

Summit Engineering & Survey, Inc.

**HYDRAULIC / HYDROLOGIC CALCULATIONS**

**Richard Hayes**

**130 Morse Street  
Foxboro, Massachusetts**

Prepared For:  
**Richard Hayes**

Prepared By:

**SUMMIT ENGINEERING & SURVEY, INC.  
710 MAIN STREET  
OXFORD, MASSACHUSETTS**

**March 10, 2021**

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## **DRAINAGE SUMMARY**

Summit Engineering & Survey, Inc. is pleased to provide the following Hydraulic / Hydrologic analysis for the redevelopment of 130 Morse Street, Foxboro, Massachusetts. The existing site is a previously disturbed lot that consists of gravel, paved and wooded areas. All runoff flow toward the rear of the parcel where there are currently wetlands located. The hydrologic conditions were analyzed using TR-55 and HydroCAD® for the 2, 10, 25 and 100 year storm events utilizing Technical Paper 40, 24 hour Rainfall events.

The proposed site consists of the construction of a new 4,000 square foot building and loading area, parking areas and grass areas. The project also consists of restoring areas that have been previously disturbed. The project consists of construction of new drainage system to collect runoff created by the new pavement and new building roof. The project will also consist of the construction of grass swales with check dams and two openinfiltration basins to collect runoff generated from the pavement and building. The project as designed conforms to the Massachusetts DEP Stormwater Management Policy.

### EXISTING CONDITIONS:

For the purpose of the analysis of the effect on site development, the site was analyzed as one independent watershed. In the Pre-Development Condition, Subcatchment 1 represents the drainage area of the property that flows toward the existing wetland located at the rear of the lot.

According to the online USGS soil survey, the analyzed area consists of soils with "A" hydrologic ratings. Soil testing was performed to determine soil classification and depth to ground water..

### PROPOSED CONDITIONS:

The proposed condition of the site includes the construction of a new 4,000 s.f. building, paved loading and parking areas.

The site will be graded to support the project and control stormwater in accordance with the Massachusetts Stormwater Management Policy. The development includes the construction of two open infiltration drainage basins, roof drain recharge basins, and proprietary devices to provide stormwater treatment and attenuation to reduce the impact of surface alterations.

In order to analyze the surface water flows, the site was divided into 3 Subcatchment. The Subcatchment compared to the Pre-Development Conditions.

In summary, the peak rates of runoff were compared under pre-development and post-development conditions for analysis of the 2 year, 10 year, 25 year and 100 year storm events. The following is a **Peak Discharge Summary Table**:

**Design Point Analysis:**

Interest Point		Design Event			
		2 Year	10 Year	25 Year	100 Year
Pre-Dev	1	0.19	1.38	1.89	3.63
Post-Dev	1	0.0	0.0	0.0	0.21

DEP Stormwater Management Standards:

Standard #1: The proposed changes will not cause erosion in adjacent water of the Commonwealth, as BMP measures are proposed in accordance with the design requirements of the Stormwater Management handbook. The Erosion & Sedimentation Control Plan provides for the installation of siltation barriers, temporary basins, temporary construction entrances and outlines intermediary measures to control runoff during construction and after construction.

Standard #2: The proposed development peak discharge rates for the total off-site flow are less than or equal to pre-development discharge rates for the 2 year, 10 year, and 100 year storm events for the design points analyzed. Attached calculations show how the site mitigates the increased flow rates due to surface changes from the site development.

Standard #3: The new roof drain runoff is directed to a direct infiltration basin that meets the recharge requirement for Class C Soils. Basin 1 is designed to infiltrate runoff from the ½ new roof area. Infiltration depths are designed to drain in less than 72 hours as required by the Policy. Basin 2 is designed to infiltrate runoff from ½ the new roof as well as loading area in front of building.

Standard #4: Over 80% TSS shall occur based on the BMP measurements provided. The treatment train varies for each section. TSS worksheets are provided in the report for each treatment train in the site. The water quality volume was determined using 1.0" of runoff over the proposed impervious area.

Standard #5: The proposed development will not generate higher potential pollutant loads and therefore will not require additional BMP practices.

Standard #6: The proposed project is not near a critical area.

Standard #7: The proposed project is a redevelopment project.

Standard #8: Erosion and sediment control measures are proposed as part of the proposed project.

Standard #9: An Operation & Maintenance plan is provided within this document

Standard #10: This project does not propose any illicit discharges.

## **STANDARD #2- PEAK DISCHARGE RATES**

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# **STANDARD #3 –LOSS OF ANNUAL RECHARGE**

The site is predominately un-developed. The site design incorporates direct recharge of roof drains to infiltration basin. All basins are designed to infiltrate retained runoff after pre-treatment. Soils were found to be Class C permeability.

The table below shows the required and provided recharge volumes for the project. As shown, the proposed condition exceeds the minimum requirement for the additional impervious areas.

**Recharge Volume Summary**

Soil Type	Recharge Factor (in. runoff)	Existing Impervious Area (sf)	Proposed Impervious Area (sf)	Min. Req. Recharge Volume (cf)
A	0.60	5,500	15,969	798
B	0.35	0	0	0
C	0.25	0	0	0
D	0.10	0	0	0
<b>Total Required</b>				<b>798</b>

Standard #3 Only Applies to Impervious

<b>Provided Recharge Volume (cf)</b>		
Basin 1		767
Basin 2		659
<b>Total Provided</b>		<b>1,426</b>

## **STANDARD #4- 80% TSS REMOVAL**

### **REQUIRED WATER QUALITY VOLUME:**

<b>Water Quality Volume</b>		
Required Treatment Volume	1.0	Inches Over Impervious Areas
Watershed Series	Paved Area	Water Quality Volume
Basin 1 ( roof)	4,876	406
Basin 2 (Pavement & roof)	11,093	924

The design of the drainage system is such that the site is routed through a series of treatment BMP's meeting the Standard. No bypass is designed of the BMP's reducing the WQV.

**\*\*PLEASE SEE THE FOLLOWING PAGES FOR TSS REMOVAL CALCULATIONS AND STORMCEPTOR® SIZING DETAILED REPORTS\*\***



# **STANDARD #9- OPERATION & MAINTENANCE**

## *OPERATION & MAINTENANCE PLAN:*

### **CURRENT OWNER & RESPONSIBLE PARTY:**

Richard Hayes (Contractor shall be responsible during construction)

### **OWNER & RESPONSIBLE PARTY:**

Richard Hayes

### **DURING CONSTRUCTION:**

#### ***SILT FENCE BARRIER:***

The silt fence barrier shall be installed prior to construction.

During construction the contractor shall inspect the silt fence barrier on a weekly basis and after any significant rainstorm resulting in greater than 0.5" of rainfall. The barrier shall be inspected for any breaches or disturbed silt fence and repaired immediately.

After construction the barrier shall be maintained as stated above until all new areas are vegetated.

After construction these duties shall transfer to the property owner.

#### ***CONSTRUCTION ENTRANCE APRONS:***

Construction aprons shall be installed to protect Charlton Road. The construction entrance apron shall be installed as show on the Erosion Control Plan prior to commencement of construction and shall be inspected weekly. The construction entrance apron shall be replaced when debris becomes noticeable on the existing pavement surfaces leading to and from the construction site.

#### ***SLOPE STABILIZATION:***

The slope stabilization controls shall be installed immediately upon obtaining final grades as shown on the project plans. Slopes in the swale area shall be stabilized according to the details provided. All 3:1 slopes established on-site shall be loamed and seeded as soon as weather permits. Any 2:1 slopes established shall be covered with slope stabilization fabric, then loamed and seeded as soon as weather permits. Areas in failure shall be re-graded to final grade and stabilized as necessary.

#### ***TEMPORARY BASINS:***

The temporary basins shall be inspected immediately after storm events and cleaned to remove sediment build-up. Outfalls shall be inspected for erosion or scouring. Additional rip rap shall be added as required to minimize erosion.

#### ***CATCH BASINS:***

Catch basins shall have temporary stone or other filtration device installed around inlet to prevent sediment deposits. Sediment shall be removed when accumulation exceeds 1" depth on paved surfaces.

#### ***CHECK DAMS:***

Check Dams shall be inspected weekly and after rainfall in excess of 0.5". Accumulated sediment shall be removed when depth exceeds 3" on the upstream sided of the dam. Stone or fabric shall be replaced when evidence of clogging is present.

#### ***CONSTRUCTION COMPLETION:***

The entire stormwater management system shall be inspected upon completion of construction. Portions of the system containing sediment shall be cleaned and all sediment properly removed.

#### **AFTER CONSTRUCTION:**

#### ***STORMCEPTORS:***

At a minimum, the stormceptors shall be inspected and cleaned on a quarterly basis. It is preferred that collection of accumulated sediment shall be accomplished by means of vacuum pumping and not by means of a clamshell bucket. Disposal of accumulated sediment shall be performed in accordance with applicable local, state, and federal guidelines and regulations.

#### **INFILTRATION BASIN**

Inspect infiltration basins after major storm events (>3.0 inches) to verify stabilization and infiltration. Mow slopes, berms quarterly. Removed accumulated clippings from infiltration stone. Inspect basin semi-annually for the following:

- Signs of differential settlement
- Cracking
- Erosion
- Leakage in embankments
- Tree growth on embankments
- Condition of rip rap
- Sediment accumulation

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- Turf health.

***FLARED END SECTIONS/RIP RAP***

Flared End Sections/Rip Rap shall be visually inspected quarterly for accumulation of debris, slope failure, or stone displacement. Surrounding slopes shall be mowed quarterly, woody vegetation shall be removed. Accumulated sediment shall be removed by hand or other methods as needed.

## LONG TERM POLLUTION PREVENTION PLAN

The following are the material management practices that shall be used to reduce the risk of spills or other accidental exposure of materials and substances to stormwater runoff.

**Good Housekeeping:** The following good housekeeping practices will be followed on site during the construction project and continued upon completion of the construction activities.

1. A concerted effort shall be made to store only enough product required to complete a particular task.
2. All materials stored on site shall be stored in a neat and orderly fashion in their appropriate containers and, if possible, under a roof or other secure enclosure.
3. Products shall be kept in their original containers with the original manufacturer's label.
4. Substances shall not be mixed with one another unless recommended by the manufacturer.
5. Whenever possible, all of a product shall be used up before disposing of the container.
6. Manufacturer's recommendations for proper use and disposal shall be followed.
7. The site superintendent shall inspect daily to ensure proper use and disposal of materials on site.

**Hazardous Products:** The following practices are intended to reduce the risks associated with hazardous materials.

1. Products shall be kept in original containers unless they are not re-sealable.
2. Where feasible, the original label and material safety data shall be retained, whereas they contain important product information.
3. If surplus product must be disposed of, follow manufacturers or local and State recommended methods for proper disposal.

**Product Specific Practices:** The following product-specific practices shall be followed on site:

Petroleum Products:

1. All on site vehicles shall be monitored for leaks and receive regular preventative maintenance to reduce the risk of leakage.
2. Petroleum products shall be stored in tightly sealed containers which are clearly labeled.
3. Petroleum Products shall be stored in compliance with Fire Marshall regulations.

Bituminous Concrete:

Any bituminous concrete or asphalt substances used on site shall be applied according to the manufacturer's recommendations.

Fertilizers:

Fertilizers shall be applied in the minimum amounts recommended by the manufacturer. Once applied, fertilizers shall be worked into the soil to limit exposure to stormwater. Storage shall be in a covered shed or trailer. The contents of any partially-used bags of fertilizer shall be transferred to a sealable plastic bag or bin to avoid spills

Paints:

1. All containers shall be tightly sealed and stored when not required for use.

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2. Excess paint shall not be discharged into any catch basin, drain manhole or any portion of the stormwater management system.
3. Excess paint shall be properly disposed of according to manufacturer's recommendations or State and local regulations.

**Concrete Trucks:**

Concrete trucks shall not be allowed to wash out or discharge surplus concrete or drum wash water on site.

**SPILL CONTROL PRACTICES**

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

1. Manufacturer's recommended methods for cleanup shall be readily available at the onsite trailer, and site personnel shall be made aware of the procedures and the location of the information.
2. Materials and equipment necessary for spill cleanup shall be kept in the material storage area on site. Equipment and materials shall include, but not be limited to, brooms, dust pans, mops, rags, gloves, goggles, kitty litter, sand, sawdust and plastic and metal trash containers specifically for this purpose.
3. All spills shall be cleaned up immediately after discovery.
4. The spill area shall be kept well ventilated, and personnel shall wear appropriate protective clothing to prevent injury from contact with hazardous substance.
5. Spills of toxic or hazardous material shall be reported to the appropriate State and/or local authority in accordance with local and/or State regulations.
6. The spill prevention plan shall be adjusted to include measures to prevent a particular type of spill from reoccurring and instructions on how to clean up the spill if there is another occurrence. A description of the spill, what caused it, and the clean up measures shall also be included.
7. The "Manager" shall be the spill prevention and cleanup coordinator. The "Manager" shall designate at least three other site personnel who will be trained in the spill control practices identified above.

***PUBLIC SAFETY FEATURES***

All cast iron storm structure grates and covers shall be kept in good condition and kept closed at all times. Any damaged or broken structures will be replaced immediately upon discovery

***OPERATION AND MAINTENANCE BUDGET***

The Owner recognizes that the Stormwater Management System requires inspections and regular maintenance. The Owner or designee shall maintain an adequate annual budget to maintain the system in proper working condition.

**Attachment**  
**Illicit Discharge Compliance Statement**

It is the intent of the Owner/Applicant, Richard Hayes to control illicit disposal into the storm drainage system. There will be no connection to the storm water system to inadvertently direct other types of liquids, chemicals or solids into the storm drainage system. The Applicant will also promote a clean Green Environment by mitigating spills onto pavements; oils, soda, chemicals, pet waste, debris and litter.

Respectfully Acknowledged,

Richard Hayes

# **STORMWATER MANAGEMENT CHECKLIST**

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# 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.<sup>1</sup> 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<sup>2</sup>
- 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.

<sup>1</sup> 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.

<sup>2</sup> 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.





# Checklist for Stormwater Report

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## 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.

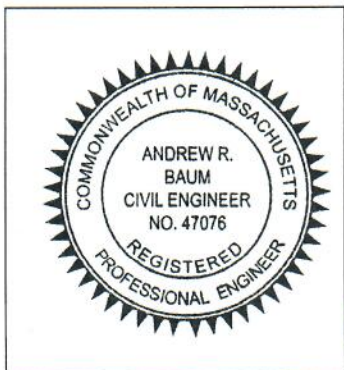
A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

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### Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



Signature and Date

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## 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

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## 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

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## 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<sup>1</sup>
- 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.

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<sup>1</sup> 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.



