STORMWATER REPORT

PROPOSED TOWNHOUSE DEVELOPMENT
BRALEY ROAD
NEW BEDFORD, MASSACHUSETTS

Applicant:

BRALEY NORTH REALTY TRUST
C/O DANIEL MONIZ
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CEC Project 304-439

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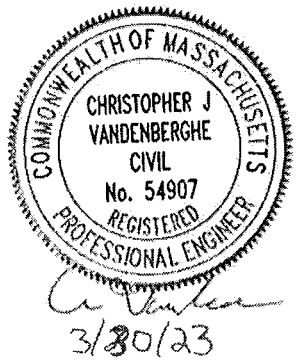

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1.0 PROJECT NARRATIVE

1.1 INTRODUCTION

On behalf of Braley North Realty Trust (The Applicant), Civil & Environmental Consultants, Inc. (CEC) has prepared this stormwater report and analysis to demonstrate compliance with the Massachusetts Department of Environmental Protection (MassDEP) Stormwater Management Standards & City of New Bedford Stormwater requirements.

The Applicant is proposing to develop one parcel of land identified as City of New Bedford parcel Assessors parcel number 136-309, located in the Mixed-Use Business (MUB) District. The development includes the construction of six townhomes in one building totaling 5,280 S.F with site improvements including new utilities, a new five-foot-wide side concrete ribbon sidewalk from the intersection of Braley Road Extension to the new curb curt driveway apron, and drainage improvements.

1.2 EXISTING CONDITIONS

The subject property is a 30,130 s.f. lot located on the east side of Braley Road at the entrance to the New Bedford Industrial Park. The property is bordered by a single-family house lot on the north, Route 140 on the east and Braley Road Extension on the south. The property is located in a Mixed-Use Business (MUB) district.

The subject property was previously approved for the construction of a mixed-use business building with associated parking and utilities in June 2019. The construction was started and the perimeter retaining walls was constructed in accordance with the original design plans. The area within the walls were graded and construction was suspended due to changing market conditions. The area beyond the wall consists of a combination of grass, scrub brush and woodlands that include areas identified as Bordering Vegetated Wetlands.

1.2.1 Geotechnical Conditions

According to the Natural Resources Conservation Service (NRCS) Web Soil Survey, the Site is comprised of Sudbury fine Sandy Loam Loam (#260A). Sudbury fine Sandy Loam is described to be comprised of friable coarse-loamy eolian deposits over loose sandy glaciofluvial deposits.

For the purpose of the hydrologic analysis, a Hydrologic Soils Group (HSG) "B" was assigned to the Project in accordance with the NRCS Web Soil Survey data.

Test pits were performed for the site in January 2004 in which sand was found at a depth of approximately 30" below existing grade. As the predominant underlying soils were classified as sand, infiltration (where proposed) used an infiltration rate of 8.21 in/hr. A note stating that the contractor shall remove and replace all unsuitable material down to a depth suitable for the drainage design is shown on Detail sheet C801.

1.2.2 Flood Zone

The Site is located within an Area of Minimal Flood Hazard shown on the Federal Emergency Agency (FEMA) Flood Insurance Rate Map (FIRM) for the City of New Bedford, Map# 25005C0377G effective July 6, 2021. Refer to Figure 3 for the FEMA Flood Insurance Rate Map (FIRM) Firmette.

1.3 PROPOSED PROJECT

The applicant is proposing to construct six townhomes in one building totaling 5,280 S.F. The project will be serviced by municipal water and sewer with connections within Braley Road.

Access to the site will be via a 24' wide driveway located on the north side of the development in order to maximize the separation to the Industrial Park entrance road. A new five-foot-wide side concrete ribbon sidewalk will be installed from the intersection of Braley Road Extension to the new curb curt driveway apron serving the project. An accessible curb ramp with painted crosswalk will be added along the frontage to match the recently constructed ramp located on the west side of Braley Road.

Stormwater runoff from the site pavement will be directed to a water quality treatment unit and subsurface infiltration system for water quality and peak flow mitigation. Stormwater runoff from the building will be directed to subsurface infiltration systems at the rear of the building.

2.0 STORMWATER MANAGEMENT SYSTEMS

2.1 DESCRIPTION OF RUNOFF CONTROLS

The stormwater management improvements consist of components designed to manage runoff from the Site. These components attenuate runoff discharge peaks, minimize erosion, minimize the transport of sediments, improve water quality, and minimize impacts to downstream resource areas.

The stormwater management system implements a treatment train of the Best Management Practices designed to provide minimum of 80% TSS (Total Suspended Solids) removal for stormwater runoff from the proposed pavement, roof and parking area. The proposed stormwater management system will use the following specific control measures:

- Proprietary particle separators (Stormceptor water quality unit): The proposed Stormceptor water quality unit provides efficient removal of free oils, debris, and total suspended solids (TSS). Although not the main objective of the water quality unit, some removal of heavy metals and other nutrients is also achieved. Water quality units allow for safe and easy removal of collected material and should be inspected and cleaned in accordance with the O&M Plan and per manufacturer's recommendations. See the Long-Term Pollution Prevention and O&M Plan included in Section 6.0 and Appendix D for supporting information.

- Subsurface Infiltration Structures: The stormwater runoff from the proposed pavement will be routed through the Stormceptor water quality unit to subsurface stormwater infiltration chambers (Cultec-R280HD). These subsurface infiltration structures are proposed under the pavement to control stormwater runoff. The proposed runoff controls are detailed on the Site Plans provided under a separate cover. The clean roof runoff will be conveyed to additional Cultec-R280HD chambers at the rear of the buildings. The subsurface structures handling the stormwater runoff from the pavement have been sized to contain all storm events up to and including the 100-year storm event with all runoffs discharging through a new outlet control structure. The subsurface infiltration structures for the roof runoff have been sized to fully accommodate the 25-year storm. The proposed runoff controls are detailed on the Site Plans provided under a separate cover.

2.2 CONSTRUCTION SEQUENCE PLAN

The purpose of the Construction Sequence Plan is to develop a working schedule for the implementation of the proposed stormwater improvements. Prior to initiating work, the siltation control barriers will be installed along the limit of work. Once the appropriate permits are obtained, the construction project will commence in the following sequence:

1. Install all erosion and sediment control measures per the enclosed plans. The Contractor will implement the use of widely accepted principles for erosion and sediment control during construction.
2. Adjust site grades to design base elevations.
3. Installation of foundation, utilities, drainage, and retention system.
4. Construct building, sidewalks, and pavement area. Stabilize site with landscaping.
5. Construction sequence may vary to minimize disturbance on site.
   All construction water will be collected and treated in accordance with the Erosion and Sediment Control Plan included in Section 5.0.

3.0 STORMWATER ANALYSIS

3.1 METHOD OF ANALYSIS

A hydrologic analysis has been performed for the Site comparing existing conditions and post-development conditions using a software program developed by HydroCAD. This program analyzes site hydrology by the graphic peak discharge method documented in Technical Release No. 20 and Technical Release No. 55 published by the United States Department of Agriculture (USDA) Soil Conservation Service.

The following variables were developed for the contributing watersheds (drainage areas) in order to complete the analysis:

- **Rainfall Depth:** A hydrologic analysis was performed for the 24-hour 2-year, 10-year, 25-year, and 100-year, NRCS TR-55 storm events (3.30, 4.88, 6.10, and 8.56 inches respectively) for each drainage area. The rainfall depths for the study area were obtained from available charts published in Technical Paper No. 40.

- **Runoff Curve Number (RCN):** The RCN is a hydrologic characteristic that contributes to the peak rate of runoff and volume from a given storm event. It is dependent upon soil conditions

and land use. Generally, higher curve numbers are associated with less pervious soils and, hence, greater amounts of runoff. As previously noted, based on the geotechnical investigation, Hydrologic Soil Group (HSG) B was used in determining RCNs.

- **Time of Concentration:** The time of concentration is defined as the time it takes runoff to travel from the hydraulically most distant part of the watershed to the downstream point of interest. This parameter is dependent on the characteristics of the ground surface and condition of the travel path. Times of concentration were calculated for the various sub catchments using the HydroCAD program, with a minimum time of concentration of six (6) minutes used in accordance with the protocol outlined in Technical Release No. 55.

3.2 DRAINAGE AREAS

In order to perform the analysis, the contributing drainage areas for pre-development, existing, and post-development conditions were delineated. The delineation of the drainage areas was determined by the topography depicted on the Existing Conditions plan. Brief descriptions of the existing conditions and proposed conditions drainage areas are as follows

- **Existing Conditions:** The Site is divided into two (2) drainage areas and the stormwater runoff was evaluated for one (1) design point, Flow to Wetlands (Design Point 1). Refer to Figure HYD-EX for the existing conditions drainage areas. For the purpose of the analysis, the times of concentration were calculated to the edge of the wetlands where present. A summary of existing conditions drainage areas is listed below:

TABLE 3.1
EXISTING CONDITIONS

Drainage Area	Design Point	Area (ac.)	Curve Number	Time of Concentration (minutes)
A1-EX	1	0.16	67	6.0
A2-EX	1	0.50	67	7.0

Refer to Appendix C for Pre Drainage Analysis HydroCAD report.

- **Proposed Conditions:** The Site is composed of four (4) drainage areas and the stormwater runoff will continue to flow to one (1) design point, Flow to Wetlands (Design Point 1). Refer to Figure HYD-PR for the proposed conditions drainage area. A summary of the proposed conditions drainage areas are listed below:

TABLE 3.2
POST-DEVELOPMENT CONDITIONS

Drainage Area	Design Point	Area (ac.)	Curve Number	Time of Concentration (minutes)
A1-PR	1	0.21	61	6.0
A2-PR		0.33	75	9.0
RD-A1		0.06	98	6.0
RD-A2		0.06	98	6.0

Refer to Appendix C for Post Drainage Analysis HydroCAD report.

3.3 RESULTS OF ANALYSIS

A stormwater analysis was performed for the 24-hour 2-year, 10-year, 25-year, and 100-year storm events to determine that there will be no increase in stormwater runoff discharge off-site once the proposed construction is complete. Detailed calculations are attached in Appendix C. Compliance for existing and post-development conditions was evaluated for the site as a whole. A summary of the peak stormwater runoff is provided below.

As shown below in Table 3.3, post-development runoff rates from the Site do not exceed existing runoff rates in all storm events, with exception on the 100-year storm. Supporting calculations are provided in Appendix C.

