff. A key feature of the First Defense is an internal Bypass Chute (Figure 1) that allows treatment without requiring additional flow-diversion structures and prevents scour velocities from re-suspending captured pollutants. The MTFRs are 0.7 cfs and 2.2 cfs for the 4-ft and 6-ft diameter models, respectively. Internal weirs are set to ensure all flows up to the MTFRs can be treated without bypass. This laboratory-based test program was conducted to evaluate the overall system performance while accounting for variable inlet concentrations and sediment retention over a wide range of loading rates.

Test Objectives

The First Defense was tested utilizing protocols that met or exceeded the most recent recommendations by testing authorities, including NJDEP and WIDNR. Objectives included:

- Determine the MTFR using washout as the limiting factor.
- Quantify washout at 125% and 200% of the MTFR by measuring the maximum effluent concentration and maximum allowable reduction in sump load.
- Determine the Suspended Sediment Concentration (SSC) and Total Suspended Solids (TSS) removal efficiency for inlet concentrations of 50 mg/L, 100 mg/L, and 200 mg/L at 25%, 50%, 75%, 100%, and 125% of the MTFR, with the sump filled to 50% of the maximum storage volume.
- Determine the weighted removal efficiency based on the calculation method described in the NJDEP protocol for laboratory testing of hydrodynamic sedimentation devices.
- Provide independent witnessing during testing to validate and confirm procedures described and followed in this report.
- Validate TSS and SSC analytics by outsourcing samples to an independent, state-certified laboratory.

In an effort to satisfy regulations that require results reported according to TSS procedures, results of this study included both TSS and SSC analysis. Recent settleable solids performance evaluations are reporting percent removal of SSC with a general consensus that SSC methods can improve the accuracy and repeatability of measurements for samples that have relatively high sediment settling velocities.

Test System Description

The distribution of the test material, US Silica OK-110, is shown in Figure 2. Approximately 20% of the particles are less than 75 µm with the remaining 80% are between 75 and 150 µm.

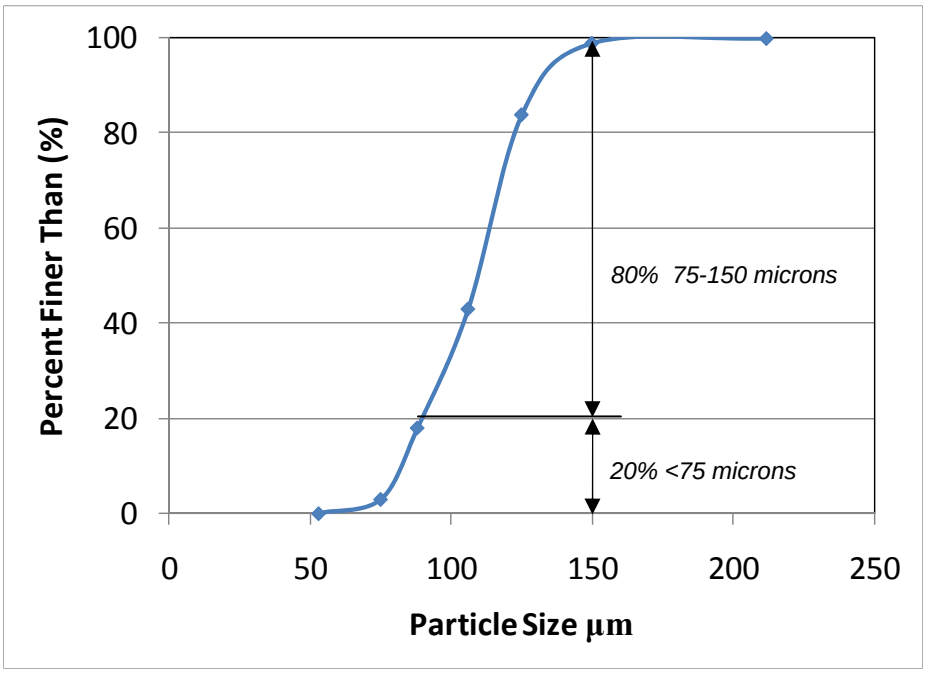

Figure 2: Test sand particle size gradation (OK-110)

A full-scale First Defense with 4-ft diameter vortex chamber was tested at Hydro International's state-of-the-art hydraulics laboratory in Portland, ME. Clean water from a 23,000-gallon reservoir was pumped using an 8-inch variable Flygt pump at targeted flow rates through a pipe network to the First Defense (see Figure 3). Dosing equipment delivered a slurry of the OK-110 test material to the First Defense. Grab samples were collected at the inlet sampling point and effluent pipe. Effluent was discharged back into the reservoir.