# Checklist for Stormwater Report

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## 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

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## 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

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## 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

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## Checklist (continued)

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

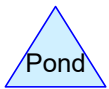
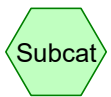
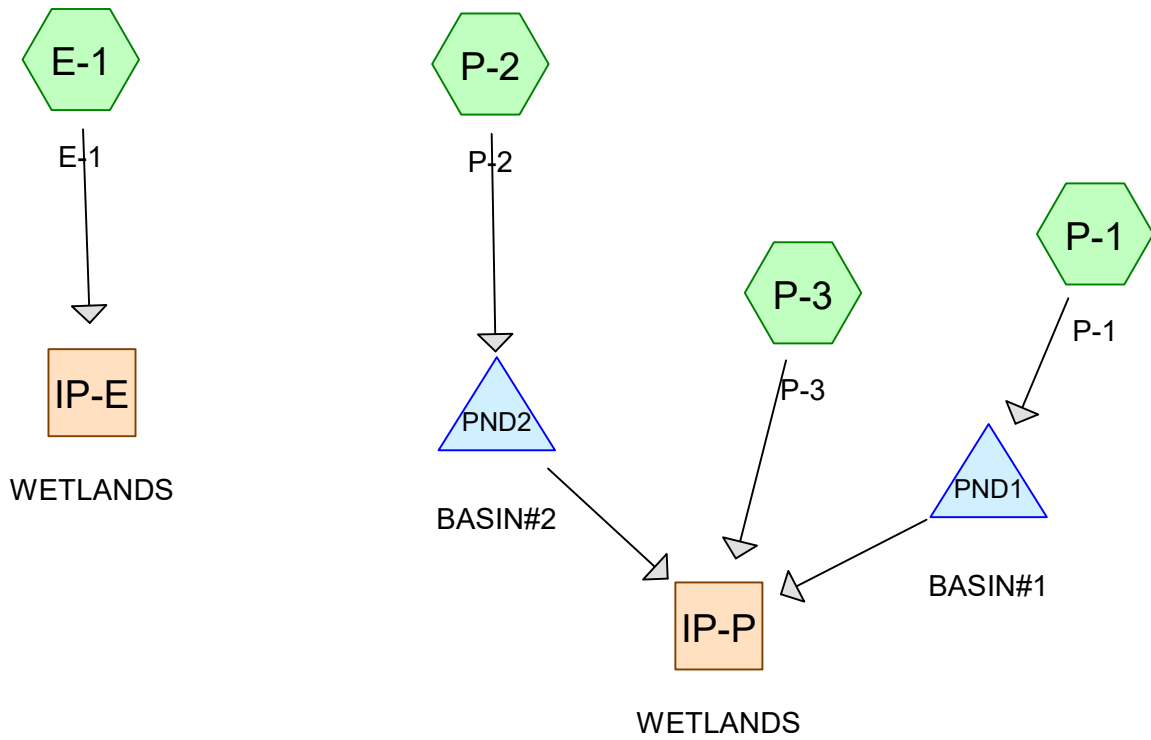
- The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has **not** been included in the Stormwater Report but will be submitted **before** land disturbance begins.
- The project is **not** covered by a NPDES Construction General Permit.
- The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.
- The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

### Standard 9: Operation and Maintenance Plan

- The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:
  - Name of the stormwater management system owners;
  - Party responsible for operation and maintenance;
  - Schedule for implementation of routine and non-routine maintenance tasks;
  - Plan showing the location of all stormwater BMPs maintenance access areas;
  - Description and delineation of public safety features;
  - Estimated operation and maintenance budget; and
  - Operation and Maintenance Log Form.
- The responsible party is **not** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:
  - A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
  - A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

### Standard 10: Prohibition of Illicit Discharges

- The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;
- An Illicit Discharge Compliance Statement is attached;
- NO Illicit Discharge Compliance Statement is attached but will be submitted **prior to** the discharge of any stormwater to post-construction BMPs.



**Routing Diagram for pre -post**  
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**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
0.321	68	<50% Grass cover, Poor, HSG A (E-1)
0.320	39	>75% Grass cover, Good, HSG A (P-1, P-2)
0.402	96	Gravel surface, HSG A (E-1)
0.367	98	Paved parking, HSG A (P-1, P-2)
0.126	98	Paved roads w/curbs & sewers, HSG A (E-1)
2.211	30	Woods, Good, HSG A (E-1, P-3)

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**Soil Listing (all nodes)**

Area (acres)	Soil Group	Subcatchment Numbers
3.747	HSG A	E-1, P-1, P-2, P-3
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	

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**Ground Covers (all nodes)**

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.321	0.000	0.000	0.000	0.000	0.321	<50% Grass cover, Poor	E-1
0.320	0.000	0.000	0.000	0.000	0.320	>75% Grass cover, Good	P-1
							,
							P-2
0.402	0.000	0.000	0.000	0.000	0.402	Gravel surface	E-1
0.367	0.000	0.000	0.000	0.000	0.367	Paved parking	P-1
							,
							P-2
0.126	0.000	0.000	0.000	0.000	0.126	Paved roads w/curbs & sewers	E-1
2.211	0.000	0.000	0.000	0.000	2.211	Woods, Good	E-1
							,
							P-3

**pre -post**

Type III 24-hr 2YR Rainfall=3.20"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment E-1: E-1</b>	Runoff Area=81,606 sf 6.74% Impervious Runoff Depth>0.21" Tc=10.0 min CN=55 Runoff=0.19 cfs 0.033 af
<b>Subcatchment P-1: P-1</b>	Runoff Area=7,749 sf 62.92% Impervious Runoff Depth>1.06" Tc=6.0 min CN=76 Runoff=0.23 cfs 0.016 af
<b>Subcatchment P-2: P-2</b>	Runoff Area=22,138 sf 50.11% Impervious Runoff Depth>0.70" Tc=6.0 min CN=69 Runoff=0.40 cfs 0.030 af
<b>Subcatchment P-3: P-3</b>	Runoff Area=51,719 sf 0.00% Impervious Runoff Depth=0.00" Tc=0.0 min CN=30 Runoff=0.00 cfs 0.000 af
<b>Reach IP-E: WETLANDS</b>	Inflow=0.19 cfs 0.033 af Outflow=0.19 cfs 0.033 af
<b>Reach IP-P: WETLANDS</b>	Inflow=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af
<b>Pond PND1: BASIN#1</b>	Peak Elev=178.36' Storage=224 cf Inflow=0.23 cfs 0.016 af Discarded=0.04 cfs 0.016 af Primary=0.00 cfs 0.000 af Outflow=0.04 cfs 0.016 af
<b>Pond PND2: BASIN#2</b>	Peak Elev=176.83' Storage=377 cf Inflow=0.40 cfs 0.030 af Discarded=0.08 cfs 0.030 af Primary=0.00 cfs 0.000 af Outflow=0.08 cfs 0.030 af

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Type III 24-hr 2YR Rainfall=3.20"

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**Summary for Subcatchment E-1: E-1**

Runoff = 0.19 cfs @ 12.40 hrs, Volume= 0.033 af, Depth> 0.21"

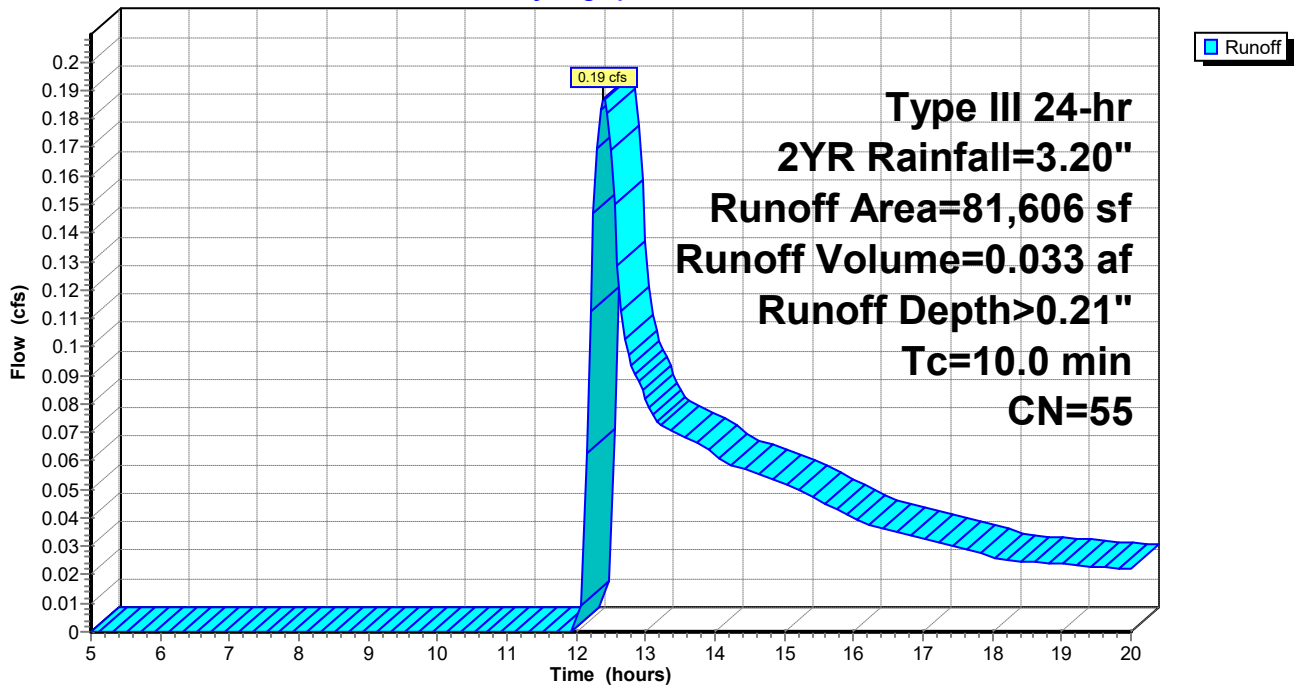
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2YR Rainfall=3.20"

Area (sf)	CN	Description
17,508	96	Gravel surface, HSG A
5,500	98	Paved roads w/curbs & sewers, HSG A
14,000	68	<50% Grass cover, Poor, HSG A
44,598	30	Woods, Good, HSG A
81,606	55	Weighted Average
76,106		93.26% Pervious Area
5,500		6.74% Impervious Area

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

**Subcatchment E-1: E-1**

Hydrograph



**pre -post**

Type III 24-hr 2YR Rainfall=3.20"

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**Summary for Subcatchment P-1: P-1**

Runoff = 0.23 cfs @ 12.10 hrs, Volume= 0.016 af, Depth> 1.06"

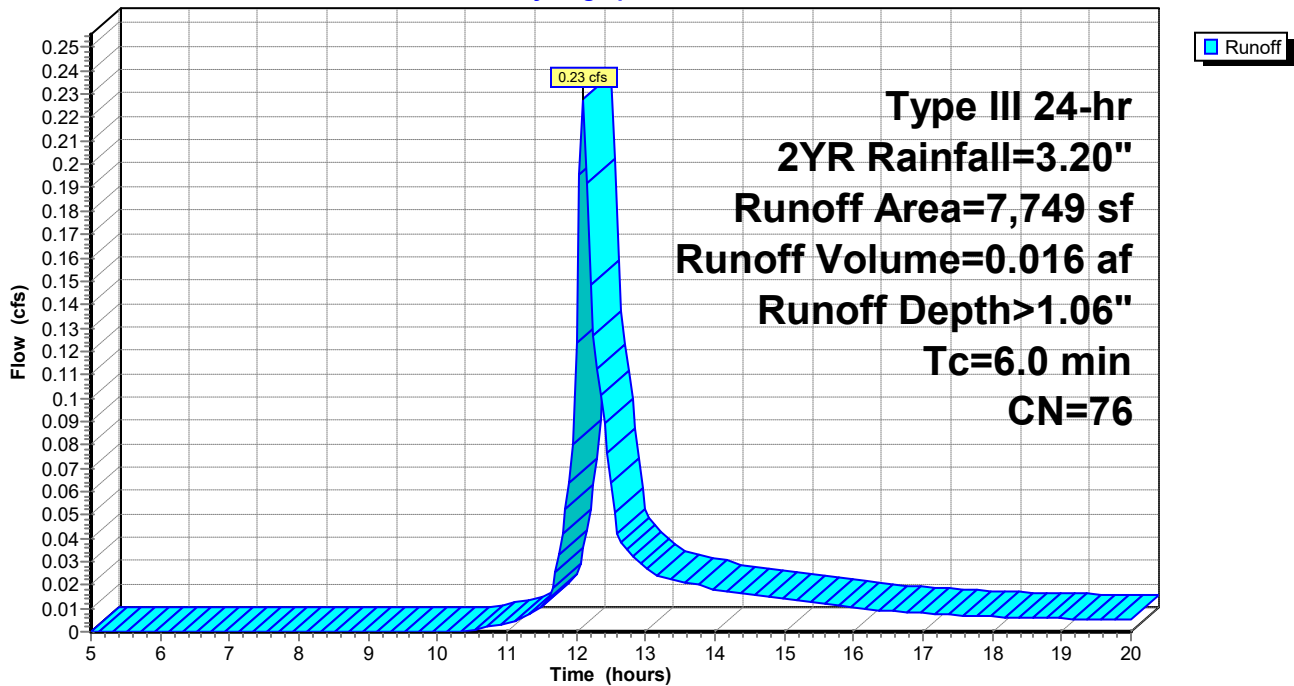
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2YR Rainfall=3.20"

Area (sf)	CN	Description
4,876	98	Paved parking, HSG A
2,873	39	>75% Grass cover, Good, HSG A
7,749	76	Weighted Average
2,873		37.08% Pervious Area
4,876		62.92% Impervious Area

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

**Subcatchment P-1: P-1**

Hydrograph



### Summary for Subcatchment P-2: P-2

Runoff = 0.40 cfs @ 12.11 hrs, Volume= 0.030 af, Depth> 0.70"

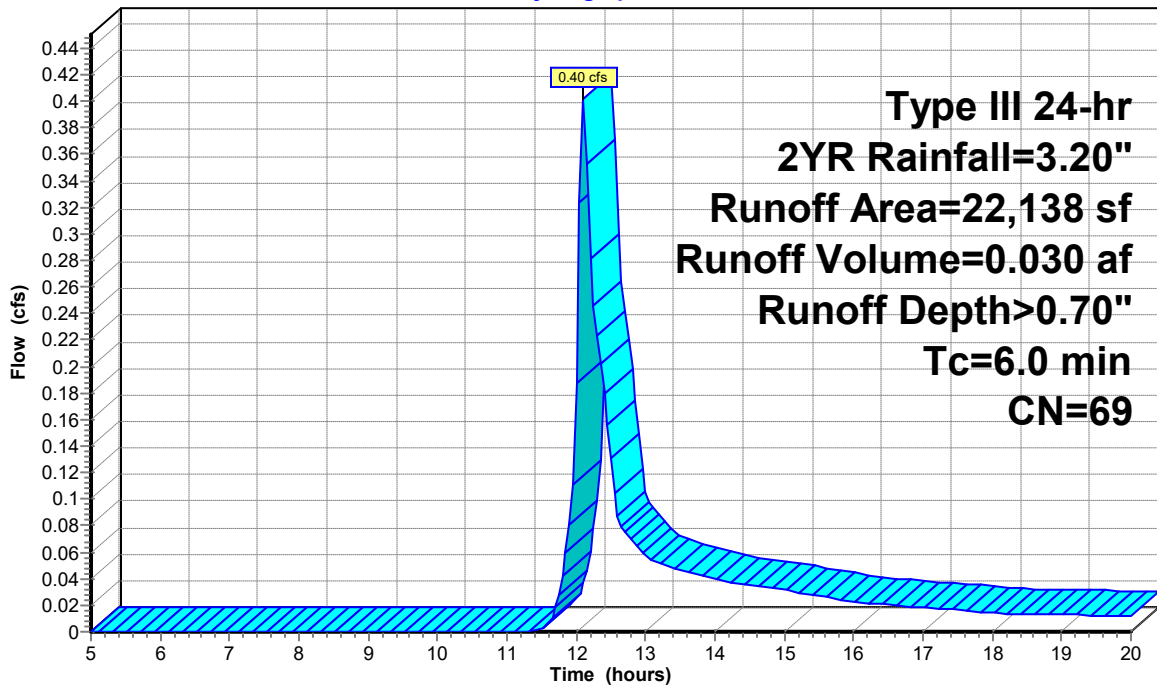
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2YR Rainfall=3.20"