TABLE 3.3 PROJECT STORMWATER RUNOFF RATES								
	Peak Runoff Rate (cfs)							
Design Point	2-Year		10-Year		25-Year		100-Year	
	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.
1	0.44	0.03	1.00	0.18	1.59	0.45	2.07	3.44

cfs = cubic feet per second

As shown below in Table 3.4, post-development discharge volume from the Site decreased for design point 1. Supporting calculations are provided in Appendix C.

TABLE 3.4 PROJECT STORMWATER RUNOFF RATES								
	Runoff Volume (af)							
Design Point	2-Year		10-Year		25-Year		100-Year	
	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.	Ex.	Prop.
1	0.033	0.008	0.069	0.022	0.109	0.043	0.151	0.124

af = acre feet

4.0 STORMWATER CONTROL SYSTEM DESIGN CRITERIA

4.1 MASSDEP STORMWATER MANAGEMENT POLICY

Stormwater discharge from the proposed Project is subject to the Massachusetts DEP Stormwater Management Policy (the Policy). The Policy is designed *"to protect the wetlands and waters of the Commonwealth from adverse impacts of storm water runoff."* To accomplish this goal, the Policy establishes ten (10) performance standards to control stormwater quantity and quality. These standards establish the level of required controls that can be achieved with site planning, structural and non-structural controls, and other best management practices (BMPs). The Stormwater Checklist is provided in Appendix A. Stormwater modeling methodology is discussed in detail in Section 3.0. Results of the stormwater modeling of the existing and proposed conditions are provided as Appendix C.

4.1.1 Stormwater Management Standards

The following section documents compliance with the MassDEP Stormwater Management Standards.

Standard 1

No new stormwater conveyances (e.g., outfalls) may discharge untreated stormwater directly to or cause erosion in wetlands or waters of the Commonwealth.

The project is designed to limit to the extent possible new stormwater conveyances that could discharge untreated stormwater into, or cause erosion to, wetlands or waters of the Commonwealth. The proposed project captures and provides additional treatment for the runoff from old and new impervious paved areas and roof areas and will be conveyed through an existing series of stormwater BMPs with proposed improvements, then will eventually discharge to the Bordering Vegetated Wetlands.

The project is designed so that there are no new stormwater conveyances that could discharge untreated stormwater into, or cause erosion to, wetlands or waters of the Commonwealth. Outlet protection from the drainage pipes discharges have been designed to provide non-erosive velocities prior to discharging to natural grade or vegetated surfaces. The stormwater management system has been designed to provide water quality treatment providing TSS removal for all paved areas in accordance with the regulations.

Standard 2

Stormwater management systems must be designed so that post-development peak discharge rates do not exceed pre-development peak discharge rates. This Standard may be waived for discharges to land subject to coastal storm flowage as defined in 310 CMR 10.04.

The post-development peak discharge rate to design point 1, Flow to Wetlands, do not exceed pre-development rates for all storm events. Stormwater modeling methodology is discussed in detail in Section 3.0. The model output is provided as Appendix C. A summary of the model results are provided above in Table 3.3.

Standard 3

Loss of annual recharge to groundwater should be minimized through the use of infiltration measures to the maximum extent practicable. The annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site conditions, based on soil types.

The project is designed to comply with this criteria. The project will result in the addition of approximately 0.25 acres of new impervious areas. In accordance with the stormwater standards, 0.35-inches of recharge must be provided for the increase in impervious areas on the Site for HSG B soils. Accordingly, a total of 316 cubic feet (cf) of groundwater recharge is required based on the increase of impervious areas within the site. Through the introduction of the various stormwater infiltration practices, a total of 2,004 cf of recharge is proposed, providing significantly more recharge than the regulatory requirement.

Based on the soil analysis, a Rawls Rate of 8.27 in/hr was utilized for the recharge facilities. Each of the infiltration systems has been designed to provide the drawdown of all stormwater below the low flow outlets in less than 72 hours. Supporting calculations are provided in Appendix C.

Standard 4

For new development, stormwater management systems must be designed to remove 80% of the average annual load (post-development conditions) of Total Suspended Solids (TSS). It is presumed that this standard is met when:

A. *Suitable nonstructural practices for source control and pollution prevention are implemented;*
B. *Stormwater management best practices (BMPs) are sized to capture the prescribed runoff volume; and*
C. *Stormwater management BMPs are maintained as designed.*

The proposed development utilizes the use of several particle separators (Stormceptor 450i) and level spreaders prior to discharging, consistent with the Policy.

The estimated TSS removal rate from the proposed BMP pre-treatment is a minimum of 80%, which complies with the 80% requirement.

See Water Quality Calculations and TSS Calculations provided in Appendix C for supporting information. A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included in Section 6.0 of this report.

Standard 5

Stormwater discharges from areas with higher potential pollutant loads require the use of specific stormwater management BMPs. The use of infiltration practices without pre-treatment is prohibited.

The Site is not considered to in an area with higher potential pollutant loads.

Standard 6

Stormwater discharges to critical areas must utilize certain stormwater management BMPs approved for critical areas. Critical areas are Outstanding Resources Waters (ORWs), shellfish beds, bathing beaches, cold water fisheries, and recharge areas for public water supplies.

The Site is not anticipated to discharge to critical areas.

Standard 7

Redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. Where it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

The Project is not redevelopment project.

Standard 8

Erosion and sediment controls must be implemented to prevent impacts during construction, or land disturbance activities.

Erosion and sediment controls are integral to the project improvements. The plan includes compost silt socks, which will be installed down-gradient of the proposed work area. A temporary stabilized construction exit will be constructed as well. Prior to, and during construction, the Site's Erosion and Sediment Control Plan, included in Section 5.0 of this report will be followed. These measures will be utilized throughout construction to prevent erosion, control sediments, and stabilize exposed soils as discussed in Section 5.0.

Standard 9

All stormwater management systems must have an operations and maintenance plan to ensure that systems function as designed.

A comprehensive Operations and Maintenance Plan (O&M) has been developed and is included in Section 6.0 of this report. The Manufacturer's O&M Procedures for the proposed water quality units are included in Appendix D.

Standard 10

All illicit discharges to the stormwater management system are prohibited.

There are no known illicit discharges at the Site. If found, any illicit discharges will be eliminated, and the project will not be constructed with any illicit connections. A draft Illicit Discharge Statement is provided in Appendix D.

5.0 CONSTRUCTION SEDIMENTATION AND EROSION CONTROL PLAN

5.1 INTRODUCTION

The greatest potential for sediment generation will occur during the construction. An extensive erosion and sedimentation program is proposed and will be diligently implemented during construction of the project. The erosion control program will minimize erosion and sedimentation that could potentially impact resources areas. Water quality will be maintained by minimizing erosion of exposed soils and siltation. Erosion control barriers will be installed and exposed soil areas re-vegetated as soon as possible after work in an area is completed.

Responsible Party for Plan Compliance:

Braley North Realty Trust
70 Lambeth Street
New Bedford, MA 02740

Contact: Daniel Moniz
Phone: 508-294-7974

5.2 SITE DESCRIPTION

The development includes the construction of six townhomes in one building totaling 5,280 S.F with site improvements including new utilities, a new five foot wide side concrete ribbon sidewalk from the intersection of Braley Road Extension to the new curb curt driveway apron, and drainage improvements. The site is relatively flat and currently includes a combination of gravel, brush, woods and a concrete retaining wall which surrounds the proposed building and parking area. The onsite soils have been classified by a licensed soil evaluator and consist of fill material over a medium to coarse sand.

Soil disturbing activities will include installing perimeter and other sediment controls, finish grading of the site, followed by the installation of the stormwater infiltration systems, pavement area, utilities, curbing and sidewalks. Upon completion of construction, landscaping will be installed and all disturbed areas will be stabilized.

SEQUENCE OF MAJOR ACTIVITIES

1. Install all erosion and sediment control measures per the enclosed approved plans. The Contractor will implement the use of widely accepted principles for erosion and sediment control during construction.
2. Adjust site grades to design base elevations.
3. Installation of foundation, utilities, drainage, and retention system.
4. Construct building, sidewalks, and parking. Stabilize site with landscaping.
5. Construction sequence may vary to minimize disturbance on site.

5.3 EROSION AND SEDIMENT CONTROLS

In addition to the perimeter controls, erosion control will be accomplished using temporary measures such as tracking entrance, seeding or mulching, spraying of liquid stabilizers or any combination of these measures. Seeds should be applied at a rate of 2 lbs/ 1000 square feet at a depth of 1/2 inch. Soil netting or covering should be used in extreme conditions.

Only minor stockpiling of soils will be allowed on site. Soil stockpiles will be ringed with hay bales/ silt fencing or covered in extreme conditions.

Maintenance / Inspection Procedures for Erosion and Sediment Controls

- Construction to commence in a phased manner.
- All control measures will be inspected at least once each week and following any storm event of 0.5 inches of precipitation or greater.
- All measures will be maintained in good working order; if repair is necessary, it will be initiated within 24 hours of report.
- Built up sediment will be removed from erosion control when it has reached one-third the height of the fence or bale.
- Silt fence will be inspected for depth of sediment, tears and to see if fabric is securely attached to the fence post, are firmly in the ground.
- Any temporary sediment basin used will be inspected for depth of sediment. Any buildup of sediment will be removed when it reaches 10% of the design capacity or at the end of the project completion.

- Temporary and permanent seeding and planting will be inspected for bare spots, washouts and healthy growth.

- A maintenance and inspection report will be made after each inspection. A copy of the report form to be completed by the inspector and kept on site.

- Construction site supervisor will be responsible for training workers in all inspection and maintenance practices necessary for keeping erosion and sediment controls in good working order.

5.4 OTHER CONTROLS

5.4.1 Waste Disposal

All waste materials will be disposed of offsite in accordance with all applicable local, State, and Federal regulations. No construction waste is to be buried on site. All personnel will be instructed regarding the correct procedure for waste disposal. The individual who manages the day-to-day site operations will be responsible for seeing that these procedures are followed.

5.4.2 Hazardous Waste

All hazardous waste materials will be disposed of in a manner specified by local, State, and Federal regulations and in accordance with any manufacturer's recommendations.

5.4.3 Sanitary Waste

All sanitary waste will be collected in portable units installed on site. The portable units will be cleaned and emptied by a qualified licensed contractor.

5.4.4 Concrete Waste

All concrete washings will be disposed on in a designated area away from wetlands and any property line. When the concrete hardens it be removed from the site.

5.5 POLLUTION AND SPILL PREVENTION

5.5.1 Materials

The following materials are anticipated to be present onsite during construction:

- General construction materials
- Asphalt/concrete
- Paint
- Petroleum-based products
- Cleaning solvents

5.5.2 Material Management Practices

Good Housekeeping Practices

- Store only enough materials needed for current construction activities.
- All materials that are stored outside will be stored in a neat, orderly manner, in the original containers.
- Materials will be kept in their original containers with manufacturer's labels.
- Whenever possible, all materials should be used before disposing the container.
- The site contractor shall be responsible for daily inspections to ensure proper handling and disposal of materials on site.