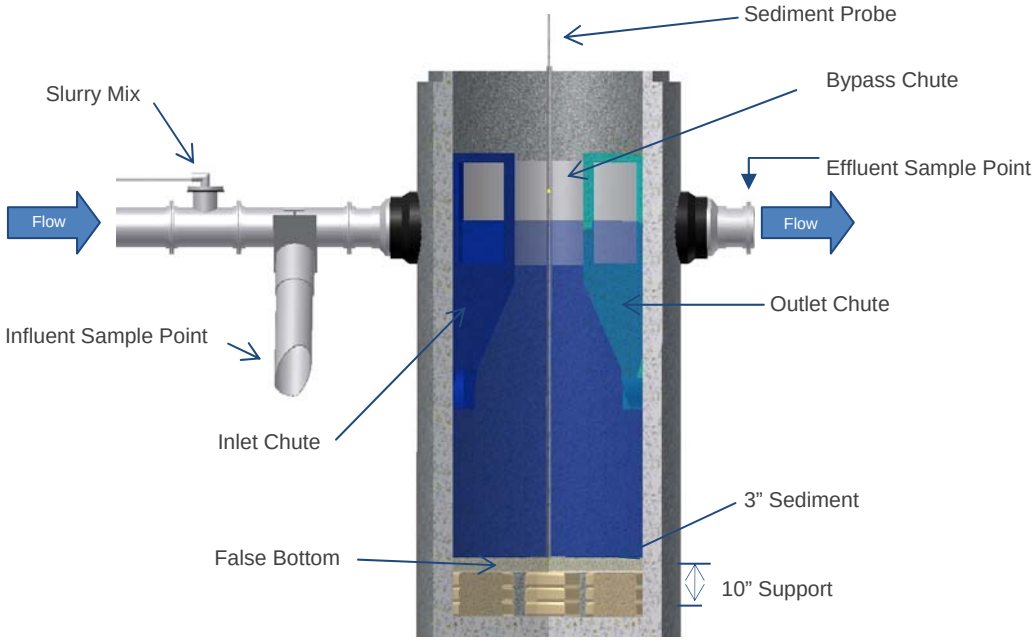

Figure 3: Cutaway diagram of test setup with false bottom, sediment probe and internal components

Washout Test Procedure

The sediment storage sump was pre-loaded to 50% maximum storage volume by depositing greater than three inches of OK-110 on a false floor 10 inches from the sump bottom (Figure 3). The sediment depth was measured with a sediment probe at thirteen locations, evenly spaced over the sump bottom, and averaged to determine initial sediment depth.

Clean water from the reservoir was pumped to the First Defense vortex chamber at the target flow rate of 0.88 cfs for 125% of the MTFR. After the flow had stabilized, water was pumped to the test unit for a period of 15-minutes. At the conclusion of the test period, the sediment depth was re-measured and compared to the initial depth.

After determining that greater than 90% of the pre-loaded volume remained in the sump, washout testing using effluent sampling was initiated. The pump was restarted at the target flow rate of 0.88 cfs, and influent and effluent samples were collected after the flow rate had stabilized. For a test period of 25 minutes, influent and effluent samples were collected at five-minute intervals, resulting in six paired samples, which were analyzed for SSC by ASTM D3977 Method B and TSS by APHA SM2540D. The test was repeated for the flow rate of 1.4 cfs or 200% of the MTFR.

A representative from the University of New Hampshire Stormwater Center observed all of the tests as an independent witness and reviewed data analysis and quality control procedures of the external laboratory used for sample analysis.

Removal Efficiency Test Procedure

The sediment storage sump was pre-loaded to 50% maximum storage volume by depositing greater than three inches of the test sand on a false floor 10 inches from the sump bottom. Clean water from the reservoir was pumped to the First Defense vortex chamber. The five target flow rates were 25%, 50%, 75%, 100%, and 125% of the MTFR. Background influent and effluent samples were collected to ensure clean water supplied from the reservoir did not exceed non-detect concentrations of 4 mg/L for SSC/TSS.

A slurry mixture dosing system (see Figure 4) was used to obtain the variable influent concentrations of 50 mg/L, 100 mg/L and 200 mg/L for the target flow rates. The required mass of test sand was mixed with clean water in a 60-gallon barrel to form the slurry, which was continually stirred to keep the mixture in suspension. The slurry was pumped at a constant rate from the mixing barrel to a dosing port located upstream of the First Defense using a peristaltic pump. The first influent sample was collected after displacing three test volumes, or three residence times within the vessel. Four additional influent samples were collected at one-minute intervals.