Area (sf)	CN	Description
11,093	98	Paved parking, HSG A
11,045	39	>75% Grass cover, Good, HSG A
22,138	69	Weighted Average
11,045		49.89% Pervious Area
11,093		50.11% Impervious Area

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

### Subcatchment P-2: P-2

Hydrograph



Runoff

**Type III 24-hr  
 2YR Rainfall=3.20"  
 Runoff Area=22,138 sf  
 Runoff Volume=0.030 af  
 Runoff Depth>0.70"  
 Tc=6.0 min  
 CN=69**

### Summary for Subcatchment P-3: P-3

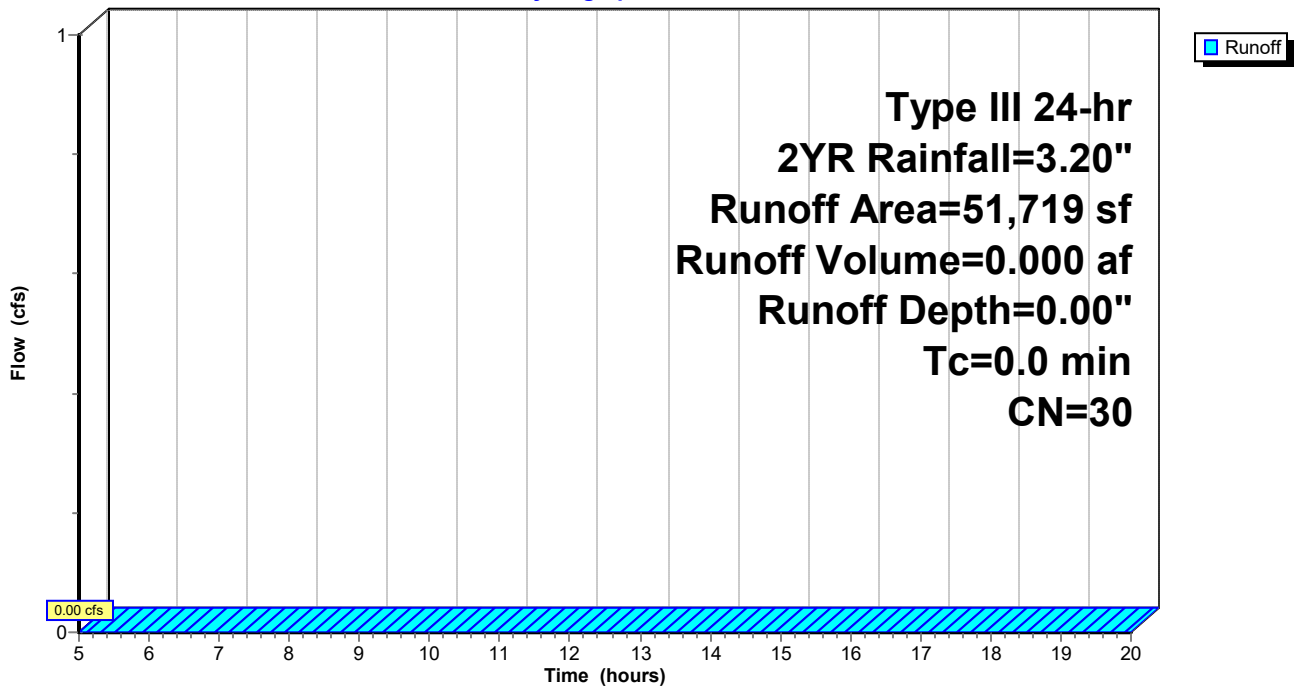
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 2YR Rainfall=3.20"

Area (sf)	CN	Description
51,719	30	Woods, Good, HSG A
51,719		100.00% Pervious Area

### Subcatchment P-3: P-3

Hydrograph





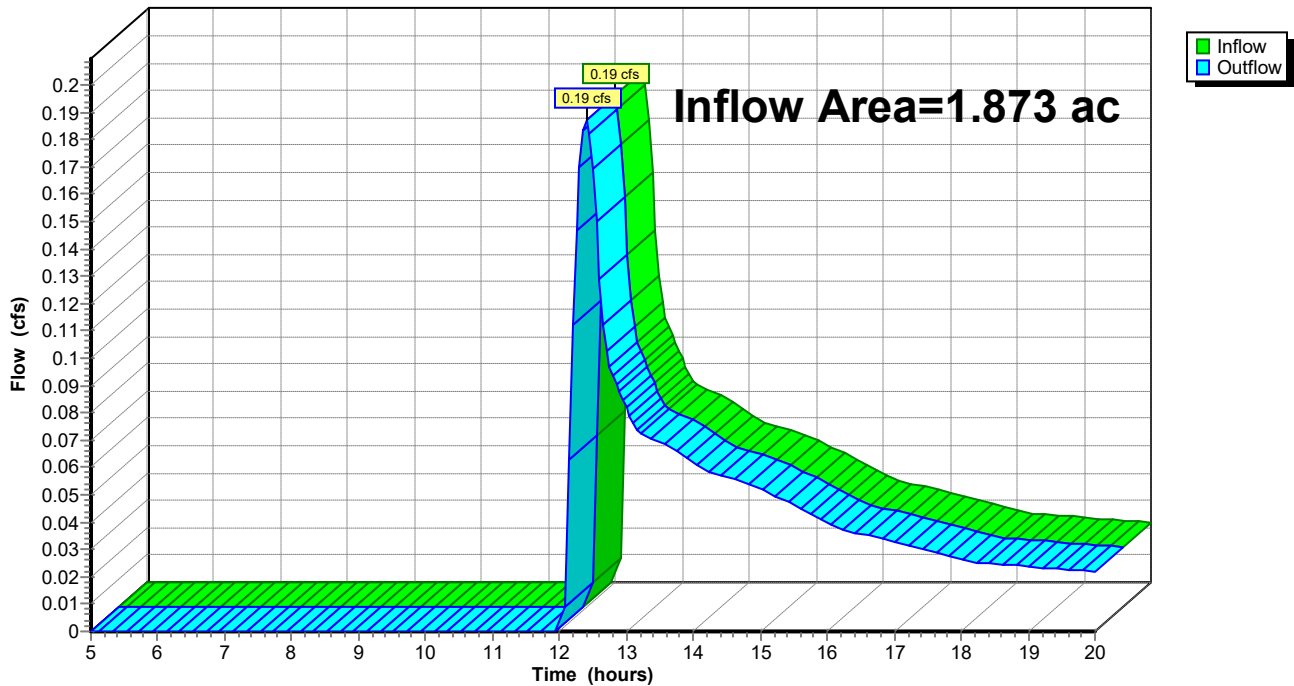
### Summary for Reach IP-E: WETLANDS

Inflow Area = 1.873 ac, 6.74% Impervious, Inflow Depth > 0.21" for 2YR event  
Inflow = 0.19 cfs @ 12.40 hrs, Volume= 0.033 af  
Outflow = 0.19 cfs @ 12.40 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach IP-E: WETLANDS

Hydrograph



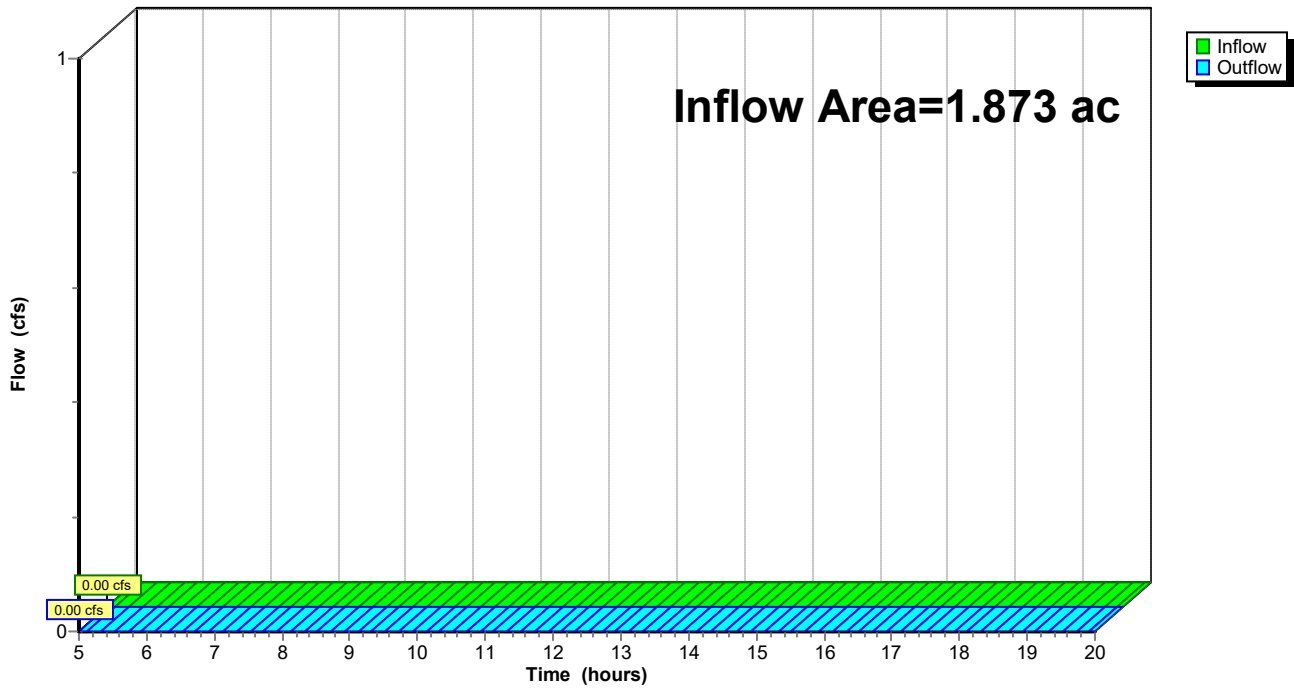
### Summary for Reach IP-P: WETLANDS

Inflow Area = 1.873 ac, 19.57% Impervious, Inflow Depth = 0.00" for 2YR event  
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af  
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach IP-P: WETLANDS

Hydrograph



**Summary for Pond PND1: BASIN#1**

Inflow Area = 0.178 ac, 62.92% Impervious, Inflow Depth > 1.06" for 2YR event  
 Inflow = 0.23 cfs @ 12.10 hrs, Volume= 0.016 af  
 Outflow = 0.04 cfs @ 12.62 hrs, Volume= 0.016 af, Atten= 82%, Lag= 31.3 min  
 Discarded = 0.04 cfs @ 12.62 hrs, Volume= 0.016 af  
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 178.36' @ 12.62 hrs Surf.Area= 728 sf Storage= 224 cf

Plug-Flow detention time= 49.8 min calculated for 0.016 af (99% of inflow)  
 Center-of-Mass det. time= 48.2 min ( 861.7 - 813.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	178.00'	2,851 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
178.00	512	0	0
179.00	1,109	811	811
180.50	1,612	2,041	2,851

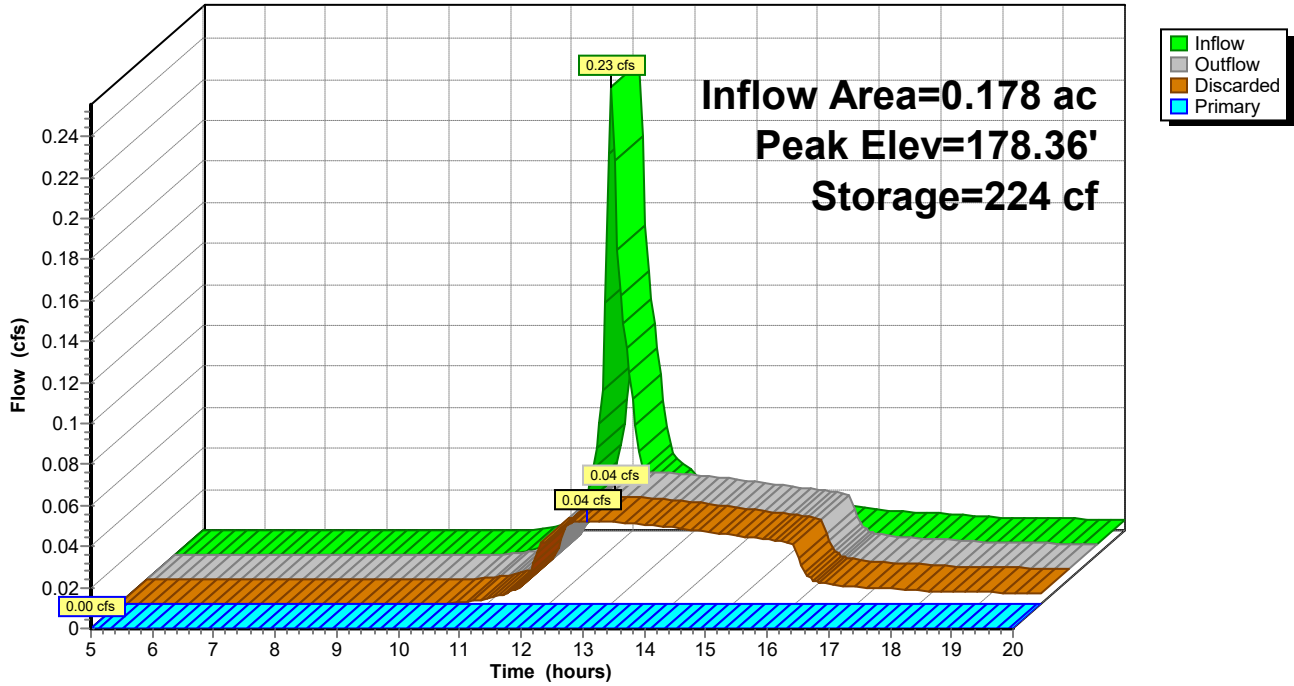
Device	Routing	Invert	Outlet Devices
#1	Discarded	178.00'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	180.25'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600