Product Specific Practices

Petroleum/Fertilizer Products:

- Refueling vehicles shall be DOT certified and shall contain SPCC Plans in place along with emergency equipment to contain and clean up spills.
- All on site construction vehicles shall be inspected for leaks and receive regular preventive maintenance to reduce the chance of leakage.
- Petroleum-based products will be stored in tightly sealed containers, which are properly marked.
- All fertilizers will be stored in a dry protected area and only used according to manufacturer's recommendation.

Paints:

- All containers will be tightly sealed and stored when not required for use.
- All procedures will be followed to minimize spills and to keep products in the original containers.

Concrete Trucks:

- The site contractor is responsible for designating a safe area, away from abutting property and resource areas, for excess concrete disposal.

Product Specific Practices

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

- Manufacturer recommended methods for spill clean up will be clearly posted and site personnel will be made aware of the procedures and the location of the information and cleanup supplies.
- All spills will be cleaned up immediately after discovery.
- In any case or threat of explosion or life threatening condition, all personnel shall evacuate the are to safety and then contact the local fire department for assistance.
- The spill area will be ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.
- The site contractor shall be responsible for spill prevention and cleanup and will designate at least three personnel who will receive spill prevention and cleanup training. The names of the assigned three personnel will be posted in the material storage area in the field office on site.

5.6 RECORDKEEPING

The following records will be maintained on the Site:

1. Dates when major grading activities occur,
2. Dates when construction activities temporarily or permanently cease on a portion of the Site,
3. Dates when stabilization measures are initiated, and
4. In addition, the following records will also be kept:
    - The Order of Conditions; and any additional permit conditions/approvals,
    - All inspection reports, and
    - Any spill reports.

Table 5.1 - Construction BMPs Maintenance Log

Project Name: Braley Road
Project Location: Assessors Map 136 Lot 309
Project Number: 304-439

Date: 3/22/2023
Prepared By: CJV
Approved By: KPS

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed (List Items if Required)	Date of Cleaning or Repair	Performed by
Pavement Sweeping	To be monitored as needed			Paved areas within the active construction site can be swept on a regular basis to remove larger sediment particles from construction activities. Pavement areas adjacent to the Site will be swept if dirt and debris is tracked from the active construction site.			
Inlet Protection (Silt Sack Sediment Trap)	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for proper operation. If clogged, remove accumulated sediment and properly dispose of to maintain the capacity of the catch basin.			
Erosion Control Barrier (Silt fence with straw wattles)	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			Inspect for deterioration or failure. Remove sediment when buildup exceeds 6 inches or half the barrier height. The underside of straw bales should be kept in close contact with the earth and reset as necessary.			
Stabilized Construction Exit	Inspect at least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of storm event of 0.25 inches or greater.			The exit shall be maintained in a condition that will prevent tracking of sediment onto public rights-of-way. The contractor shall sweep or wash pavement at exits which have experienced mud-tracking onto the pavement or traveled way. When wheel washing is required, it shall be done on an area stabilized with aggregate that drains into an approved sediment trapping device. When the construction exit becomes ineffective, the stone shall be removed along with the collected soil material and redistributed on-site in a stable manner. The exit should then be reconstructed. All sediment shall be prevented from entering storm drains, ditches, or waterways.			

Stormwater Supervisor Contact Information: _____

6.0 OPERATIONS AND MAINTENANCE (O&M) PLAN

6.1 GENERAL

Stormwater management systems with multiple components, such as the one proposed for the project, assures the cleanest possible discharges of stormwater to the environment. However, these systems must be routinely maintained to keep them in good working order. Additionally, this plan identifies potential sources of pollution that may affect the quality of stormwater discharges and describes the implementation of Long-Term Pollution Prevention practices to reduce potential pollutants in stormwater discharge. The party identified below will be responsible for the operation and maintenance of the stormwater management system and Site. Schedules and procedures for inspection and maintenance of the existing and proposed stormwater management system components are provided in the following sections.

Responsible Party for Plan Compliance:

Braley North Realty Trust
70 Lambeth Street
New Bedford, MA 02740

Contact: Daniel Moniz
Phone: 508-294-7974

Emergency Contact Information:
Civil & Environmental Consultants, Inc.
(774) 501-2176

Estimated O&M Budget
It is estimated that an annual budget of $1,000 should be allocated to performing routine inspections and maintenance identified in this O&M Plan.

Upon a transfer of ownership, the future owner shall assume the responsibilities for compliance with this O&M Plan.

6.2 ROUTINE INSPECTIONS

Inspections of the stormwater management system as a whole, and of the individual components of the system, will be carried out on a routine basis in accordance with the schedule identified in Section 6.3.. Components to be inspected include the catch basins and subsurface infiltration chambers. Each will be inspected for sediment buildup, presence of oil, color, and structural damage. The results of each inspection will be entered into an inspection log. Refer to Table 6.1 for the inspection log forms.

6.3 MAINTENANCE PLAN

The Responsible Party will incorporate a routine maintenance program to assure proper operation of the stormwater management system. The program will include the following maintenance activities:

Roof Drain Leaders

- Perform routine roof inspections twice per year, typically in the spring and fall.
- Inspect for blockage and remove debris if required.
- Keep roofs clean and free of debris.
- Keep roof drainage systems clear.
- Keep roof access limited to authorized personnel.

Water Quality Unit (Stormceptor STC 450i)

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Inspect and clean twice per year or as required by manufacturer.
- Remove sediment and other trapped pollutants at the frequency or level specified by the manufacturer.

Subsurface Infiltration System

- See the attached Manufacturer's instructions on operation and maintenance requirements and methodology.
- Perform routine inspections on a monthly basis for the first three months after installation. Then, at a minimum, the treatment structure is to be inspected twice annually and the infiltrating structure is to be inspected annually.

- The subsurface infiltration system will be inspected twice during for the first year and annually thereafter by removing the manhole/access port covers and determining the thickness of sediment that has accumulated.
- If sediment is more than two inches deep, it must be suspended via flushing with clean water and removed using a vactor truck.
- Emergency overflow pipes will be examined at least once each year and verified that no blockage has occurred.

Rip-Rap Outlet

- Inspect after the first several rainfall events and after any major storm events within the first year. After the first year, inspect regularly on an annual basis.
- Remove any sediment, trash, debris, leaves and grass clippings. Remove any tree seedlings before they become firmly established.
- Note and repair any erosion or low spots.

6.4 LONG TERM POLLUTION PREVENTION MAINTENANCE

The Responsible Party will incorporate a routine maintenance program to ensure the continued effectiveness of the structural water quality controls. Maintenance will be performed based on the results of inspections in accordance with the schedules identified below. The program will include the following maintenance activities:

Maintenance of Pavement Systems

Regular maintenance of pavement surfaces will prevent pollutants such as oil and grease, trash, and sediments from entering the stormwater management system. The following practices should be performed:

- Sweep or vacuum asphalt pavement areas annually with a commercial cleaning unit and dispose of removed material.
- Routinely pick up and remove litter from the parking areas, islands, and perimeter landscaping.

Maintenance of Vegetated Areas

Proper maintenance of vegetated areas can prevent the pollution of stormwater runoff by controlling the source of pollutants such as suspended sediments, excess nutrients, and chemicals

from landscape care products. Practices that should be followed under the regular maintenance of the vegetated landscape include:

- Inspect planted areas on a semi-annual basis and remove any litter.
- Maintain planted areas adjacent to pavement to prevent soil washout.
- Immediately clean any soil deposited on pavement.
- Re-seed bare areas: install appropriate erosion control measures when native soil is exposed, or erosion channels are forming.
- Plant alternative mixture of grass species in the event of unsuccessful establishment.
- Grass vegetation should not be cut to a height less than four inches.
- Pesticide/Herbicide Usage – No pesticides are to be used unless a single spot treatment is required for a specific control application.
- Fertilizer usage should be avoided. If deemed necessary, slow-release fertilizer should be used. Fertilizer may be used to begin the establishment of vegetation in bare or damaged areas but should not be applied on a regular basis unless necessary.

Management of Snow and Ice

Should significant snow fall events occur, which result in stockpiled snow impacting the operation of the Project Site, through the temporary loss of parking or limiting access in any way, the property manager may choose to have snow removed from the site. All snow removal operations will be done in accordance with Massachusetts DEP guidelines BRPG01-01, effective date March 8, 2001.

Salt and Deicing Chemicals

The amount of salt and deicing chemicals to be used on the site shall be reduced to the minimum amount needed to provide safe pedestrian and vehicle travel. The following practices should be followed to control the amount of salt and deicing materials that come into contact with stormwater runoff:

- Devices used for spreading salt and deicing chemicals should be capable of varying the rate of application based on the site-specific conditions.
- Sand and salt should be stockpiled under covered storage facilities that prevent precipitation and adjacent runoff from coming in contact with the deicing materials.

6.5 EMPLOYEE TRAINING

Training of personnel is essential to achieving proper operation and maintenance of the stormwater management system. Therefore, those Facility personnel who are responsible for operation and maintenance will be trained on the following subjects:

- Environmental laws and regulations relating to stormwater,
- The components and goals of the current Erosion and Sediment Control Plan,
- Site specific permit conditions and requirements,
- General Facility spill response procedures,
- General good housekeeping procedures, and
- General material management procedures.

Refresher training sessions will be held once a year following the completion of the Site Compliance Evaluation.

6.6 RECORDKEEPING

Records of inspections and maintenance shall be up to date and available for review and inspection, if requested by the towns official.

Table 6.1 - Stormwater Operations and Maintenance Log

Project Name: Braley Road
Project Location: ASSESORS Map 136 Lot3109
Project Number: 304-439

Date: 3/22/2023
Prepared By: CJV
Approved By: KPS

Best Management Practice	Inspection Frequency	Date Inspected	Inspector	Minimum Maintenance and Key Items to Check	Cleaning or Repair Needed (List Items if Required)	Date of Cleaning or Repair	Performed by
Pavement Sweeping	Inspect quarterly.			Paved areas will be swept annually at a minumum, and as otherwise needed.			
Infiltration Chambers for Roof Runoff and Stormwater Runoff (Cultec Recharger 280HD)	Inspect after every major storm			Water depth should be measured in the observation well at 24-hours and 48-hours after a storm. The clearance rate can be calculated based on the drop in depth divided by the elapsed time. If the clearance rate has been significantly reduced, repair or replacement may be necessary.			
Water Quality Units	Insepct 2 times per year. Clean two times per year, in the spring and fall, Refer to Manufacturers specifications			Refer to Manufacturers Specifications			
Vegetated Areas	Inspect twice per year, typically in the spring and fall.			Perform maintenance on a regular basis during the growing season. Mow grassed areas on a regular basis to maintain growth. Plant alternative mixture of grass species in the event of unsuccessful establishment. Grass vegetation should not be cut to a height less than six inches. Maintain planted areas adjacent to pavement to prevent soil washout and immediately clean any soil deposited on pavement. Re-seed bare areas; install appropriate erosion control measures when native soil is exposed or erosion channels are forming. Remove trash, sediment debris and invasive vegetation.			