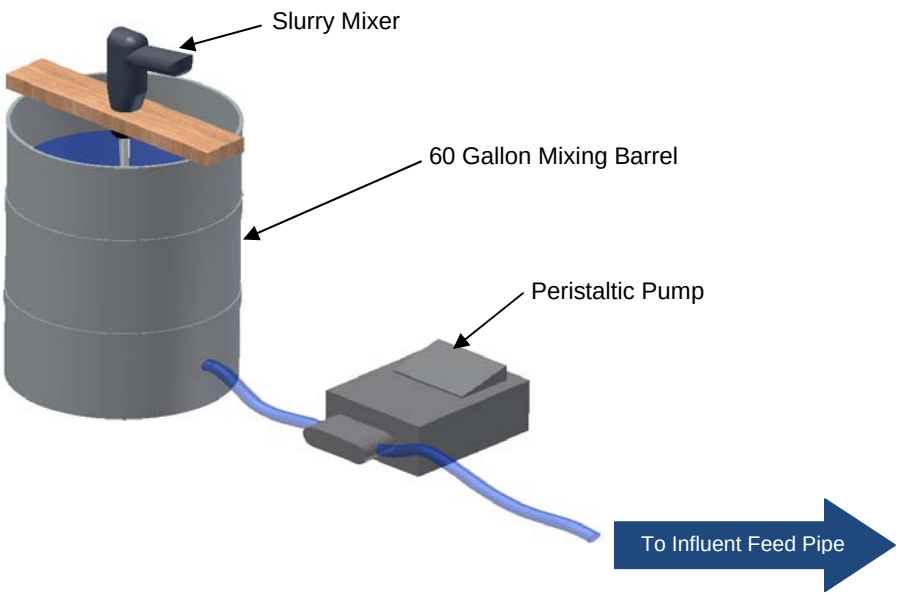

Figure 4: Slurry Mixture Dosing System

The first effluent sample was collected one residence time after collection of the first influent sample. Four additional effluent samples were collected at the same time interval, for a total of five repeats. The test was repeated for three influent concentrations at five flow rates, for a total of 150 influent and effluent samples collected for 15 test runs.

Dosing was ceased after collection of the last effluent sample. Another set of influent and effluent background samples was collected one residence time after the peristaltic pump had stopped and sediment was no longer entering the system. The influent and effluent samples were analyzed for SSC by ASTM D3977 Method B and TSS by APHA SM2540D.

A representative from the University of New Hampshire Stormwater Center observed 20% of the tests as an independent witness and reviewed data analysis and quality control procedures of the external laboratory used for sample analysis. Twenty percent of the SSC samples for the removal efficiency testing were analyzed by an external laboratory and all TSS samples were analyzed by an external laboratory.

Washout Test Results and Discussion

The ability of the First Defense to retain sediment solids was evaluated in two ways:

1. Measure the reduction in the sediment sump level prior to and following testing at operating rates of 125% and 200% of the MTFR with the sump 50% pre-loaded, and

2. Measure the effluent concentrations with the sump 50% pre-loaded with sediment at operating rates 125% and 200% of the MTFR.

The goal of the first part of the washout testing was to demonstrate that less than 10% of the sediment was reduced (i.e. show greater than 90% of the sediment was retained). Sediment depths were determined by averaging the depth measurements taken from 13 sampling locations within the sump. Sampling locations were replicated for each flow rate with the intent of monitoring changes in depths throughout the sump. Although the initial sediment depth was approximately three inches as measured from the false floor, additional sediment was deposited throughout the test program resulting in sediment depths greater than three inches. However, for both flow rate tests, the difference in average sediment depth prior to and following testing remained the same and all measurements were greater than three inches.

The goal of the second part of the test was to demonstrate that effluent concentrations did not exceed 10 mg/L at operating rates of 125% and 200% of the MTFR. As seen in Table 1, at 50% of the sediment capacity, the effluent concentrations were below the analytical detention limit of 4 mg/L for both TSS and SSC for flow rates of 125% and 200% of the MTFR.

Table 1: Washout test results for First Defense® at 125% and 200% MTFR

Percent of MTFR	Influent Flow (cfs)	Effluent EMC (mg/L)	
		SSC	TSS
125	0.88	Non detect	Non detect
200	1.4	Non detect	Non detect

Overall, the First Defense met or exceeded the test requirements to show no measurable effluent TSS or SSC concentrations, as well as retaining greater than 90% of the pre-loaded sediment, at both 125% and 200% of the MTFR.