**Discarded OutFlow** Max=0.04 cfs @ 12.62 hrs HW=178.36' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.04 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=178.00' (Free Discharge)  
 ↑2=Orifice/Grate ( Controls 0.00 cfs)

### Pond PND1: BASIN#1

Hydrograph



**pre -post**

Type III 24-hr 2YR Rainfall=3.20"

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**Summary for Pond PND2: BASIN#2**

Inflow Area = 0.508 ac, 50.11% Impervious, Inflow Depth > 0.70" for 2YR event  
 Inflow = 0.40 cfs @ 12.11 hrs, Volume= 0.030 af  
 Outflow = 0.08 cfs @ 12.62 hrs, Volume= 0.030 af, Atten= 79%, Lag= 31.0 min  
 Discarded = 0.08 cfs @ 12.62 hrs, Volume= 0.030 af  
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 176.83' @ 12.62 hrs Surf.Area= 1,503 sf Storage= 377 cf

Plug-Flow detention time= 42.3 min calculated for 0.030 af (100% of inflow)  
 Center-of-Mass det. time= 41.4 min ( 872.5 - 831.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	176.50'	3,203 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
176.50	767	0	0
177.00	1,876	661	661
178.00	3,208	2,542	3,203

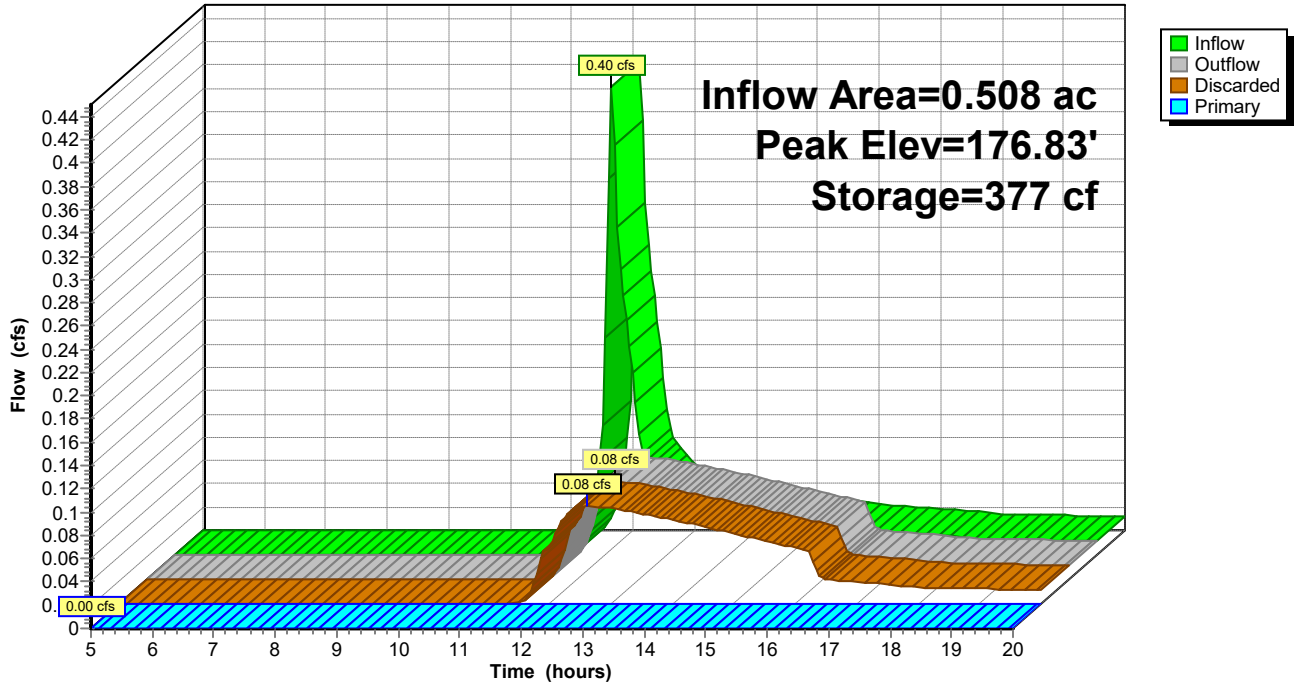
Device	Routing	Invert	Outlet Devices
#1	Discarded	176.50'	<b>2.410 in/hr Exfiltration over Surface area</b>
#2	Primary	177.50'	<b>6.0" Vert. Orifice/Grate</b> C= 0.600

**Discarded OutFlow** Max=0.08 cfs @ 12.62 hrs HW=176.83' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.08 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=176.50' (Free Discharge)  
 ↑2=Orifice/Grate ( Controls 0.00 cfs)

### Pond PND2: BASIN#2

Hydrograph



## STAGE-STORAGE WORKSHEET

STAGE-STORAGE WORKSHEET					
DATE:		CLIENT: hayes			
PROJECT NUMBER:		CALCULATED BY: PML			
BASIN NUMBER: 1		CHECKED BY: AB			
LOCATION: BASIN 1					
ELEVATION	AREA	AVERAGE AREA	VERTICAL INTERVAL	VOLUME INCREMENTAL	VOLUME CUMULATIVE
(FEET)	(FT <sup>2</sup> )	(FT <sup>2</sup> )	(FT)	(FT <sup>3</sup> )	(FT <sup>3</sup> )
178.0	512				0
178.5	723	618	1	309	309
179	1109	916	1	458	767

**pre -post**

Type III 24-hr 10YR Rainfall=4.90"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment E-1: E-1</b>	Runoff Area=81,606 sf 6.74% Impervious Runoff Depth>0.83" Tc=10.0 min CN=55 Runoff=1.38 cfs 0.129 af
<b>Subcatchment P-1: P-1</b>	Runoff Area=7,749 sf 62.92% Impervious Runoff Depth>2.28" Tc=6.0 min CN=76 Runoff=0.50 cfs 0.034 af
<b>Subcatchment P-2: P-2</b>	Runoff Area=22,138 sf 50.11% Impervious Runoff Depth>1.73" Tc=6.0 min CN=69 Runoff=1.08 cfs 0.073 af
<b>Subcatchment P-3: P-3</b>	Runoff Area=51,719 sf 0.00% Impervious Runoff Depth>0.00" Tc=0.0 min CN=30 Runoff=0.00 cfs 0.000 af
<b>Reach IP-E: WETLANDS</b>	Inflow=1.38 cfs 0.129 af Outflow=1.38 cfs 0.129 af
<b>Reach IP-P: WETLANDS</b>	Inflow=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af
<b>Pond PND1: BASIN#1</b>	Peak Elev=178.82' Storage=618 cf Inflow=0.50 cfs 0.034 af Discarded=0.06 cfs 0.033 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.033 af
<b>Pond PND2: BASIN#2</b>	Peak Elev=177.31' Storage=1,308 cf Inflow=1.08 cfs 0.073 af Discarded=0.13 cfs 0.072 af Primary=0.00 cfs 0.000 af Outflow=0.13 cfs 0.072 af



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Type III 24-hr 25YR Rainfall=5.40"

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment E-1: E-1</b>	Runoff Area=81,606 sf 6.74% Impervious Runoff Depth>1.06" Tc=10.0 min CN=55 Runoff=1.89 cfs 0.165 af
<b>Subcatchment P-1: P-1</b>	Runoff Area=7,749 sf 62.92% Impervious Runoff Depth>2.67" Tc=6.0 min CN=76 Runoff=0.59 cfs 0.040 af
<b>Subcatchment P-2: P-2</b>	Runoff Area=22,138 sf 50.11% Impervious Runoff Depth>2.08" Tc=6.0 min CN=69 Runoff=1.30 cfs 0.088 af
<b>Subcatchment P-3: P-3</b>	Runoff Area=51,719 sf 0.00% Impervious Runoff Depth>0.01" Tc=0.0 min CN=30 Runoff=0.00 cfs 0.001 af
<b>Reach IP-E: WETLANDS</b>	Inflow=1.89 cfs 0.165 af Outflow=1.89 cfs 0.165 af
<b>Reach IP-P: WETLANDS</b>	Inflow=0.00 cfs 0.001 af Outflow=0.00 cfs 0.001 af
<b>Pond PND1: BASIN#1</b>	Peak Elev=178.95' Storage=753 cf Inflow=0.59 cfs 0.040 af Discarded=0.06 cfs 0.037 af Primary=0.00 cfs 0.000 af Outflow=0.06 cfs 0.037 af
<b>Pond PND2: BASIN#2</b>	Peak Elev=177.46' Storage=1,653 cf Inflow=1.30 cfs 0.088 af Discarded=0.14 cfs 0.083 af Primary=0.00 cfs 0.000 af Outflow=0.14 cfs 0.083 af

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Type III 24-hr 100YR Rainfall=6.90"

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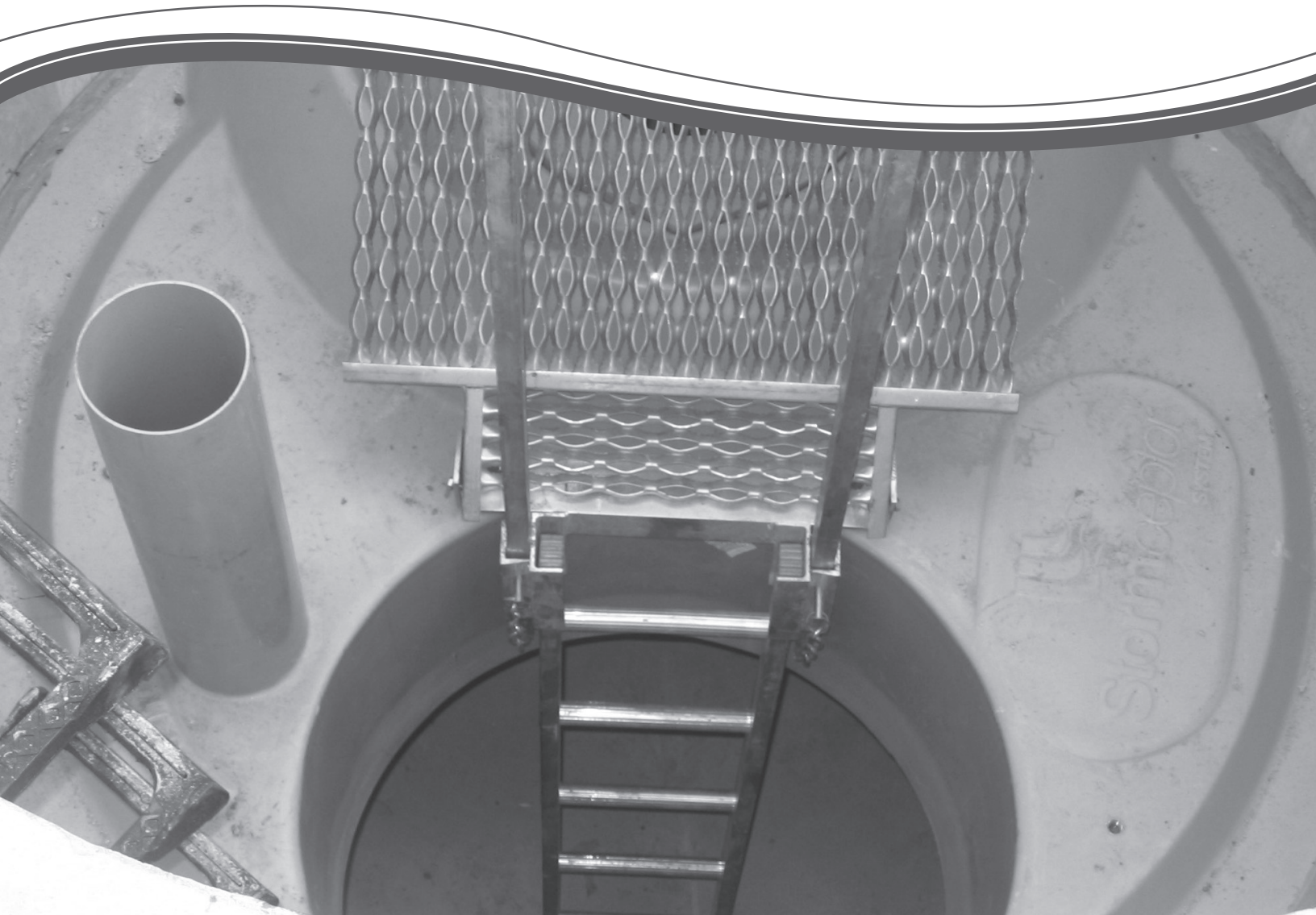
Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

<b>Subcatchment E-1: E-1</b>	Runoff Area=81,606 sf 6.74% Impervious Runoff Depth>1.87" Tc=10.0 min CN=55 Runoff=3.63 cfs 0.292 af
<b>Subcatchment P-1: P-1</b>	Runoff Area=7,749 sf 62.92% Impervious Runoff Depth>3.90" Tc=6.0 min CN=76 Runoff=0.85 cfs 0.058 af
<b>Subcatchment P-2: P-2</b>	Runoff Area=22,138 sf 50.11% Impervious Runoff Depth>3.19" Tc=6.0 min CN=69 Runoff=2.00 cfs 0.135 af
<b>Subcatchment P-3: P-3</b>	Runoff Area=51,719 sf 0.00% Impervious Runoff Depth>0.15" Tc=0.0 min CN=30 Runoff=0.03 cfs 0.015 af
<b>Reach IP-E: WETLANDS</b>	Inflow=3.63 cfs 0.292 af Outflow=3.63 cfs 0.292 af
<b>Reach IP-P: WETLANDS</b>	Inflow=0.21 cfs 0.034 af Outflow=0.21 cfs 0.034 af
<b>Pond PND1: BASIN#1</b>	Peak Elev=179.34' Storage=1,209 cf Inflow=0.85 cfs 0.058 af Discarded=0.07 cfs 0.048 af Primary=0.00 cfs 0.000 af Outflow=0.07 cfs 0.048 af
<b>Pond PND2: BASIN#2</b>	Peak Elev=177.77' Storage=2,496 cf Inflow=2.00 cfs 0.135 af Discarded=0.16 cfs 0.100 af Primary=0.19 cfs 0.020 af Outflow=0.35 cfs 0.120 af

## **Supplemental Drainage Supporting Documents**

- Stormceptor Maintenance Manual
- Rip Rap Sizing Calculations.

**Stormceptor<sup>®</sup> STC**  
**Operation and Maintenance Guide**



## Stormceptor Design Notes

- Only the STC 450i is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 450i to STC 7200 may accommodate multiple inlet pipes.

### Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences			
Inlet Pipe Configuration	STC 450i	STC 900 to STC 7200	STC 11000 to STC 16000
Single inlet pipe	3 in. (75 mm)	1 in. (25 mm)	3 in. (75 mm)
Multiple inlet pipes	3 in. (75 mm)	3 in. (75 mm)	Only one inlet pipe.