Stormwater Supervisor Contact Information:_____

FIGURES

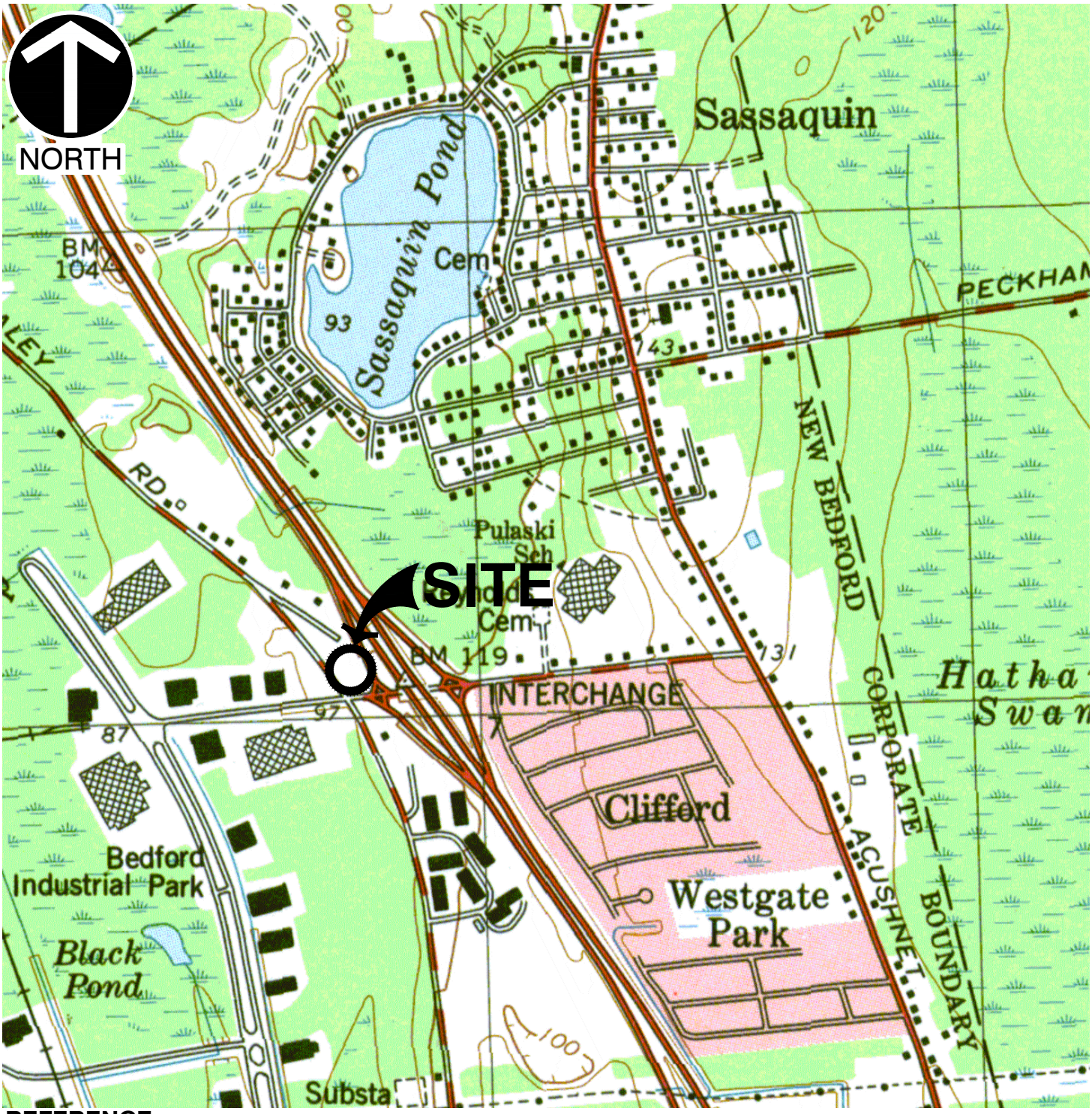
Figure 1 – Site Locus

Figure 2 – Aerial Exhibit

Figure 3 – FEMA Firmette

Figure HYD-EX – Existing Conditions Drainage Area Map

Figure HYD-PR – Proposed Conditions Drainage Area Map



REFERENCE

1. U.S.G.S. 7.5' TOPOGRAPHIC MAP, 249830, QUADRANGLE, MA DATED: 1987, ACCESSED: DECEMBER 2022.

SCALE IN FEET

0 1000 2000

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BRALEY NORTH REALTY TRUST
PROPOSED TOWNHOUSE DEVELOPMENT
ES BRALEY ROAD
NEW BEDFORD, MASSACHUSETTS

SITE LOCUS

DRAWN BY:	CJV	CHECKED BY:	CJV	APPROVED BY:	CJV	FIGURE NO.:	1
DATE:	MARCH 2023	DWG SCALE:	1"=1000'	PROJECT NO:	304-439		

P:\300-000\304-439\-CADD\Dwg\SP01\Figures\304439-CVD1-SP01-Report Figures.dwg[USGS LOCUS] LS:(3/2/2023 - cvandenberghe) - LP: 3/2/2023 4:13 PM

REFERENCE

1. PROPERTY LINES ARE BASED ON GIS DATA PROVIDED BY THE BUREAU OF GEOGRAPHIC INFORMATION (MASS GIS), COMMONWEALTH OF MASSACHUSETTS EXECUTIVE OFFICE OF TECHNOLOGY AND SECURITY AND SERVICES.
2. AERIAL PHOTOGRAPHY BY EARTHSTAR GEOGRAPHICS SIO PROVIDED BY AUTODESK, ACCESSED 2/9/2023, DATED 2023

SCALE IN FEET

0 500 1000

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ES BRALEY ROAD
NEW BEDFORD, MASSACHUSETTS

SITE LOCUS

DRAWN BY:	CJV	CHECKED BY:	CJV	APPROVED BY:	CJV	FIGURE NO.:	2
DATE:	MARCH 2023	DWG SCALE:	1"=500'	PROJECT NO:	304-439		

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National Flood Hazard Layer FIRMette

FEMA

70°57'29"W 41°43'57"N

FIGURE 3

70°56'52"W 41°43'30"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

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
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

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

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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 3/2/2023 at 4:31 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.

NORTH

LEGEND

DP–1 DESIGN POINT

A1–EX EXISTING SUBCATCHMENT AREA

PROPOSED SUBCATCHMENT BOUNDARY

EXISTING TIME OF CONCENTRATION PATH

DRAINAGE EASEMENT

BORDERING VEGETATED WETLAND

DP–1

A1–EX

A2–EX

93.09

92.59

92.59

92.89

92.29

92.79

TW:97.4

TW:97.4

TW:96.9

TW:97.4

TW:95.0

TW:97.2

CB (BENCHMARK)
F&G=93.96
INV=89.7

BRALEY (CITY LAYOUT OF 1956 – 80' WIDTH) ROAD

EDGE OF PAVEMENT (TYP.)

10" SEWER

WG

STOP

EXISTING SIDEWALK

APPROXIMATE LOCATION EXISTING

CB
F&G=94.03
INV=89.7

DMH

BRALEY ROAD EXTENSION (PUBLIC – 200' WIDTH)

16" SEWER

SMH
RIM=95.58
10" INV IN=80.91

12" SEWER

SCALE IN FEET
0 20 40

REVISION RECORD

NO	DATE	DESCRIPTION

CEC

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BRALEY NORTH REALTY TRUST
PROPOSED TOWNHOUSE DEVELOPMENT
BRALEY ROAD
NEW BEDFORD MA, 02745