Removal Efficiency Test Results and Discussion

Removal efficiency data was based on a total of 150 influent and effluent samples collected from 15 test runs at five target flow rates and three target inlet concentrations. Each test run included five influent and effluent samples that were averaged to determine the test run "event mean concentrations" (EMC) and resulting removal efficiencies for SSC and TSS. All tests were run with sediment pre-loaded to 50% of the sump volume.

Table 2: First Defense Performance Test Results - Test Sand OK-110

Test Run	Percent of MTFR	Target Flow (cfs)	Target EMC (mg/L)	EMC (mg/L)				% Removal Efficiency	
				Influent		Effluent			
				SSC	TSS	SSC	TSS	(SSC)	(TSS)
1	25	0.18	50	43	20	2.7	0	94	100
2	25	0.18	100	103	49	6.2	0	94	100
3	25	0.18	200	216	114	7.8	10	96	91
4	50	0.35	50	55	33	11	6	80	82
5	50	0.35	100	107	52	28	14	74	73
6	50	0.35	200	232	98	50	29	78	70
7	75	0.53	50	47	25	23	11	52	56
8	75	0.53	100	105	57	37	26	65	54
9	75	0.53	200	192	126	81	41	58	67
10	100	0.71	50	62	37	28	15	55	59
11	100	0.71	100	123	67	58	33	53	51
12	100	0.71	200	196	111	107	54	45	51
13	125	0.88	50	39	16	21	13	44	19
14	125	0.88	100	112	50	66	36	41	28
15	125	0.88	200	190	104	99	58	48	44

Note: All TSS samples analyzed by external state-certified laboratory.

The results from all SSC and TSS test runs with the sump volume greater than 50% full are shown in Table 2. Target flow rates ranged from 25% of the MTFR (0.18 cfs) to 125% of the MTFR (0.88 cfs) and target influent EMC concentrations ranged from 50 mg/L to 200 mg/L. Consistent with flow-based separation systems, the results indicate that system performance was dependent on flow rate, with higher removal efficiencies achieved at lower flow rates. In general, the discrete removal efficiencies for the 15 test runs remained positive for flow rates up to 125% of the MTFR, at which point bypass would be occurring. This demonstrates better control over the tested loading rates than conventional gravity-based separators with internal bypass.

All samples were included in calculating the removal rates, as there were no observed outliers. Minimal variation was measured between the SSC target influent concentration and the measured SSC concentrations. Measured influent TSS concentrations were approximately 50% lower than the target EMC. However, lower TSS measurements are expected for particles having high settling velocities due to the TSS analytical method, and both the TSS influent and effluent measurements were consistent with this trend. As a result, the variation of TSS influent concentration relative to the target EMC did not have a significant effect on removal efficiencies.

The annual system performance was calculated using the NJDEP method for weighting removal efficiency data. The results in Table 3 show that the First Defense will achieve approximately 70% removal of SSC/TSS based on the NJDEP weighted removal efficiency calculation.

Table 3: First Defense NJ DEP Weighted Removal Efficiency

% MTFR	Target Flow (cfs)	NJDEP Weight Factor	Average Removal Efficiency		Weighted Removal Efficiency	
			SSC	TSS	SSC	TSS
25	0.18	0.25	95%	94%	24%	23%
50	0.35	0.30	77%	79%	23%	24%
75	0.53	0.20	58%	63%	12%	13%
100	0.71	0.15	51%	47%	8%	7%
125	0.88	0.10	44%	32%	4%	3%
				Treatment Efficiency =	**71%**	**70%**

Washout Testing Conclusions

The washout test results showed no measurable washout from the First Defense when 50% of the sump was pre-loaded with OK-110 at flow rates of 125% and 200% of the MTFR. Additionally, washout test results showed sediment retention greater than 90% of the pre-loaded sediment for both 125% and 200% of the MTFR.

Washout testing results also met the NJDEP protocol requirement of less than 10 mg/L effluent concentration for both 125% and 200% of the MTFR. In conclusion, the First Defense met or exceeded the test requirements to show no measurable effluent TSS or SSC levels. This implies that a larger MTFR or a shallower sump is possible. Alternatively, it is reasonable to expect that finer particle sizes with lower settling velocities are likely to be retained and not washed out at the tested flow rates.

Removal Efficiency Testing Conclusions

Removal efficiency results from 15 test runs, operating within a flow range of 0.18 – 0.88 cfs showed good correlation between flow rate and removal efficiency for both SSC and TSS. In general, removal efficiencies were independent of the inlet concentrations, which ranged from 50 to 200 mg/L. The NJDEP weighted TSS/SSC removal efficiency calculation showed that overall performance was 70% for the First Defense with sediment pre-loaded in the sump to reduce the sump volume by 50%.