### Maximum inlet and outlet pipe diameters:

Inlet/Outlet Configuration	Inlet Unit STC 450i	In-Line Unit STC 900 to STC 7200	Series* STC 11000 to STC 16000
Straight Through	24 inch (600 mm)	42 inch (1050 mm)	60 inch (1500 mm)
Bend (90 degrees)	18 inch (450 mm)	33 inch (825 mm)	33 inch (825 mm)

- The inlet and in-line Stormceptor units can accommodate turns to a maximum of 90 degrees.
- Minimum distance from top of grade to crown is 2 feet (0.6 m)
- Submerged conditions. A unit is submerged when the standing water elevation at the proposed location of the Stormceptor unit is greater than the outlet invert elevation during zero flow conditions. In these cases, please contact your local Stormceptor representative and provide the following information:
  - Top of grade elevation
  - Stormceptor inlet and outlet pipe diameters and invert elevations
  - Standing water elevation
  - Stormceptor head loss,  $K = 1.3$  (for submerged condition,  $K = 4$ )



## OPERATION AND MAINTENANCE GUIDE

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# 1. About Stormceptor

The Stormceptor® STC (Standard Treatment Cell) was developed by Imbrium™ Systems to address the growing need to remove and isolate pollution from the storm drain system before it enters the environment. The Stormceptor STC targets hydrocarbons and total suspended solids (TSS) in stormwater runoff. It improves water quality by removing contaminants through the gravitational settling of fine sediments and floatation of hydrocarbons while preventing the re-suspension or scour of previously captured pollutants.

The development of the Stormceptor STC revolutionized stormwater treatment, and created an entirely new category of environmental technology. Protecting thousands of waterways around the world, the Stormceptor System has set the standard for effective stormwater treatment.

## 1.1. Patent Information

The Stormceptor technology is protected by the following patents:

- Australia Patent No. 693,164 • 693,164 • 707,133 • 729,096 • 779401
- Austrian Patent No. 289647
- Canadian Patent No 2,009,208 • 2,137,942 • 2,175,277 • 2,180,305 • 2,180,383 • 2,206,338 • 2,327,768 (Pending)
- China Patent No 1168439
- Denmark DK 711879
- German DE 69534021
- Indonesian Patent No 16688
- Japan Patent No 9-11476 (Pending)
- Korea 10-2000-0026101 (Pending)
- Malaysia Patent No PI9701737 (Pending)
- New Zealand Patent No 314646
- United States Patent No 4,985,148 • 5,498,331 • 5,725,760 • 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690
- Stormceptor OSR Patent Pending • Stormceptor LCS Patent Pending

# 2. Stormceptor Design Overview

## 2.1. Design Philosophy

The patented Stormceptor System has been designed to focus on the environmental objective of providing long-term pollution control. The unique and innovative Stormceptor design allows for continuous positive treatment of runoff during all rainfall events, while ensuring that all captured pollutants are retained within the system, even during intense storm events.

An integral part of the Stormceptor design is PCSWMM for Stormceptor - sizing software developed in conjunction with Computational Hydraulics Inc. (CHI) and internationally acclaimed expert, Dr. Bill James. Using local historical rainfall data and continuous simulation modeling, this software allows a Stormceptor unit to be designed for each individual site and the corresponding water quality objectives.

By using PCSWMM for Stormceptor, the Stormceptor System can be designed to remove a wide range of particles (typically from 20 to 2,000 microns), and can also be customized to remove a specific particle size distribution (PSD). The specified PSD should accurately reflect what is in the stormwater runoff to ensure the device is achieving the desired water quality objective. Since stormwater runoff contains small particles (less than 75 microns), it is important to design a treatment system to remove smaller particles in addition to coarse particles.

## 2.2. Benefits

The Stormceptor System removes free oil and suspended solids from stormwater, preventing spills and non-point source pollution from entering downstream lakes and rivers. The key benefits, capabilities and applications of the Stormceptor System are as follows:

- Provides continuous positive treatment during all rainfall events
- Can be designed to remove over 80% of the annual sediment load
- Removes a wide range of particles
- Can be designed to remove a specific particle size distribution (PSD)
- Captures free oil from stormwater
- Prevents scouring or re-suspension of trapped pollutants
- Pre-treatment to reduce maintenance costs for downstream treatment measures (ponds, swales, detention basins, filters)
- Groundwater recharge protection
- Spills capture and mitigation
- Simple to design and specify
- Designed to your local watershed conditions
- Small footprint to allow for easy retrofit installations
- Easy to maintain (vacuum truck)
- Multiple inlets can connect to a single unit
- Suitable as a bend structure
- Pre-engineered for traffic loading (minimum AASHTO HS-20)
- Minimal elevation drop between inlet and outlet pipes
- Small head loss
- Additional protection provided by an 18" (457 mm) fiberglass skirt below the top of the insert, for the containment of hydrocarbons in the event of a spill.

## 2.3. Environmental Benefit

Freshwater resources are vital to the health and welfare of their surrounding communities. There is increasing public awareness, government regulations and corporate commitment to reducing the pollution entering our waterways. A major source of this pollution originates from stormwater runoff from urban areas. Rainfall runoff carries oils, sediment and other contaminants from roads and parking lots discharging directly into our streams, lakes and coastal waterways.

The Stormceptor System is designed to isolate contaminants from getting into the natural environment. The Stormceptor technology provides protection for the environment from spills that occur at service stations and vehicle accident sites, while also removing contaminated sediment in runoff that washes from roads and parking lots.



## 3. Key Operation Features

### 3.1. Scour Prevention

A key feature of the Stormceptor System is its patented scour prevention technology. This innovation ensures pollutants are captured and retained during all rainfall events, even extreme storms. The Stormceptor System provides continuous positive treatment for all rainfall events, including intense storms. Stormceptor slows incoming runoff, controlling and reducing velocities in the lower chamber to create a non-turbulent environment that promotes free oils and floatable debris to rise and sediment to settle.

The patented scour prevention technology, the fiberglass insert, regulates flows into the lower chamber through a combination of a weir and orifice while diverting high energy flows away through the upper chamber to prevent scouring. Laboratory testing demonstrated no scouring when tested up to 125% of the unit's operating rate, with the unit loaded to 100% sediment capacity (NJDEP, 2005). Second, the depth of the lower chamber ensures the sediment storage zone is adequately separated from the path of flow in the lower chamber to prevent scouring.

### 3.2. Operational Hydraulic Loading Rate

Designers and regulators need to evaluate the treatment capacity and performance of manufactured stormwater treatment systems. A commonly used parameter is the "operational hydraulic loading rate" which originated as a design methodology for wastewater treatment devices.

Operational hydraulic loading rate may be calculated by dividing the flow rate into a device by its settling area. This represents the critical settling velocity that is the prime determinant to quantify the influent particle size and density captured by the device. PCSWMM for Stormceptor uses a similar parameter that is calculated by dividing the hydraulic detention time in the device by the fall distance of the sediment.

$$v_{sc} = \frac{H}{\theta_H} = \frac{Q}{A_s}$$

Where:

$v_{sc}$  = critical settling velocity, ft/s (m/s)

H = tank depth, ft (m)

$\theta_H$  = hydraulic detention time, ft/s (m/s)

Q = volumetric flow rate, ft<sup>3</sup>/s (m<sup>3</sup>/s)

$A_s$  = surface area, ft<sup>2</sup> (m<sup>2</sup>)

(Tchobanoglous, G. and Schroeder, E.D. 1987. Water Quality. Addison Wesley.)

Unlike designing typical wastewater devices, stormwater systems are designed for highly variable flow rates including intense peak flows. PCSWMM for Stormceptor incorporates all of the flows into its calculations, ensuring that the operational hydraulic loading rate is considered not only for one flow rate, but for all flows including extreme events.

### 3.3. Double Wall Containment

The Stormceptor System was conceived as a pollution identifier to assist with identifying illicit discharges. The fiberglass insert has a continuous skirt that lines the concrete barrel wall for a depth of 18 inches (457 mm) that provides double wall containment for hydrocarbons storage. This protective barrier ensures that toxic floatables do not migrate through the concrete wall into the surrounding soils.

## 4. Stormceptor Product Line

### 4.1. Stormceptor Models

A summary of Stormceptor models and capacities are listed in Table 1.

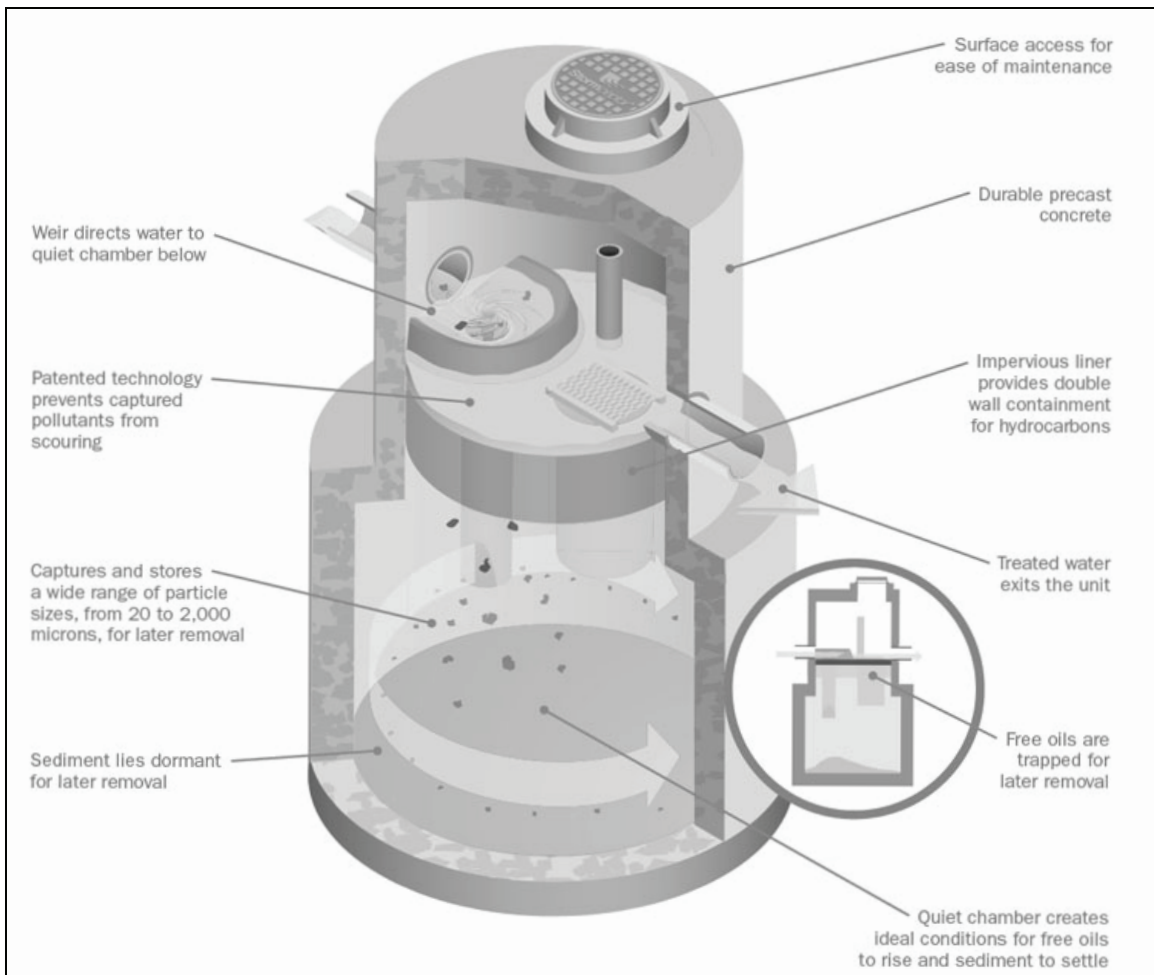
**Table 1. Stormceptor Models**

Stormceptor Model	Total Storage Volume U.S. Gal (L)	Hydrocarbon Storage Capacity U.S. Gal (L)	Maximum Sediment Capacity ft <sup>3</sup> (L)
STC 450i	470 (1,780)	86 (330)	46 (1,302)
STC 900	952 (3,600)	251 (950)	89 (2,520)
STC 1200	1,234 (4,670)	251 (950)	127 (3,596)
STC 1800	1,833 (6,940)	251 (950)	207 (5,861)
STC 2400	2,462 (9,320)	840 (3,180)	205 (5,805)
STC 3600	3,715 (1,406)	840 (3,180)	373 (10,562)
STC 4800	5,059 (1,950)	909 (3,440)	543 (15,376)
STC 6000	6,136 (23,230)	909 (3,440)	687 (19,453)
STC 7200	7,420 (28,090)	1,059 (4,010)	839 (23,757)
STC 11000	11,194 (42,370)	2,797 (10, 590)	1,086 (30,752)
STC 13000	13,348 (50,530)	2,797 (10, 590)	1,374 (38,907)
STC 16000	15,918 (60,260)	3,055 (11, 560)	1,677 (47,487)

NOTE: Storage volumes may vary slightly from region to region. For detailed information, contact your local Stormceptor representative.

### 4.2. Inline Stormceptor

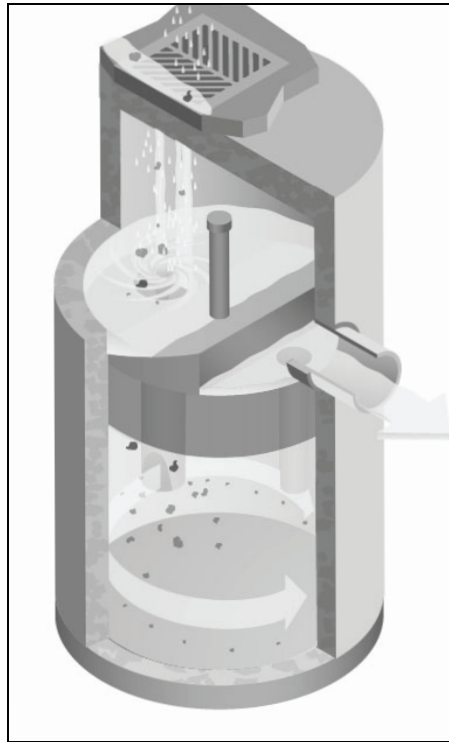
The Inline Stormceptor, Figure 1, is the standard design for most stormwater treatment applications. The patented Stormceptor design allows the Inline unit to maintain continuous positive treatment of total suspended solids (TSS) year-round, regardless of flow rate. The Inline Stormceptor is composed of a precast concrete tank with a fiberglass insert situated at the invert of the storm sewer pipe, creating an upper chamber above the insert and a lower chamber below the insert.



**Figure 1. Inline Stormceptor**

## Operation

As water flows into the Stormceptor unit, it is slowed and directed to the lower chamber by a weir and drop tee. The stormwater enters the lower chamber, a non-turbulent environment, allowing free oils to rise and sediment to settle. The oil is captured underneath the fiberglass insert and shielded from exposure to the concrete walls by a fiberglass skirt. After the pollutants separate, treated water continues up a riser pipe, and exits the lower chamber on the downstream side of the weir before leaving the unit. During high flow events, the Stormceptor System's patented scour prevention technology ensures continuous pollutant removal and prevents re-suspension of previously captured pollutants.