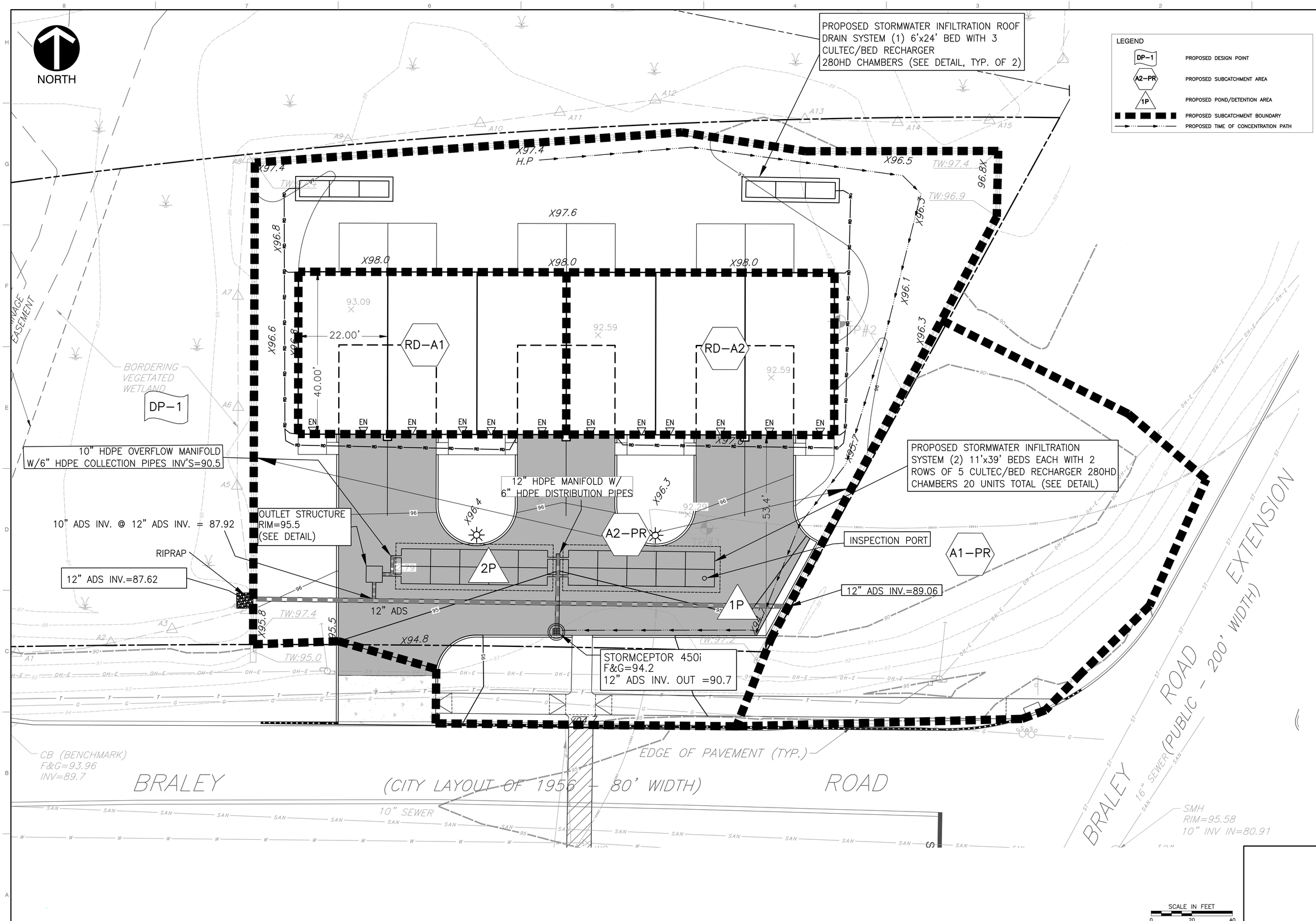
PRE DEVELOPMENT MAP

DRAWN BY:	CJV
CHECKED BY:	KPS
DATE:	MARCH 2023
DWG SCALE:	1" = 10'
PROJECT NO:	304-439
APPROVED BY:	DRAFT

DRAWING NO.:

HYD-EX

SHEET 1 OF 1



REVISION RECORD

NO	DATE	DESCRIPTION

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BRALEY ROAD
NEW BEDFORD MA, 02745

POST DEVELOPMENT MAP

DATE:	MARCH 2023	DRAWN BY:	CJV
DWG SCALE:	1"=10'	CHECKED BY:	KPS
PROJECT NO:			304-439
APPROVED BY:			DRAFT

DRAWING NO.: HYD-PR

SHEET 1 OF 1

APPENDIX A

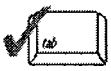
DEP STORMWATER CHECKLIST

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

Checklist for Stormwater Report

A. Introduction

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



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

The Stormwater Report must include:

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

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

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

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

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

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

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

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

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

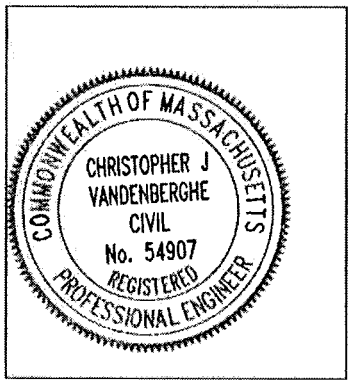
Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the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

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

Registered Professional Engineer's Certification

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

Registered Professional Engineer Block and Signature



C. Vandenberghe 3/30/23
Signature and Date

Checklist

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

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

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

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

Standard 1: No New Untreated Discharges

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

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

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

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

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

Standard 3: Recharge

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

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

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

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

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

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

Standard 4: Water Quality

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

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

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

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

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

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

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

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

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

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

☐ All exposure has been eliminated.

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

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

Standard 6: Critical Areas

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

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

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

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

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

Checklist for Stormwater Report

Checklist (continued)

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

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

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

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

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

Standard 9: Operation and Maintenance Plan

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

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

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

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

Standard 10: Prohibition of Illicit Discharges

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

☒ An Illicit Discharge Compliance Statement is attached;

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

APPENDIX B

GEOTECHNICAL INFORMATION

NRCS Soil Resource Report

NRCS Soil Resource Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

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

Custom Soil Resource Report for Bristol County, Massachusetts, Southern Part

February 28, 2023

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:1,150 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 15 30 60 90

Feet
0 50 100 200 300

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

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

Special Point Features

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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, Southern Part
Survey Area Data: Version 16, Sep 9, 2022

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

Date(s) aerial images were photographed: Jun 10, 2022—Jun 30, 2022

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
260A	Sudbury fine sandy loam, 0 to 3 percent slopes	2.5	85.1%
656	Udorthents - Urban land complex	0.4	14.9%
Totals for Area of Interest		**2.9**	**100.0%**

Map Unit Descriptions

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

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

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

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Bristol County, Massachusetts, Southern Part

260A—Sudbury fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: v5rh
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sudbury and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sudbury

Setting

Landform: Outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over loose sandy glaciofluvial deposits derived from granite and gneiss

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 18 inches: fine sandy loam
H3 - 18 to 28 inches: gravelly coarse sandy loam
H4 - 28 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: B
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Ninigret

Percent of map unit: 5 percent

Hydric soil rating: No

Merrimac

Percent of map unit: 5 percent
Hydric soil rating: No

Deerfield

Percent of map unit: 5 percent
Hydric soil rating: No

Walpole

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

656—Udorthents - Urban land complex

Map Unit Setting

National map unit symbol: v5y8
Elevation: 0 to 250 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Udorthents and similar soils: 55 percent
Urban land: 45 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udorthents

Properties and qualities

Slope: 0 to 8 percent
Depth to restrictive feature: More than 80 inches
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

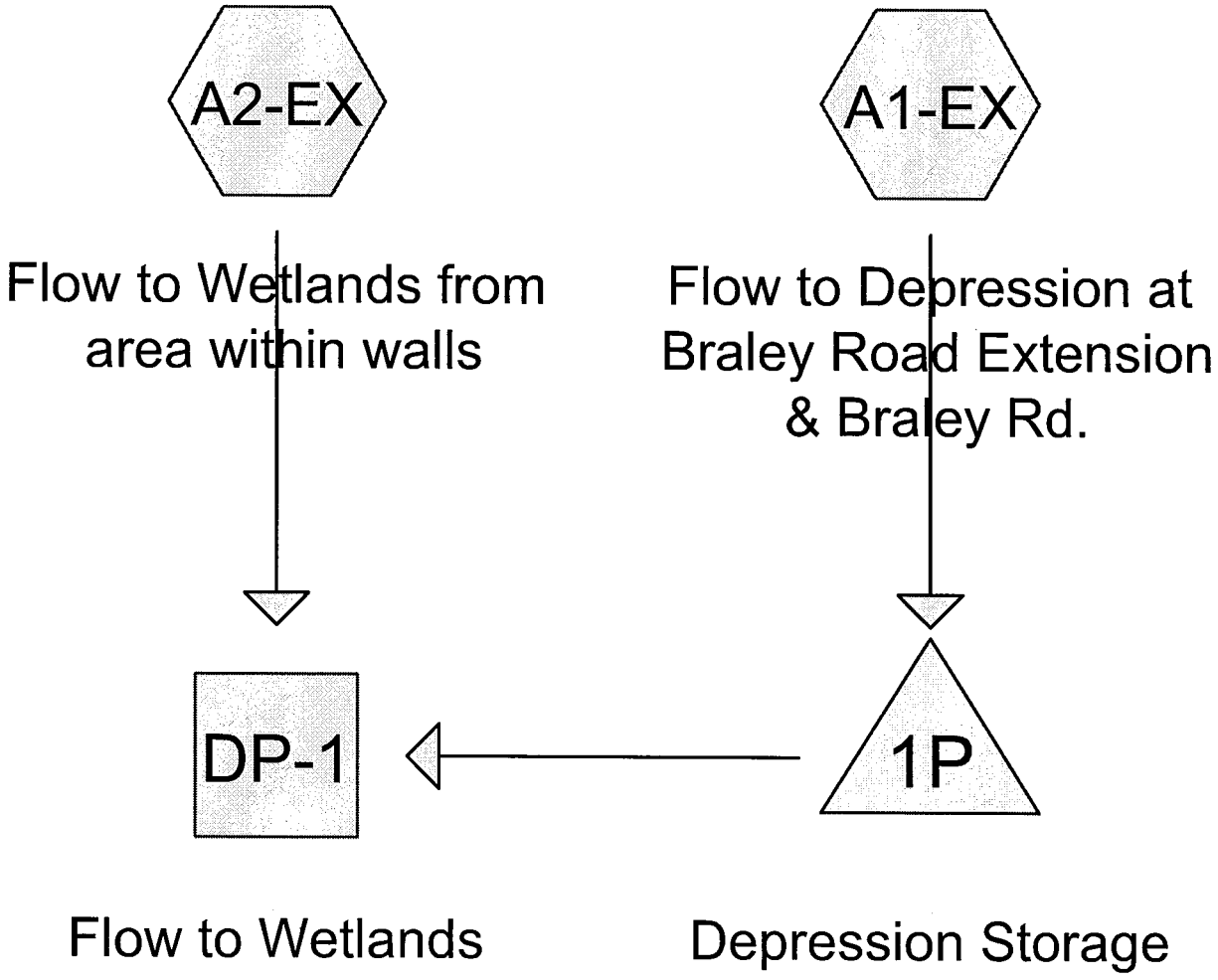
APPENDIX C

SUPPORTING CALCULATIONS

HydroCAD Drainage Analysis
TSS Calculations
Water Quality Calculations
Recharge Calculations

HydroCAD Drainage Analysis

EXISTING CONDITIONS



Subcat Reach Pond Link

Routing Diagram for Pre Drainage Analysis
Prepared by CEC Inc, Printed 4/5/2023
HydroCAD® 10.20-2g s/n 01006 © 2022 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	C	Default	24.00	1	3.40	2
2	10-Year	NRCC 24-hr	C	Default	24.00	1	4.80	2
3	25-Year	NRCC 24-hr	C	Default	24.00	1	6.10	2
4	100-Year	NRCC 24-hr	C	Default	24.00	1	7.10	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.660	67	Brush, Poor, HSG B (A1-EX, A2-EX)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.660	HSG B	A1-EX, A2-EX
0.000	HSG C	
0.000	HSG D	
0.000	Other	

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.660	0.000	0.000	0.000	0.660	Brush, Poor	A1-EX, A2-EX

Summary for Subcatchment A1-EX: Flow to Depression at Braley Road Extension & Braley Rd.