**Figure 2. Inlet Stormceptor**

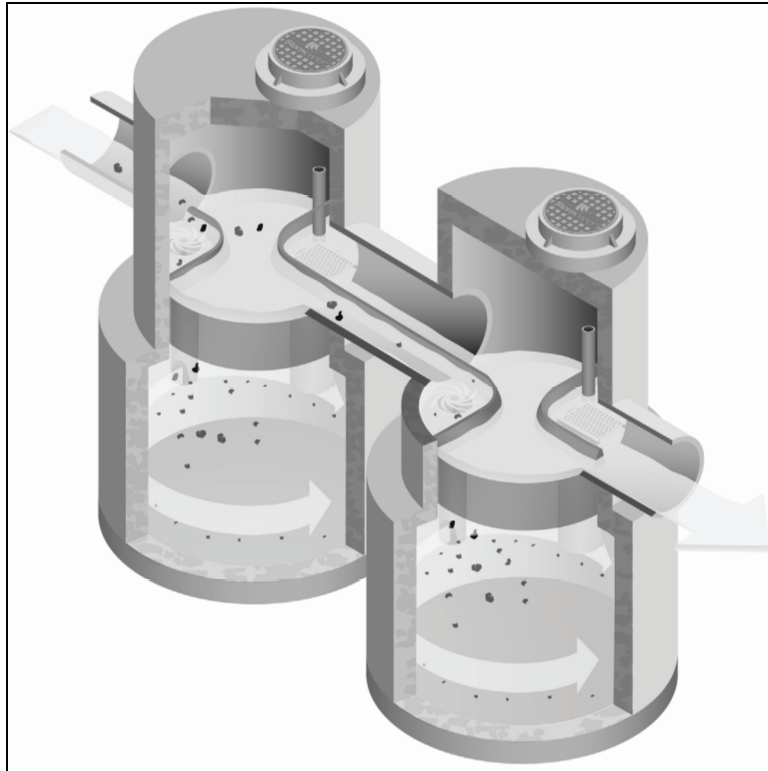
#### **4.3. Inlet Stormceptor**

The Inlet Stormceptor System, Figure 2, was designed to provide protection for parking lots, loading bays, gas stations and other spill-prone areas. The Inlet Stormceptor is designed to remove sediment from stormwater introduced through a grated inlet, a storm sewer pipe, or both.

The Inlet Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

#### **4.4. Series Stormceptor**

Designed to treat larger drainage areas, the Series Stormceptor System, Figure 3, consists of two adjacent Stormceptor models that function in parallel. This design eliminates the need for additional structures and piping to reduce installation costs.



**Figure 3. Series System**

The Series Stormceptor design operates in the same manner as the Inline unit, providing continuous positive treatment, and ensuring that captured material is not re-suspended.

## 5. Sizing the Stormceptor System

The Stormceptor System is a versatile product that can be used for many different aspects of water quality improvement. While addressing these needs, there are conditions that the designer needs to be aware of in order to size the Stormceptor model to meet the demands of each individual site in an efficient and cost-effective manner.

PCSWMM for Stormceptor is the support tool used for identifying the appropriate Stormceptor model. In order to size a unit, it is recommended the user follow the seven design steps in the program. The steps are as follows:

### STEP 1 – Project Details

The first step prior to sizing the Stormceptor System is to clearly identify the water quality objective for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a particle size distribution.

### STEP 2 – Site Details

Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of imperviousness based on paved surfaces, sidewalks and rooftops.

### STEP 3 – Upstream Attenuation

The Stormceptor System is designed as a water quality device and is sometimes used in conjunction with onsite water quantity control devices such as ponds or underground detention systems. When possible, a greater benefit is typically achieved when installing a Stormceptor unit upstream of a detention facility. By placing the Stormceptor unit upstream of a detention structure, a benefit of less maintenance of the detention facility is realized.

## STEP 4 – Particle Size Distribution

It is critical that the PSD be defined as part of the water quality objective. PSD is critical for the design of treatment system for a unit process of gravity settling and governs the size of a treatment system. A range of particle sizes has been provided and it is recommended that clays and silt-sized particles be considered in addition to sand and gravel-sized particles. Options and sample PSDs are provided in PCSWMM for Stormceptor. The default particle size distribution is the Fine Distribution, Table 2, option.

**Table 2. Fine Distribution**

Particle Size	Distribution	Specific Gravity
20	20%	1.3
60	20%	1.8
150	20%	2.2
400	20%	2.65
2000	20%	2.65

If the objective is the long-term removal of 80% of the total suspended solids on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (greater than 75 microns) would provide relatively poor removal efficiency of finer particles that may be naturally prevalent in runoff from the site.

Since the small particle fraction contributes a disproportionately large amount of the total available particle surface area for pollutant adsorption, a system designed primarily for coarse particle capture will compromise water quality objectives.

## STEP 5 – Rainfall Records

Local historical rainfall has been acquired from the U.S. National Oceanic and Atmospheric Administration, Environment Canada and regulatory agencies across North America. The rainfall data provided with PCSMM for Stormceptor provides an accurate estimation of small storm hydrology by modeling actual historical storm events including duration, intensities and peaks.

## STEP 6 – Summary

At this point, the program may be executed to predict the level of TSS removal from the site. Once the simulation has completed, a table shall be generated identifying the TSS removal of each Stormceptor unit.

## STEP 7 – Sizing Summary

Performance estimates of all Stormceptor units for the given site parameters will be displayed in a tabular format. The unit that meets the water quality objective, identified in Step 1, will be highlighted.

## 5.1. PCSWMM for Stormceptor

The Stormceptor System has been developed in conjunction with PCSWMM for Stormceptor as a technological solution to achieve water quality goals. Together, these two innovations model, simulate, predict and calculate the water quality objectives desired by a design engineer for TSS removal.

PCSWMM for Stormceptor is a proprietary sizing program which uses site specific inputs to a computer model to simulate sediment accumulation, hydrology and long-term total suspended solids removal. The model has been calibrated to field monitoring results from Stormceptor units that have been monitored in North America. The sizing methodology can be described by three processes:

1. Determination of real time hydrology
2. Buildup and wash off of TSS from impervious land areas
3. TSS transport through the Stormceptor (settling and discharge). The use of a calibrated model is the preferred method for sizing stormwater quality structures for the following reasons:
  - » The hydrology of the local area is properly and accurately incorporated in the sizing (distribution of flows, flow rate ranges and peaks, back-to-back storms, inter-event times)
  - » The distribution of TSS with the hydrology is properly and accurately considered in the sizing
  - » Particle size distribution is properly considered in the sizing
  - » The sizing can be optimized for TSS removal
  - » The cost benefit of alternate TSS removal criteria can be easily assessed
  - » The program assesses the performance of all Stormceptor models. Sizing may be selected based on a specific water quality outcome or based on the Maximum Extent Practicable

For more information regarding PCSWMM for Stormceptor, contact your local Stormceptor representative, or visit [www.imbriumsystems.com](http://www.imbriumsystems.com) to download a free copy of the program.

## 5.2. Sediment Loading Characteristics

The way in which sediment is transferred to stormwater can have a considerable effect on which type of system is implemented. On typical impervious surfaces (e.g. parking lots) sediment will build over time and wash off with the next rainfall. When rainfall patterns are examined, a short intense storm will have a higher concentration of sediment than a long slow drizzle. Together with rainfall data representing the site's typical rainfall patterns, sediment loading characteristics play a part in the correct sizing of a stormwater quality device.

### Typical Sites

For standard site design of the Stormceptor System, PCSWMM for Stormceptor is utilized to accurately assess the unit's performance. As an integral part of the product's design, the program can be used to meet local requirements for total suspended solid removal. Typical installations of manufactured stormwater treatment devices would occur on areas such as paved parking lots or paved roads. These are considered "stable" surfaces which have non – erodible surfaces.

### Unstable Sites

While standard sites consist of stable concrete or asphalt surfaces, sites such as gravel parking lots, or maintenance yards with stockpiles of sediment would be classified as "unstable". These types of sites do not exhibit first flush characteristics, are highly erodible and exhibit atypical sediment loading characteristics and must therefore be sized more carefully. Contact your local Stormceptor representative for assistance in selecting a proper unit sized for such unstable sites.

## 6. Spill Controls

When considering the removal of total petroleum hydrocarbons (TPH) from a storm sewer system there are two functions of the system: oil removal, and spill capture.

'Oil Removal' describes the capture of the minute volumes of free oil mobilized from impervious surfaces. In this instance relatively low concentrations, volumes and flow rates are considered. While the Stormceptor unit will still provide an appreciable oil removal function during higher flow events and/or with higher TPH concentrations, desired effluent limits may be exceeded under these conditions.

'Spill Capture' describes a manner of TPH removal more appropriate to recovery of a relatively high volume of a single phase deleterious liquid that is introduced to the storm sewer system over a relatively short duration. The two design criteria involved when considering this manner of introduction are overall volume and the specific gravity of the material. A standard Stormceptor unit will be able to capture and retain a maximum spill volume and a minimum specific gravity.

For spill characteristics that fall outside these limits, unit modifications are required. Contact your local Stormceptor Representative for more information.

One of the key features of the Stormceptor technology is its ability to capture and retain spills. While the standard Stormceptor System provides excellent protection for spill control, there are additional options to enhance spill protection if desired.

### 6.1. Oil Level Alarm

The oil level alarm is an electronic monitoring system designed to trigger a visual and audible alarm when a pre-set level of oil is reached within the lower chamber. As a standard, the oil

level alarm is designed to trigger at approximately 85% of the unit's available depth level for oil capture. The feature acts as a safeguard against spills caused by exceeding the oil storage capacity of the separator and eliminates the need for manual oil level inspection.

The oil level alarm installed on the Stormceptor insert is illustrated in Figure 4.

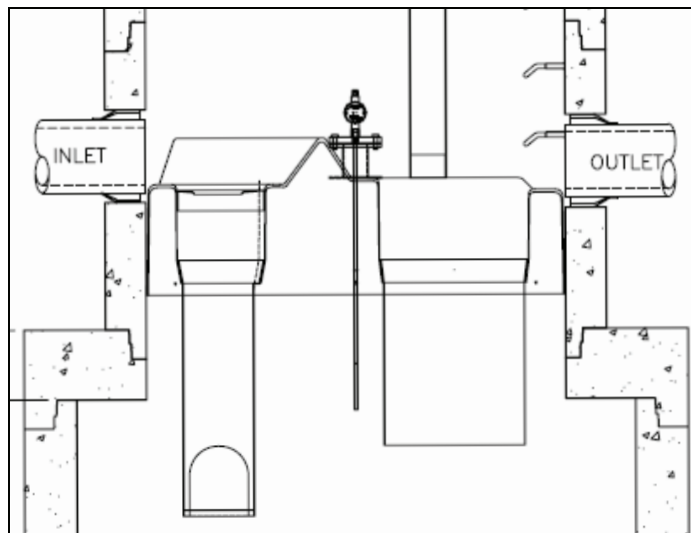


Figure 4. Oil level alarm

### 6.2. Increased Volume Storage Capacity

The Stormceptor unit may be modified to store a greater spill volume than is typically available. Under such a scenario, instead of installing a larger than required unit, modifications can be made to the recommended Stormceptor model to accommodate larger volumes. Contact your local Stormceptor representative for additional information and assistance for modifications.



## 7. Stormceptor Options

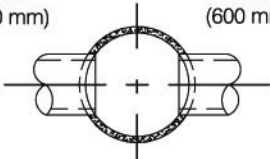
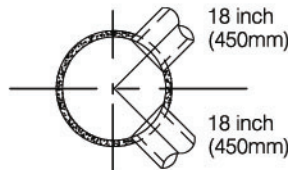
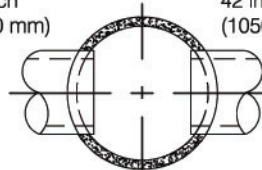
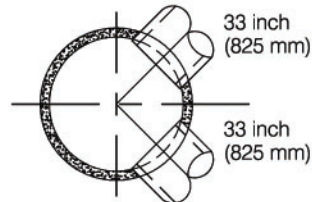
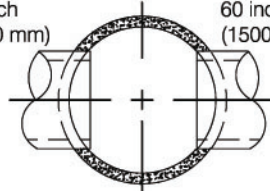
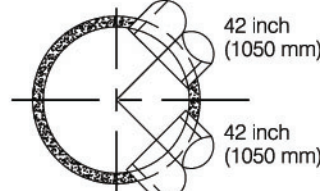
The Stormceptor System allows flexibility to incorporate to existing and new storm drainage infrastructure. The following section identifies considerations that should be reviewed when installing the system into a drainage network. For conditions that fall outside of the recommendations in this section, please contact your local Stormceptor representative for further guidance.

### 7.1. Installation Depth Minimum Cover

The minimum distance from the top of grade to the crown of the inlet pipe is 24 inches (600 mm). For situations that have a lower minimum distance, contact your local Stormceptor representative.

### 7.2. Maximum Inlet and Outlet Pipe Diameters

Maximum inlet and outlet pipe diameters are illustrated in Figure 5. Contact your local Stormceptor representative for larger pipe diameters

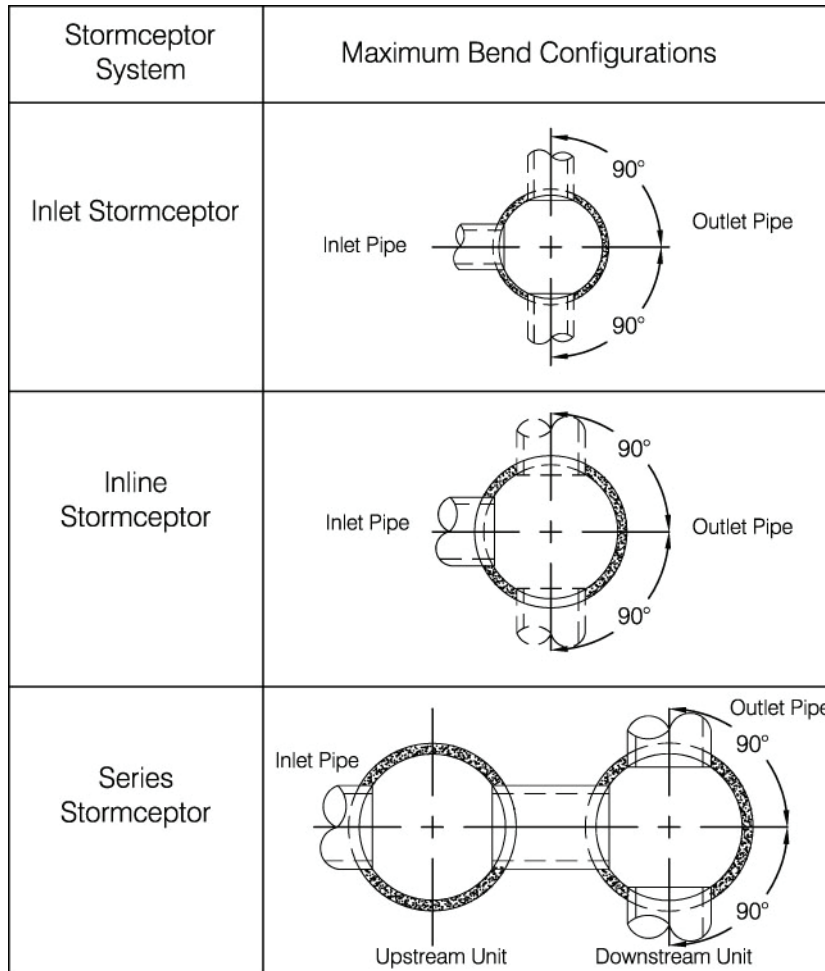
Upper Chamber Diameter	Maximum Pipe Diameters for Straight Through and 90° Bends (Based on Concrete Pipe)	
Inlet Stormceptor	24 inch (600 mm)  24 inch (600 mm)	 18 inch (450mm) 18 inch (450mm)
Inline Stormceptor	42 inch (1050 mm)  42 inch (1050 mm)	 33 inch (825 mm) 33 inch (825 mm)
Inline Stormceptor or Series Stormceptor	60 inch (1500 mm)  60 inch (1500 mm)	 42 inch (1050 mm) 42 inch (1050 mm)

**Figure 5. Maximum pipe diameters for straight through and bend applications**

\*The bend should only be incorporated into the second structure (downstream structure) of the Series Stormceptor System

### 7.3. Bends

The Stormceptor System can be used to change horizontal alignment in the storm drain network up to a maximum of 90 degrees. Figure 6 illustrates the typical bend situations of the Stormceptor System. Bends should only be applied to the second structure (downstream structure) of the Series Stormceptor System.