Runoff = 0.15 cfs @ 12.14 hrs, Volume= 0.011 af, Depth> 0.79"
Routed to Pond 1P : Depression Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 2-Year Rainfall=3.40"

Area (sf)	CN	Description
6,925	67	Brush, Poor, HSG B
6,925		100.00% Pervious Area

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

Summary for Subcatchment A2-EX: Flow to Wetlands from area within walls

Runoff = 0.44 cfs @ 12.15 hrs, Volume= 0.033 af, Depth> 0.79"
Routed to Reach DP-1 : Flow to Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 2-Year Rainfall=3.40"

Area (ac)	CN	Description
0.501	67	Brush, Poor, HSG B
0.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0080	0.26		**Sheet Flow, Gravel lot** n= 0.050 P2= 3.50"
3.8	200	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.0	250	Total			

Summary for Reach DP-1: Flow to Wetlands

Inflow Area = 0.660 ac, 0.00% Impervious, Inflow Depth > 0.60" for 2-Year event
Inflow = 0.44 cfs @ 12.15 hrs, Volume= 0.033 af
Outflow = 0.44 cfs @ 12.15 hrs, Volume= 0.033 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Depression Storage

Inflow Area = 0.159 ac, 0.00% Impervious, Inflow Depth > 0.79" for 2-Year event
Inflow = 0.15 cfs @ 12.14 hrs, Volume= 0.011 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 : Flow to Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.55' @ 24.00 hrs Surf.Area= 1,537 sf Storage= 457 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	89.00'	3,450 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
89.00	300	72.0	0	0	300
90.00	3,300	255.0	1,532	1,532	5,065
90.50	4,400	262.0	1,918	3,450	5,380

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**50.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=89.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Subcatchment A1-EX: Flow to Depression at Braley Road Extension & Braley Rd.

Runoff = 0.33 cfs @ 12.14 hrs, Volume= 0.022 af, Depth> 1.66"
Routed to Pond 1P : Depression Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 10-Year Rainfall=4.80"

Area (sf)	CN	Description
6,925	67	Brush, Poor, HSG B
6,925		100.00% Pervious Area

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

Summary for Subcatchment A2-EX: Flow to Wetlands from area within walls

Runoff = 1.00 cfs @ 12.15 hrs, Volume= 0.069 af, Depth> 1.66"
Routed to Reach DP-1 : Flow to Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 10-Year Rainfall=4.80"

Area (ac)	CN	Description
0.501	67	Brush, Poor, HSG B
0.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0080	0.26		**Sheet Flow, Gravel lot** n= 0.050 P2= 3.50"
3.8	200	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.0	250	Total			

Summary for Reach DP-1: Flow to Wetlands

Inflow Area = 0.660 ac, 0.00% Impervious, Inflow Depth > 1.26" for 10-Year event
Inflow = 1.00 cfs @ 12.15 hrs, Volume= 0.069 af
Outflow = 1.00 cfs @ 12.15 hrs, Volume= 0.069 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Depression Storage

Inflow Area = 0.159 ac, 0.00% Impervious, Inflow Depth > 1.66" for 10-Year event
Inflow = 0.33 cfs @ 12.14 hrs, Volume= 0.022 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 : Flow to Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.80' @ 24.00 hrs Surf.Area= 2,441 sf Storage= 959 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	89.00'	3,450 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
89.00	300	72.0	0	0	300
90.00	3,300	255.0	1,532	1,532	5,065
90.50	4,400	262.0	1,918	3,450	5,380

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**50.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=89.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Subcatchment A1-EX: Flow to Depression at Braley Road Extension & Braley Rd.

Runoff = 0.53 cfs @ 12.13 hrs, Volume= 0.034 af, Depth> 2.60"
Routed to Pond 1P : Depression Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 25-Year Rainfall=6.10"

Area (sf)	CN	Description
6,925	67	Brush, Poor, HSG B
6,925		100.00% Pervious Area

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

Summary for Subcatchment A2-EX: Flow to Wetlands from area within walls

Runoff = 1.59 cfs @ 12.14 hrs, Volume= 0.109 af, Depth> 2.60"
Routed to Reach DP-1 : Flow to Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 25-Year Rainfall=6.10"

Area (ac)	CN	Description
0.501	67	Brush, Poor, HSG B
0.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0080	0.26		**Sheet Flow, Gravel lot** n= 0.050 P2= 3.50"
3.8	200	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.0	250	Total			

Summary for Reach DP-1: Flow to Wetlands

Inflow Area = 0.660 ac, 0.00% Impervious, Inflow Depth > 1.97" for 25-Year event
Inflow = 1.59 cfs @ 12.14 hrs, Volume= 0.109 af
Outflow = 1.59 cfs @ 12.14 hrs, Volume= 0.109 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Depression Storage

Inflow Area = 0.159 ac, 0.00% Impervious, Inflow Depth > 2.60" for 25-Year event
Inflow = 0.53 cfs @ 12.13 hrs, Volume= 0.034 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Routed to Reach DP-1 : Flow to Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 89.99' @ 24.00 hrs Surf.Area= 3,257 sf Storage= 1,501 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	89.00'	3,450 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
89.00	300	72.0	0	0	300
90.00	3,300	255.0	1,532	1,532	5,065
90.50	4,400	262.0	1,918	3,450	5,380

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**50.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=89.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Subcatchment A1-EX: Flow to Depression at Braley Road Extension & Braley Rd.

Runoff = 0.69 cfs @ 12.13 hrs, Volume= 0.045 af, Depth> 3.38"
Routed to Pond 1P : Depression Storage

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 100-Year Rainfall=7.10"

Area (sf)	CN	Description
6,925	67	Brush, Poor, HSG B
6,925		100.00% Pervious Area

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

Summary for Subcatchment A2-EX: Flow to Wetlands from area within walls

Runoff = 2.07 cfs @ 12.14 hrs, Volume= 0.141 af, Depth> 3.38"
Routed to Reach DP-1 : Flow to Wetlands

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 100-Year Rainfall=7.10"

Area (ac)	CN	Description
0.501	67	Brush, Poor, HSG B
0.501		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	50	0.0080	0.26		**Sheet Flow, Gravel lot** n= 0.050 P2= 3.50"
3.8	200	0.0030	0.88		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
7.0	250	Total			

Summary for Reach DP-1: Flow to Wetlands

Inflow Area = 0.660 ac, 0.00% Impervious, Inflow Depth > 2.74" for 100-Year event
Inflow = 2.07 cfs @ 12.14 hrs, Volume= 0.151 af
Outflow = 2.07 cfs @ 12.14 hrs, Volume= 0.151 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Summary for Pond 1P: Depression Storage

Inflow Area = 0.159 ac, 0.00% Impervious, Inflow Depth > 3.38" for 100-Year event
Inflow = 0.69 cfs @ 12.13 hrs, Volume= 0.045 af
Outflow = 0.02 cfs @ 16.47 hrs, Volume= 0.009 af, Atten= 97%, Lag= 260.4 min
Primary = 0.02 cfs @ 16.47 hrs, Volume= 0.009 af
Routed to Reach DP-1 : Flow to Wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 90.00' @ 16.47 hrs Surf.Area= 3,307 sf Storage= 1,542 cf

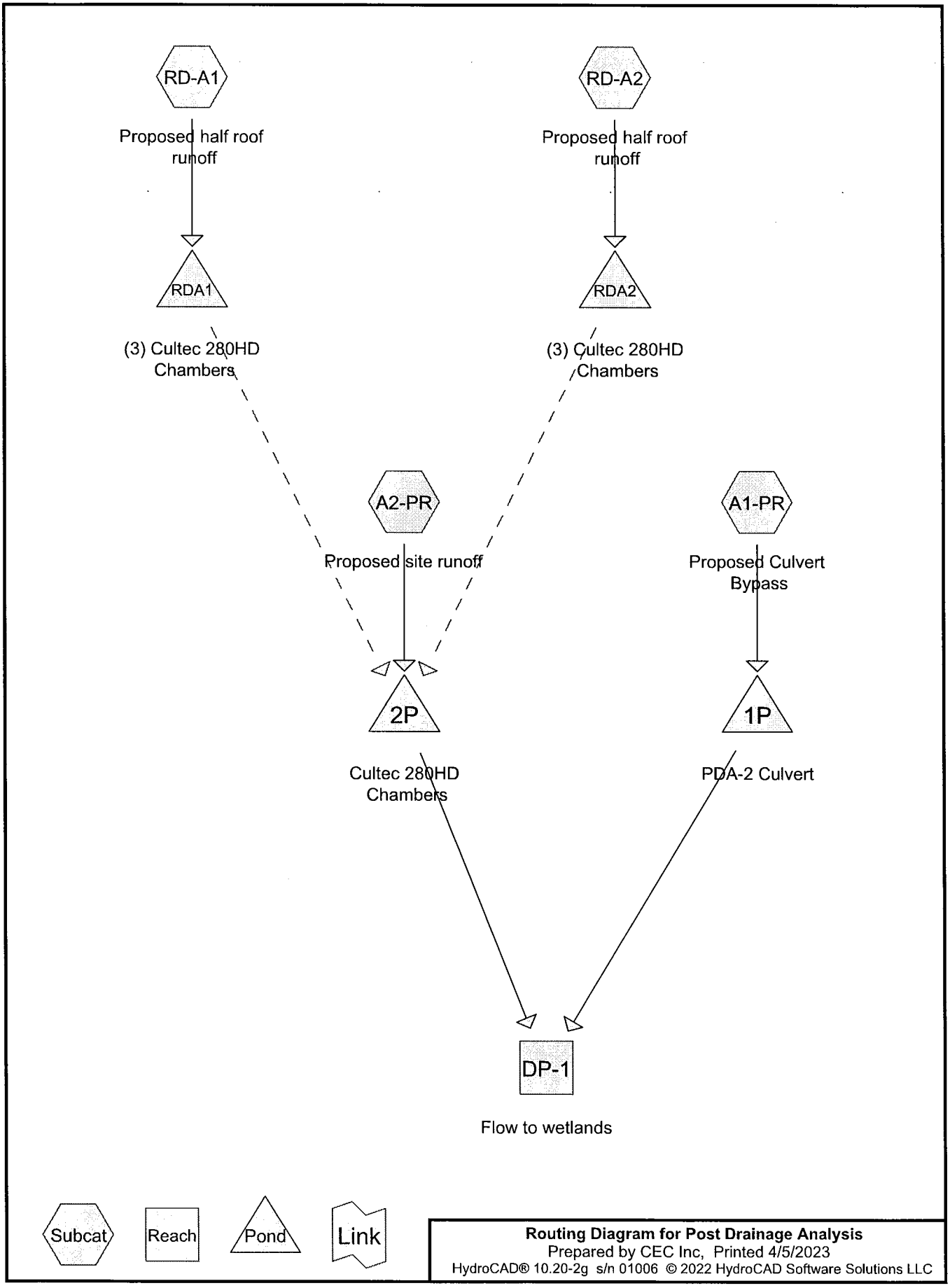
Plug-Flow detention time= 482.4 min calculated for 0.009 af (21% of inflow)
Center-of-Mass det. time= 329.2 min (1,175.6 - 846.4)