**Figure 6. Maximum bend angles**

#### 7.4. Multiple Inlet Pipes

The Inlet and Inline Stormceptor System can accommodate two or more inlet pipes. The maximum number of inlet pipes that can be accommodated into a Stormceptor unit is a function of the number, alignment and diameter of the pipes and its effects on the structural integrity of the precast concrete. When multiple inlet pipes are used for new developments, each inlet pipe shall have an invert elevation 3 inches (75 mm) higher than the outlet pipe invert elevation.

#### 7.5. Inlet/Outlet Pipe Invert Elevations

Recommended inlet and outlet pipe invert differences are listed in Table 3.

**Table 3. Recommended Drops Between Inlet and Outlet Pipe Inverts**

Number of Inlet Pipes	Inlet System	In-Line System	Series System
1	3 inches (75 mm)	1 inch (25 mm)	3 inches (75 mm)
>1	3 inches (75 mm)	3 inches (75 mm)	Not Applicable

#### 7.6. Shallow Stormceptor

In cases where there may be restrictions to the depth of burial of storm sewer systems. In this situation, for selected Stormceptor models, the lower chamber components may be increased in diameter to reduce the overall depth of excavation required.

#### 7.7. Customized Live Load

The Stormceptor system is typically designed for local highway truck loading (AASHTO HS- 20). When the project requires live loads greater than HS-20, the Stormceptor System may be customized structurally for a pre-specified live load. Contact your local Stormceptor representative for customized loading conditions.

## 7.8. Pre-treatment

The Stormceptor System may be sized to remove sediment and for spills control in conjunction with other stormwater BMPs to meet the water quality objective. For pretreatment applications, the Stormceptor System should be the first unit in a treatment train. The benefits of pre-treatment include the extension of the operational life (extension of maintenance frequency) of large stormwater management facilities, prevention of spills and lower total life-cycle maintenance cost.

## 7.9. Head loss

The head loss through the Stormceptor System is similar to a 60 degree bend at a manhole. The K value for calculating minor losses is approximately 1.3 (minor loss =  $k \cdot 1.3v^2/2g$ ).

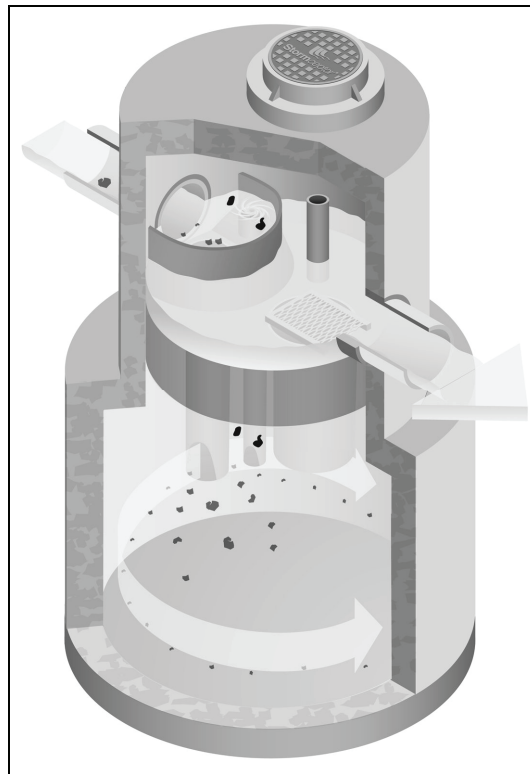
However, when a Submerged modification is applied to a Stormceptor unit, the corresponding K value is 4.

## 7.10. Submerged

The Submerged modification, Figure 7, allows the Stormceptor System to operate in submerged or partially submerged storm sewers. This configuration can be installed on all models of the Stormceptor System by modifying the fiberglass insert. A customized weir height and a secondary drop tee are added.

Submerged instances are defined as standing water in the storm drain system during zero flow conditions. In these instances, the following information is necessary for the proper design and application of submerged modifications:

- Stormceptor top of grade elevation
- Stormceptor outlet pipe invert elevation
- Standing water elevation



**Figure 7. Submerged Stormceptor**

## 8. Comparing Technologies

Designers have many choices available to achieve water quality goals in the treatment of stormwater runoff. Since many alternatives are available for use in stormwater quality treatment it is important to consider how to make an appropriate comparison between “approved alternatives”. The following is a guide to assist with the accurate comparison of differing technologies and performance claims.

### 8.1. Particle Size Distribution (PSD)

The most sensitive parameter to the design of a stormwater quality device is the selection of the design particle size. While it is recommended that the actual particle size distribution (PSD) for sites be measured prior to sizing, alternative values for particle size should be selected to represent what is likely to occur naturally on the site. A reasonable estimate of a particle size distribution likely to be found on parking lots or other impervious surfaces should consist of a wide range of particles such as 20 microns to 2,000 microns (Ontario MOE, 1994).

There is no absolute right particle size distribution or specific gravity and the user is cautioned to review the site location, characteristics, material handling practices and regulatory requirements when selecting a particle size distribution. When comparing technologies, designs using different PSDs will result in incomparable TSS removal efficiencies. The PSD of the TSS removed needs to be standard between two products to allow for an accurate comparison.

### 8.2. Scour Prevention

In order to accurately predict the performance of a manufactured treatment device, there must be confidence that it will perform under all conditions. Since rainfall patterns cannot be predicted, stormwater quality devices placed in storm sewer systems must be able to withstand extreme events, and ensure that all pollutants previously captured are retained in the system.

In order to have confidence in a system’s performance under extreme conditions, independent validation of scour prevention is essential when examining different technologies. Lack of independent verification of scour prevention should make a designer wary of accepting any product’s performance claims.

### 8.3. Hydraulics

Full scale laboratory testing has been used to confirm the hydraulics of the Stormceptor System. Results of lab testing have been used to physically design the Stormceptor System and the sewer pipes entering and leaving the unit. Key benefits of Stormceptor are:

- Low head loss (typical k value of 1.3)
- Minimal inlet/outlet invert elevation drop across the structure
- Use as a bend structure
- Accommodates multiple inlets

The adaptability of the treatment device to the storm sewer design infrastructure can affect the overall performance and cost of the site.

### 8.4. Hydrology

Stormwater quality treatment technologies need to perform under varying climatic conditions. These can vary from long low intensity rainfall to short duration, high intensity storms. Since a treatment device is expected to perform under all these conditions, it makes sense that any system’s design should accommodate those conditions as well.

Long-term continuous simulation evaluates the performance of a technology under the varying conditions expected in the climate of the subject site. Single, peak event design does not provide this information and is not equivalent to long-term simulation. Designers should request long-term simulation performance to ensure the technology can meet the long-term water quality objective.

## 9. Testing

The Stormceptor System has been the most widely monitored stormwater treatment technology in the world. Performance verification and monitoring programs are completed to the strictest standards and integrity. Since its introduction in 1990, numerous independent field tests and studies detailing the effectiveness of the Stormceptor System have been completed.

- Coventry University, UK – 97% removal of oil, 83% removal of sand and 73% removal of peat
- National Water Research Institute, Canada, - scaled testing for the development of the Stormceptor System identifying both TSS removal and scour prevention.
- New Jersey TARP Program – full scale testing of an STC 900 demonstrating 75% TSS removal of particles from 1 to 1000 microns. Scour testing completed demonstrated that the system does not scour. The New Jersey Department of Environmental Protection was followed.
- City of Indianapolis – full scale testing of an STC 900 demonstrating over 80% TSS removal of particles from 50 microns to 300 microns at 130% of the unit's operating rate. Scour testing completed demonstrated that the system does not scour.
- Westwood Massachusetts (1997), demonstrated >80% TSS removal
- Como Park (1997), demonstrated 76% TSS removal
- Ontario MOE SWAMP Program – 57% removal of 1 to 25 micron particles
- Laval Quebec – 50% removal of 1 to 25 micron particles

## 10. Installation

The installation of the concrete Stormceptor should conform in general to state highway, or local specifications for the installation of manholes. Selected sections of a general specification that are applicable are summarized in the following sections.

### 10.1. Excavation

Excavation for the installation of the Stormceptor should conform to state highway, or local specifications. Topsoil removed during the excavation for the Stormceptor should be stockpiled in designated areas and should not be mixed with subsoil or other materials.

Topsoil stockpiles and the general site preparation for the installation of the Stormceptor should conform to state highway or local specifications.

The Stormceptor should not be installed on frozen ground. Excavation should extend a minimum of 12 inches (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

In areas with a high water table, continuous dewatering may be required to ensure that the excavation is stable and free of water.

### 10.2. Backfilling

Backfill material should conform to state highway or local specifications. Backfill material should be placed in uniform layers not exceeding 12 inches (300mm) in depth and compacted to state highway or local specifications.

## 11. Stormceptor Construction Sequence

The concrete Stormceptor is installed in sections in the following sequence:

1. Aggregate base
2. Base slab
3. Lower chamber sections
4. Upper chamber section with fiberglass insert
5. Connect inlet and outlet pipes
6. Assembly of fiberglass insert components (drop tee, riser pipe, oil cleanout port and orifice plate)
7. Remainder of upper chamber
8. Frame and access cover

The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

Adjustment of the Stormceptor can be performed by lifting the upper sections free of the excavated area, re-leveling the base and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary. Once the Stormceptor has been constructed, any lift holes must be plugged with mortar.

## 12. Maintenance

### 12.1. Health and Safety

The Stormceptor System has been designed considering safety first. It is recommended that confined space entry protocols be followed if entry to the unit is required. In addition, the fiberglass insert has the following health and safety features:

- Designed to withstand the weight of personnel
- A safety grate is located over the 24 inch (600 mm) riser pipe opening
- Ladder rungs can be provided for entry into the unit, if required

### 12.2. Maintenance Procedures

Maintenance of the Stormceptor system is performed using vacuum trucks. No entry into the unit is required for maintenance (in most cases). The vacuum service industry is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean a Stormceptor will vary based on the size of unit and transportation distances.

The need for maintenance can be determined easily by inspecting the unit from the surface. The depth of oil in the unit can be determined by inserting a dipstick in the oil inspection/cleanout port.

Similarly, the depth of sediment can be measured from the surface without entry into the Stormceptor via a dipstick tube equipped with a ball valve. This tube would be inserted through the riser pipe. Maintenance should be performed once the sediment depth exceeds the guideline values provided in the Table 4.

**Table 4. Sediment Depths Indicating Required Servicing\***

Particle Size	Specific Gravity
Model	Sediment Depth inches (mm)
450i	8 (200)
900	8 (200)
1200	10 (250)
1800	15 (381)
2400	12 (300)
3600	17 (430)
4800	15 (380)
6000	18 (460)
7200	15 (381)
11000	17 (380)
13000	20 (500)
16000	17 (380)
* based on 15% of the Stormceptor unit's total storage	

Although annual servicing is recommended, the frequency of maintenance may need to be increased or reduced based on local conditions (i.e. if the unit is filling up with sediment more quickly than projected, maintenance may be required semi-annually; conversely once the site has stabilized maintenance may only be required every two or three years).

Oil is removed through the oil inspection/cleanout port and sediment is removed through the riser pipe. Alternatively oil could be removed from the 24 inches (600 mm) opening if water is removed from the lower chamber to lower the oil level below the drop pipes.

The following procedures should be taken when cleaning out Stormceptor:

1. Check for oil through the oil cleanout port
2. Remove any oil separately using a small portable pump
3. Decant the water from the unit to the sanitary sewer, if permitted by the local regulating authority, or into a separate containment tank
4. Remove the sludge from the bottom of the unit using the vacuum truck
5. Re-fill Stormceptor with water where required by the local jurisdiction



### 12.3. Submerged Stormceptor

Careful attention should be paid to maintenance of the Submerged Stormceptor System. In cases where the storm drain system is submerged, there is a requirement to plug both the inlet and outlet pipes to economically clean out the unit.

### 12.4. Hydrocarbon Spills

The Stormceptor is often installed in areas where the potential for spills is great. The Stormceptor System should be cleaned immediately after a spill occurs by a licensed liquid waste hauler.

### 12.5. Disposal

Requirements for the disposal of material from the Stormceptor System are similar to that of any other stormwater Best Management Practice (BMP) where permitted. Disposal options for the sediment may range from disposal in a sanitary trunk sewer upstream of a sewage treatment plant, to disposal in a sanitary landfill site. Petroleum waste products collected in the Stormceptor (free oil/chemical/fuel spills) should be removed by a licensed waste management company.

### 12.6. Oil Sheens

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a rainbow or sheen can be seen at very small oil concentrations (<10 mg/L). Stormceptor will remove over 98% of all free oil spills from storm sewer systems for dry weather or frequently occurring runoff events.

The appearance of a sheen at the outlet with high influent oil concentrations does not mean the unit is not working to this level of removal. In addition, if the influent oil is emulsified the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified conditions.



## SUPPORT

Drawings and specifications are available at [www.ContechES.com](http://www.ContechES.com).

Site-specific design support is available from our engineers.