Volume	Invert	Avail.Storage	Storage Description
#1	89.00'	3,450 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
89.00	300	72.0	0	0	300
90.00	3,300	255.0	1,532	1,532	5,065
90.50	4,400	262.0	1,918	3,450	5,380

Device	Routing	Invert	Outlet Devices
#1	Primary	90.00'	**50.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Primary OutFlow Max=0.02 cfs @ 16.47 hrs HW=90.00' TW=0.00' (Dynamic Tailwater)
↑—**1=Broad-Crested Rectangular Weir** (Weir Controls 0.02 cfs @ 0.13 fps)



Routing Diagram for Post Drainage Analysis
Prepared by CEC Inc, Printed 4/5/2023
HydroCAD® 10.20-2g s/n 01006 © 2022 HydroCAD Software Solutions LLC

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-Year	NRCC 24-hr	C	Default	24.00	1	3.30	2
2	10-Year	NRCC 24-hr	C	Default	24.00	1	4.88	2
3	25-Year	NRCC 24-hr	C	Default	24.00	1	6.10	2
4	100-Year	NRCC 24-hr	C	Default	24.00	1	8.56	2

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.320	61	>75% Grass cover, Good, HSG B (A1-PR, A2-PR)
0.106	56	Brush, Fair, HSG B (A1-PR)
0.019	98	Concrete patios (A2-PR)
0.122	98	Paved parking, HSG B (A1-PR, A2-PR)
0.010	98	Sidewalk area, HSG B (A2-PR)
0.122	98	Unconnected roofs, HSG B (RD-A1, RD-A2)

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.679	HSG B	A1-PR, A2-PR, RD-A1, RD-A2
0.000	HSG C	
0.000	HSG D	
0.019	Other	A2-PR

Summary for Subcatchment A1-PR: Proposed Culvert Bypass

Runoff = 1.04 cfs @ 12.13 hrs, Volume= 0.068 af, Depth= 3.88"
Routed to Pond 1P : PDA-2 Culvert

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 100-Year Rainfall=8.56"

Area (sf)	CN	Description
4,000	61	>75% Grass cover, Good, HSG B
4,600	56	Brush, Fair, HSG B
600	98	Paved parking, HSG B
9,200	61	Weighted Average
8,600		93.48% Pervious Area
600		6.52% Impervious Area

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

Summary for Subcatchment A2-PR: Proposed site runoff

Runoff = 2.26 cfs @ 12.16 hrs, Volume= 0.169 af, Depth= 5.55"
Routed to Pond 2P : Cultec 280HD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 100-Year Rainfall=8.56"

	Area (sf)	CN	Description
	4,704	98	Paved parking, HSG B
*	828	98	Concrete patios
	9,937	61	>75% Grass cover, Good, HSG B
*	450	98	Sidewalk area, HSG B
	15,919	75	Weighted Average
	9,937		62.42% Pervious Area
	5,982		37.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	50	0.0100	0.12		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
1.3	130	0.0100	1.61		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
0.6	75	0.0100	2.03		**Shallow Concentrated Flow,** Paved Kv= 20.3 fps
9.0	255	Total			

Summary for Subcatchment RD-A1: Proposed half roof runoff

Runoff = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af, Depth= 8.32"
Routed to Pond RDA1 : (3) Cultec 280HD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 100-Year Rainfall=8.56"

Area (sf)	CN	Description
2,650	98	Unconnected roofs, HSG B
2,650		100.00% Impervious Area
2,650		100.00% Unconnected

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

Summary for Subcatchment RD-A2: Proposed half roof runoff

Runoff = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af, Depth= 8.32"
Routed to Pond RDA2 : (3) Cultec 280HD Chambers

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
NRCC 24-hr C 100-Year Rainfall=8.56"

Area (sf)	CN	Description
2,650	98	Unconnected roofs, HSG B
2,650		100.00% Impervious Area
2,650		100.00% Unconnected

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

Summary for Reach DP-1: Flow to wetlands

Inflow Area = 0.577 ac, 26.20% Impervious, Inflow Depth = 2.57" for 100-Year event
Inflow = 3.44 cfs @ 12.18 hrs, Volume= 0.124 af
Outflow = 3.44 cfs @ 12.18 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min

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

Summary for Pond 1P: PDA-2 Culvert

Inflow Area = 0.211 ac, 6.52% Impervious, Inflow Depth = 3.88" for 100-Year event
Inflow = 1.04 cfs @ 12.13 hrs, Volume= 0.068 af
Outflow = 0.66 cfs @ 12.20 hrs, Volume= 0.068 af, Atten= 37%, Lag= 4.1 min
Primary = 0.66 cfs @ 12.20 hrs, Volume= 0.068 af
Routed to Reach DP-1 : Flow to wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 89.54' @ 12.20 hrs Surf.Area= 1,519 sf Storage= 448 cf

Plug-Flow detention time= 26.2 min calculated for 0.068 af (99% of inflow)
Center-of-Mass det. time= 22.0 min (873.5 - 851.4)

Volume	Invert	Avail.Storage	Storage Description
#1	89.00'	3,450 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
89.00	300	72.0	0	0	300
90.00	3,300	255.0	1,532	1,532	5,065
90.50	4,400	262.0	1,918	3,450	5,380

Device	Routing	Invert	Outlet Devices
#1	Primary	89.06'	**12.0" Round Culvert** L= 132.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 89.06' / 87.62' S= 0.0109 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.66 cfs @ 12.20 hrs HW=89.54' TW=0.00' (Dynamic Tailwater)
↑—**1=Culvert** (Barrel Controls 0.66 cfs @ 2.59 fps)

Summary for Pond 2P: Cultec 280HD Chambers

Inflow Area = 0.365 ac, 37.58% Impervious, Inflow Depth = 6.29" for 100-Year event
Inflow = 3.22 cfs @ 12.15 hrs, Volume= 0.192 af
Outflow = 2.95 cfs @ 12.18 hrs, Volume= 0.192 af, Atten= 8%, Lag= 2.0 min
Discarded = 0.17 cfs @ 11.43 hrs, Volume= 0.136 af
Primary = 2.79 cfs @ 12.18 hrs, Volume= 0.056 af
Routed to Reach DP-1 : Flow to wetlands

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 93.20' @ 12.18 hrs Surf.Area= 0.020 ac Storage= 0.038 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 48.0 min (860.4 - 812.4)

Volume	Invert	Avail.Storage	Storage Description
#1A	90.00'	0.009 af	**11.33'W x 39.00'L x 3.21'H Field A** 0.033 af Overall - 0.010 af Embedded = 0.023 af x 40.0% Voids
#2A	90.50'	0.010 af	**Cultec R-280HD** x 10 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 2 rows
		0.019 af	x 2.00 = 0.038 af Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	90.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Primary	88.00'	**10.0" Round Culvert**
			L= 4.0' CPP, square edge headwall, Ke= 0.500
			Inlet / Outlet Invert= 88.00' / 87.92' S= 0.0200 '/' Cc= 0.900
			n= 0.020 Corrugated PE, corrugated interior, Flow Area= 0.55 sf
#3	Device 2	93.20'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00
			Coef. (English) 2.80 2.92 3.08 3.30 3.32
#4	Device 2	92.70'	**2.5' long x 0.70' rise Sharp-Crested Rectangular Weir**
			2 End Contraction(s) 5.7' Crest Height

Discarded OutFlow Max=0.17 cfs @ 11.43 hrs HW=90.03' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.17 cfs)

Primary OutFlow Max=2.76 cfs @ 12.18 hrs HW=93.19' TW=0.00' (Dynamic Tailwater)
└**2=Culvert** (Passes 2.76 cfs of 5.74 cfs potential flow)
  ├**3=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)
  └**4=Sharp-Crested Rectangular Weir**(Weir Controls 2.76 cfs @ 2.33 fps)

Summary for Pond RDA1: (3) Cultec 280HD Chambers

Inflow Area = 0.061 ac,100.00% Impervious, Inflow Depth = 8.32" for 100-Year event
Inflow = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af
Outflow = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.3 min
Discarded = 0.03 cfs @ 10.70 hrs, Volume= 0.031 af
Secondary = 0.51 cfs @ 12.13 hrs, Volume= 0.011 af
Routed to Pond 2P : Cultec 280HD Chambers

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 94.21' @ 12.03 hrs Surf.Area= 0.003 ac Storage= 0.006 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 46.4 min (787.6 - 741.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.00'	0.003 af	**5.92'W x 24.00'L x 3.21'H Field A**
			0.010 af Overall - 0.003 af Embedded = 0.007 af x 40.0% Voids
#2A	91.50'	0.003 af	**Cultec R-280HD** x 3 Inside #1
			Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf
			Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap
			Row Length Adjustment= +1.00' x 6.07 sf x 1 rows
		0.006 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Secondary	94.21'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	91.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Secondary	94.20'	**4.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.03 cfs @ 10.70 hrs HW=91.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.00 cfs @ 12.13 hrs HW=94.21' TW=92.53' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.30 fps)

Summary for Pond RDA2: (3) Cultec 280HD Chambers

Inflow Area = 0.061 ac,100.00% Impervious, Inflow Depth = 8.32" for 100-Year event
Inflow = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af
Outflow = 0.54 cfs @ 12.13 hrs, Volume= 0.042 af, Atten= 0%, Lag= 0.3 min
Discarded = 0.03 cfs @ 10.70 hrs, Volume= 0.031 af
Secondary = 0.51 cfs @ 12.13 hrs, Volume= 0.011 af
Routed to Pond 2P : Cultec 280HD Chambers

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Peak Elev= 94.21' @ 12.03 hrs Surf.Area= 0.003 ac Storage= 0.006 af

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 46.4 min (787.6 - 741.2)

Volume	Invert	Avail.Storage	Storage Description
#1A	91.00'	0.003 af	**5.92'W x 24.00'L x 3.21'H Field A** 0.010 af Overall - 0.003 af Embedded = 0.007 af x 40.0% Voids
#2A	91.50'	0.003 af	**Cultec R-280HD** x 3 Inside #1 Effective Size= 46.9"W x 26.0"H => 6.07 sf x 7.00'L = 42.5 cf Overall Size= 47.0"W x 26.5"H x 8.00'L with 1.00' Overlap Row Length Adjustment= +1.00' x 6.07 sf x 1 rows
		0.006 af	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#0	Secondary	94.21'	**Automatic Storage Overflow** (Discharged without head)
#1	Discarded	91.00'	**8.270 in/hr Exfiltration over Surface area**
#2	Secondary	94.20'	**4.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.03 cfs @ 10.70 hrs HW=91.03' (Free Discharge)
↑—**1=Exfiltration** (Exfiltration Controls 0.03 cfs)