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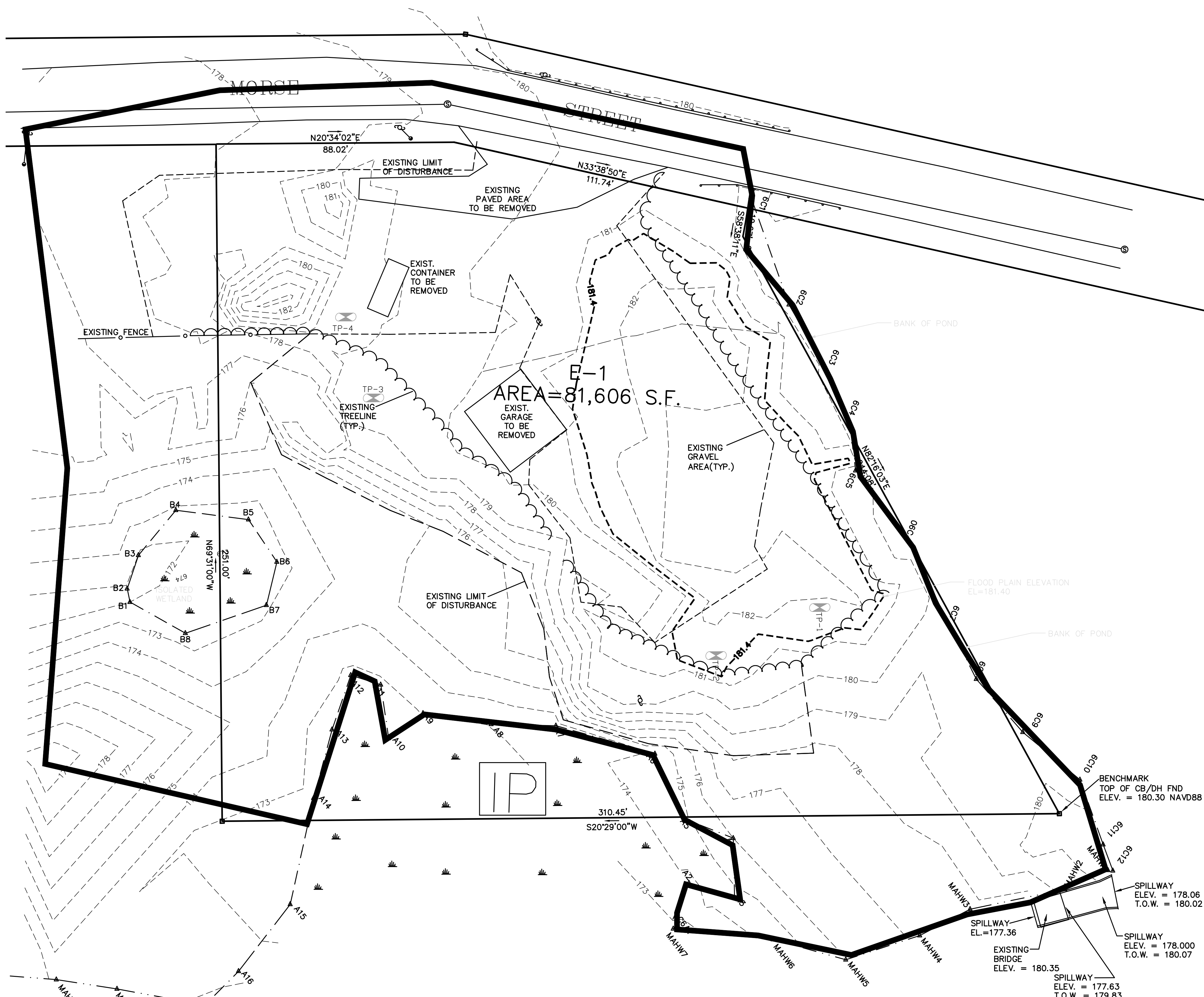
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## **Appendices:**

- Pre-Development Diagram
- Post- Development Diagram
- Pre-Development Watershed Subcatchments
- Post-Development Watershed Subcatchments
- USGS Quadrangle – Excerpt from Panel
- Soil Maps
- Flood Map



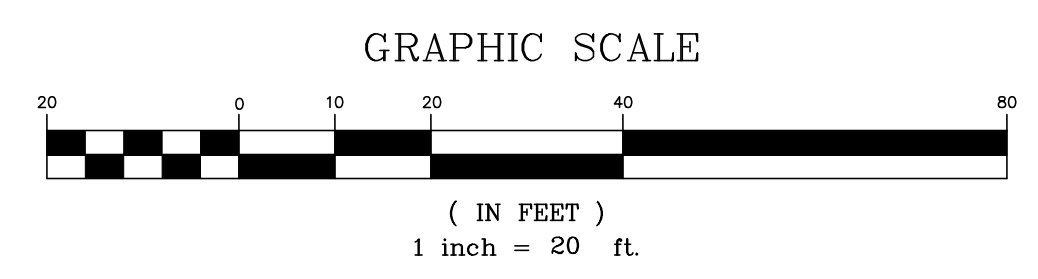


E-1  
AREA = 81,606 S.F.  
EXIST. GARAGE TO BE REMOVED

IP



**DIG SAFE NOTE:**  
UTILITIES ARE PLOTTED FROM FIELD LOCATION AND ANY RECORD INFORMATION AVAILABLE, AND SHOULD BE CONSIDERED APPROXIMATE. OTHER UTILITIES MAY EXIST WHICH ARE NOT EXHIBIT OR FOR WHICH RECORD INFORMATION WAS NOT AVAILABLE. CONTRACTORS (IN ACCORDANCE WITH MASS.G.L. CHAPTER 82 SECTION 40 AS AMENDED) MUST CONTACT ALL UTILITY COMPANIES BEFORE EXCAVATING AND DRILLING. ALSO, CALL "DIG-SAFE" AT 1(888)244-7233 [1(888)DIG-SAFE].  
EXISTING LINES OTHER THAN THOSE INDICATED ON THESE DRAWINGS MAY BE ON THE SITE. THE CONTRACTOR IS WARNED TO PROCEED WITH CAUTION WITH ALL WORK, ESPECIALLY EXCAVATION WORK, AND TO MAKE ALL POSSIBLE INVESTIGATIONS AS TO POSSIBLE UNMARKED UTILITY LINES.



REVISIONS		
REV.	DATE	DESCRIPTION

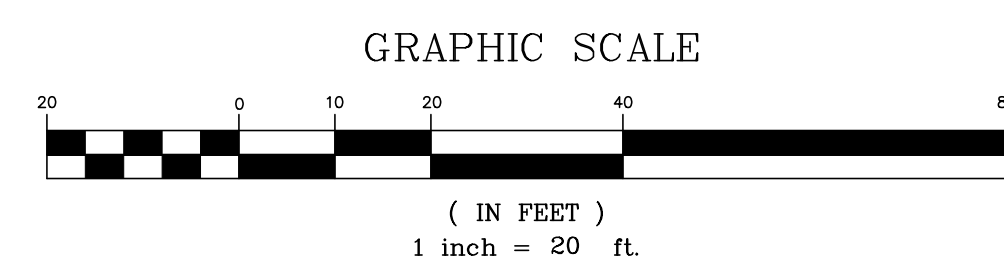
PROJECT NO.	21-151
DESIGNED BY	PML
CHECKED BY	AB
DATE	3/4/21
CAD FILE	21-151 NOI PLAN

**PREPARED BY:**  
**SUMMIT**  
Engineering & Survey, Inc.  
710 MAIN STREET  
OXFORD, MA 01537  
P:(508) 887-8713 F:(508) 887-8714

**SHEET TITLE**  
EXISTING CONDITIONS

**DEFINITIVE SITE PLAN**  
at  
**130 MORSE STREET**  
**FOXBOROUGH, MA**  
PREPARED FOR  
**HAYES EXCAVATION**

**SHEET NO.**



P.E. P.L.S.

PREPARED BY:

**SUMMIT**  
 Engineering & Survey, Inc.  
 710 MAIN STREET  
 OXFORD, MA 01537  
 P:(508) 987-8713 F:(508) 987-8714

SHEET TITLE  
 GRADING & DRAINAGE

DEFINITIVE SITE PLAN  
 at  
 130 MORSE STREET  
 FOXBOROUGH, MA  
 PREPARED FOR  
 HAYES EXCAVATION

SHEET NO.  
 C-4.0

REVISIONS		
REV.	DATE	DESCRIPTION

PROJECT NO.	21-151
DESIGNED BY	PML
CHECKED BY	AB
DATE	3/4/21
CAD FILE	21-151 NOI PLAN



USGS MAP  
130 MORSE STREET  
FOXBORO, MA

REF: 21-152

# SUMMIT

Engineering & Survey, Inc.

710 MAIN STREET  
NORTH OXFORD, MA 01537  
P:(508) 987-8713 F:(508) 987-8714

FIELD BY:	DATE	REVISIONS
DRAFTED BY: P.M.L.		
REVIEWED BY: A.B.		
SCALE: N.T.S.		
DATE: 3/10/21		
SHEET: 1 OF 1		

RICHARD HAYES



Soil Map—Bristol County, Massachusetts, Northern Part; and Norfolk and Suffolk Counties, Massachusetts  
(130 Morse Street Foxboro)



Map Scale: 1:2,560 if printed on A landscape (11" x 8.5") sheet.



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




## MAP LEGEND

### Area of Interest (AOI)

 Area of Interest (AOI)

### Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

### Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

### Water Features



Streams and Canals

### Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

### Background



Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at scales ranging from 1:20,000 to 1:25,000.

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

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

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

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Bristol County, Massachusetts, Northern Part  
Survey Area Data: Version 13, Jun 9, 2020

Soil Survey Area: Norfolk and Suffolk Counties, Massachusetts  
Survey Area Data: Version 16, Jun 11, 2020

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jul 5, 2019—Jul 8, 2019

## MAP LEGEND

## MAP INFORMATION

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

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
52A	Freetown muck, 0 to 1 percent slopes	0.2	1.0%
245A	Hinckley loamy sand, 0 to 3 percent slopes	0.2	0.6%
245B	Hinckley loamy sand, 3 to 8 percent slopes	1.3	5.6%
651	Udorthents, smoothed	0.8	3.4%
<b>Subtotals for Soil Survey Area</b>		<b>2.5</b>	<b>10.7%</b>
<b>Totals for Area of Interest</b>		<b>23.5</b>	<b>100.0%</b>

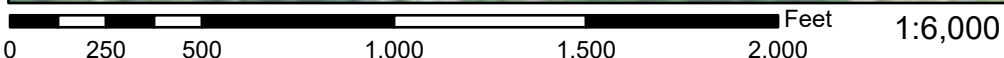
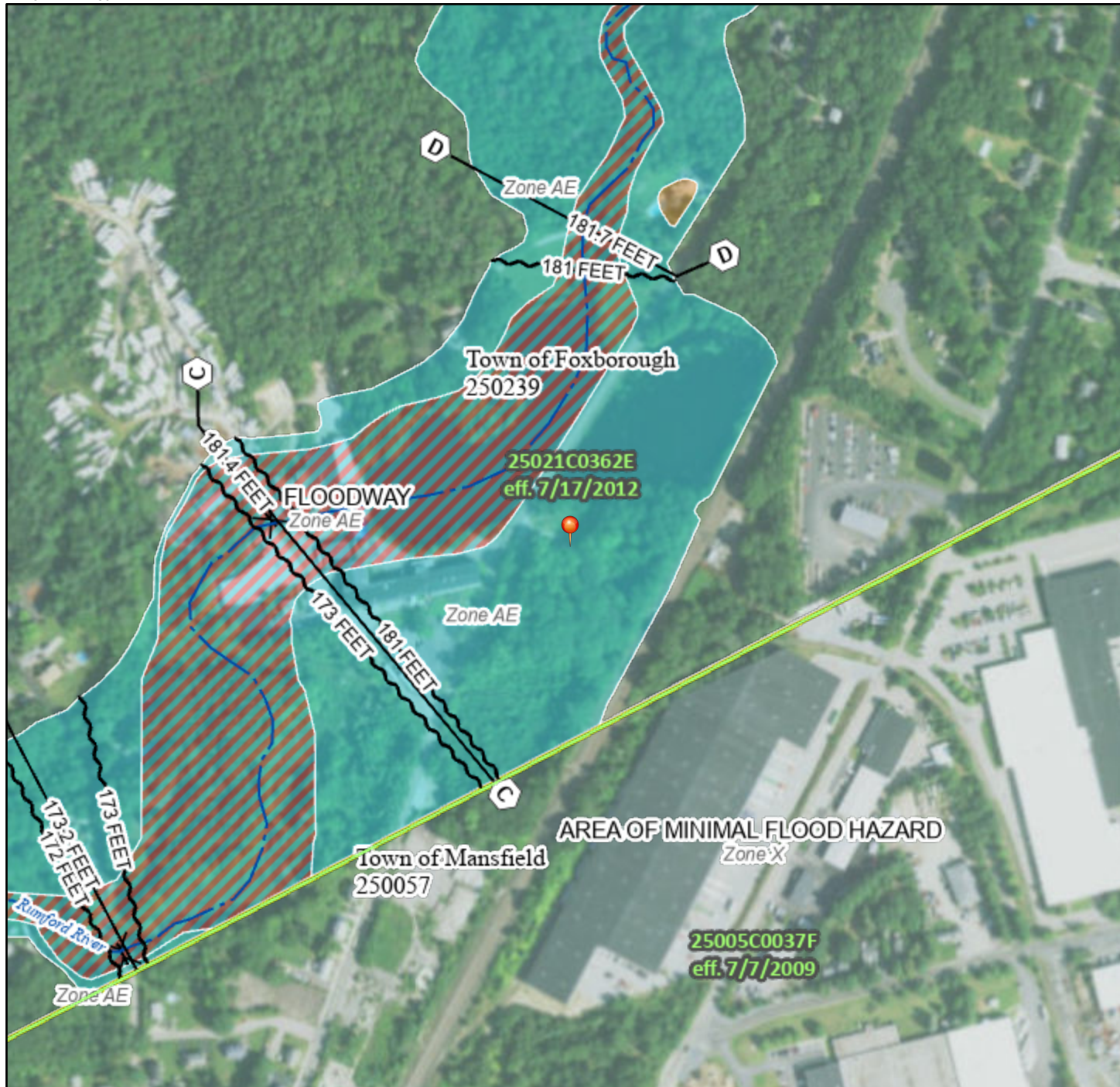
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	6.2	26.4%
52	Freetown muck, 0 to 1 percent slopes	0.3	1.4%
53	Freetown muck, ponded, 0 to 1 percent slopes	1.8	7.5%
245B	Hinckley loamy sand, 3 to 8 percent slopes	0.2	0.8%
245C	Hinckley loamy sand, 8 to 15 percent slopes	0.7	3.2%
260B	Sudbury fine sandy loam, 2 to 8 percent slopes	1.0	4.3%
602	Urban land, 0 to 15 percent slopes	5.3	22.6%
653	Udorthents, sandy	5.4	23.2%
<b>Subtotals for Soil Survey Area</b>		<b>21.0</b>	<b>89.3%</b>
<b>Totals for Area of Interest</b>		<b>23.5</b>	<b>100.0%</b>



# National Flood Hazard Layer FIRMMette



71°13'2"W 42°2'58"N



Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

## Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D

OTHER AREAS		NO SCREEN Area of Minimal Flood Hazard Zone X
		Effective LOMRs
GENERAL STRUCTURES		Area of Undetermined Flood Hazard Zone D
		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall

OTHER FEATURES		20.2 Cross Sections with 1% Annual Chance Water Surface Elevation
		17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
		Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
OTHER FEATURES		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature

MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped
		The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.



This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/8/2021 at 1:03 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.