Secondary OutFlow Max=0.00 cfs @ 12.13 hrs HW=94.21' TW=92.53' (Dynamic Tailwater)
↑—**2=Orifice/Grate** (Weir Controls 0.00 cfs @ 0.30 fps)

TSS Calculations

INSTRUCTIONS:

Version 1, Automated: Mar. 4, 2008

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

TSS Removal Calculation Worksheet

Location: Flow to Stormceptor Unit

B BMP[1]	C TSS Removal Rate[1]	D Starting TSS Load*	E Amount Removed (C*D)	F Remaining Load (D-E)
Proprietary WQU (StormTech STC450i)	**0.96**	**1.00**	**0.96**	**0.04**

Total TSS Removal = **96%**

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

Project: **Braley North**

Prepared By: **CJV**

Date: **3/1/2023**

*Equals remaining load from previous BMP (E)

which enters the BMP

*** Stormtech Isolator Row conservatively assumed to provide a minimum of 25% TSS removal*

1. TSS removal % taken from Manufacturer's sizing from Water Quality Volume Calculations from Appendix D

Recharge Calculations

Groundwater Recharge Calculations

Project Name: Braley North
Project Location: New Bedford
Project Number: 304-439

Date: 3/1/2023
Calculated By: CJV
Checked By: KPS

Existing Conditions Impervious Area

Hydrologic Soil Group	Area (sq ft)	Area (acres)	Recharge Depth (in)	Volume (cu ft)
A	0	0.00	0.60	0.0
B	0	0.00	0.35	0.0
C	0	0.00	0.25	0.0
D	0	0.00	0.10	0.0
TOTAL	**0**	**0.53**		**0**

Proposed Conditions Impervious Area

Hydrologic Soil Group	Area (sq ft)	Area (acres)	Recharge Depth (in)	Volume (cu ft)
A	0	0.00	0.60	0.0
B	10,832	0.25	0.35	315.9
C	0	0.00	0.25	0.0
D	0	0.00	0.10	0.0
TOTAL	**10,832**	**0.25**		**316**

Net Required Recharge Volume: 316 cu ft

Capture Area Adjustment

* Impervious Area to Recharge Facility: 0.25 ac
Total Site Impervious Area: 0.25 ac
** Impervious Ratio: 1.00

* (includes Subcatchments A2-PR, RDA1 and RDA1)

** (Total Site Impervious / Impervious Area to Recharge Facility)

Adjusted Required 316 cu ft

Provided Recharge Volume

Subcatchments RDA1 & RDA2	523 cf	*Cultec R-280HD*
Subcatchment A2-PR	1,481 cf	*Cultec R-280HD*
TOTAL	2,004 cf	

Total Provided 2,004 cu ft

Groundwater Recharge Calculations

Project Name: Braley North
Project Location: New Bedford
Project Number: 304-439

Date: 3/1/2023
Calculated By: CJV
Checked By: KPS

Stormwater BMP: Subcatchments RDA1 & RDA2

Description: Cultec R-280HD

Provided Recharge Volume

Bottom of Stone:	91.00	ft	
Overflow Outlet Elevation:	94.21	ft	
*** Volume Provided:	0.006	ac ft	
	523	cu ft	*** (See attached HydroCAD output)

Subcatchments RDA1 & RDA2

Total Provided Recharge Volume: 523 cu ft

72-hour Drawdown Calculation

Provided Recharge Volume:	523	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr*	*(Conservatively a Rawls Rate for Loamy Sand (HSG B) was used)
Bottom Area:	142	sq ft	
Drawdown Time:	**18.3**	**hours**	

Groundwater Recharge Calculations

Project Name: Braley North
Project Location: New Bedford
Project Number: 304-439

Date: 3/1/2023
Calculated By: CJV
Checked By: KPS

Stormwater BMP: Subcatchment A2-PR

Description: Cultec R-280HD

Provided Recharge Volume

Bottom of Stone:	90.00	ft	
Overflow Outlet Elevation:	92.70	ft	
*** Volume Provided:	0.034	ac ft	
	1481	cu ft	*** (See attached HydroCAD output)

Subcatchments RDA1 & RDA2

Total Provided Recharge Volume: 1,481 cu ft

72-hour Drawdown Calculation

Provided Recharge Volume:	1,481	cu ft	
Saturated Hydraulic Conductivity:	2.41	in / hr*	*(Conservatively a Rawls Rate for Loamy Sand (HSG B) was used)
Bottom Area:	858	sq ft	
Drawdown Time:	**8.6**	**hours**	

Water Quality Calculations

Water Quality Volume Calculations

Project Name: Braley North
Project Location: New Bedford
Project Number: 304-439

Date: 3/1/2023
Calculated By: CJV
Checked By: KPS

Stormwater BMP: STC 450i Description: Stormceptor (Subcatchment A2-PR)

Total Drainage Area:	14,244	sq ft
	0.33	ac
Total Impervious Area:	5,532	sq ft
	0.13	ac

** Roof Areas are considered clean and are not subject to WQV calculation*

Runoff Depth to be Treated: 0.5 inches

Required Water Quality Volume:	231	cf
	0.005	ac ft

FLOW RATE CONVERSION

$Q = (qu)(A)(WQV)$

Where:

Q = flow rate associated with the depth of runoff, in cfs
qu = the unit peak discharge, in csm/in.
A = impervious surface drainage area, in square miles
WQV = water quality volume in watershed inches

Given:

1-acre =	0.00156	mi^2
5 minute =	0.083	hours
qu (**1/2**-inch) =	**773**	csm/in

Calculation:

qu=	**773**	
A=	0.13	ac
WQV=	0.5	in

Required Water Quality Flow Rate: 0.08 cfs

The Stormceptor STC 450i will provide 96% TSS Removal Efficiency for flows up to 0.08 cfs

(Based on Manufacturer's sizing. See attached documentation in Appendix D.)

* Flow rate conversion based on the Massachusetts Department of Environmental Protection Wetlands Program - Standard Method to Convert Required Water Quality Volume to a Discharge Rate for Sizing Flow Based Manufactured Proprietary Stormwater Treatment Practices

APPENDIX D

Illicit Discharge Statement
Stormceptor Test Results
Manufacturer's O&M Manual

Illicit Discharge Statement

ILLICIT DISCHARGE COMPLIANCE STATEMENT

I VERIFY THAT NO ILLICIT DISCHARGES EXIST FROM THE BRALEY NORTH DEVELOPMENT. THROUGH THE IMPLEMENTATION OF THE *CONSTRUCTION PERIOD POLLUTION PREVENTION AND SEDIMENTATION AND EROSION CONTROL PLAN* AS WELL AS THE *OPERATION AND MAINTENANCE PLAN*, MEASURES ARE SET FORTH TO PREVENT ILLICIT DISCHARGES FROM ENTERING THE STORMWATER MANAGEMENT DRAINAGE SYSTEM.

SIGNATURE	**PRINT NAME**	**DATE**

TITLE	**COMPANY**

SIGNATURE	**PRINT NAME**	**DATE**

TITLE	**COMPANY**

NOTE: THIS CERTIFICATION MUST BE SIGNED BEFORE STORMWATER IS CONVEYED TO THE PROPOSED STORMWATER DRAINAGE SYSTEM IN ACCORDANCE WITH STANDARD 10 OF THE MASSACHUSETTS STORMWATER MANAGEMENT STANDARDS.

Stormceptor Test Results

Stormceptor®

CONTECH ENGINEERED SOLUTIONS
A QUIKRETE COMPANY

Detailed Stormceptor Sizing Report – Braely North

Project Information & Location			
Project Name	Braley North	Project Number	304-439
City	New Bedford	State/ Province	Massachusetts
Country	United States of America	Date	3/1/2023
Designer Information		**EOR Information (optional)**	
Name	chris Vandenberghe	Name	
Company	CEC	Company	
Phone #	617-416-1964	Phone #	
Email	cvandenberghe@cecinc.com	Email	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	Braely North
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	96
PSD	OK-110
Rainfall Station	HYANNIS

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

Stormceptor Sizing Summary	
Stormceptor Model	**% TSS Removal Provided**
STC 450i	96
STC 900	98
STC 1200	98
STC 1800	98
STC 2400	99
STC 3600	99
STC 4800	99
STC 6000	99
STC 7200	99
STC 11000	100
STC 13000	100
STC 16000	100

Stormceptor

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for each rainfall event, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.
Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Massachusetts	Total Number of Rainfall Events	1268
Rainfall Station Name	HYANNIS	Total Rainfall (in)	531.6
Station ID #	3821	Average Annual Rainfall (in)	33.2
Coordinates	41°24'0"N, 70°10'47"W	Total Evaporation (in)	11.3
Elevation (ft)	50	Total Infiltration (in)	321.1
Years of Rainfall Data	14	Total Rainfall that is Runoff (in)	199.2

Notes
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

Drainage Area	
Total Area (acres)	0.32
Imperviousness %	39.0

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	
Oil Spill Capture Volume (Gal)	
Peak Conveyed Flow Rate (CFS)	
Water Quality Flow Rate (CFS)	0.08

Up Stream Storage	
Storage (ac-ft)	Discharge (cfs)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cfs)	

Design Details	
Stormceptor Inlet Invert Elev (ft)	
Stormceptor Outlet Invert Elev (ft)	
Stormceptor Rim Elev (ft)	
Normal Water Level Elevation (ft)	
Pipe Diameter (in)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

OK-110		
Particle Diameter (microns)	Distribution %	Specific Gravity
1.0	0.0	2.65
53.0	3.0	2.65
75.0	15.0	2.65
88.0	25.0	2.65
106.0	41.0	2.65
125.0	15.0	2.65
150.0	1.0	2.65
212.0	0.0	2.65

Site Name	Braely North

Site Details

Drainage Area	
Total Area (acres)	0.32
Imperviousness %	39.0

Surface Characteristics	
Width (ft)	236.00
Slope %	2
Impervious Depression Storage (in)	0.02
Pervious Depression Storage (in)	0.2
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (in/hr)	2.44
Min. Infiltration Rate (in/hr)	0.4
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Evaporation	
Daily Evaporation Rate (in/day)	0.1

Dry Weather Flow	
Dry Weather Flow (cfs)	0

Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	

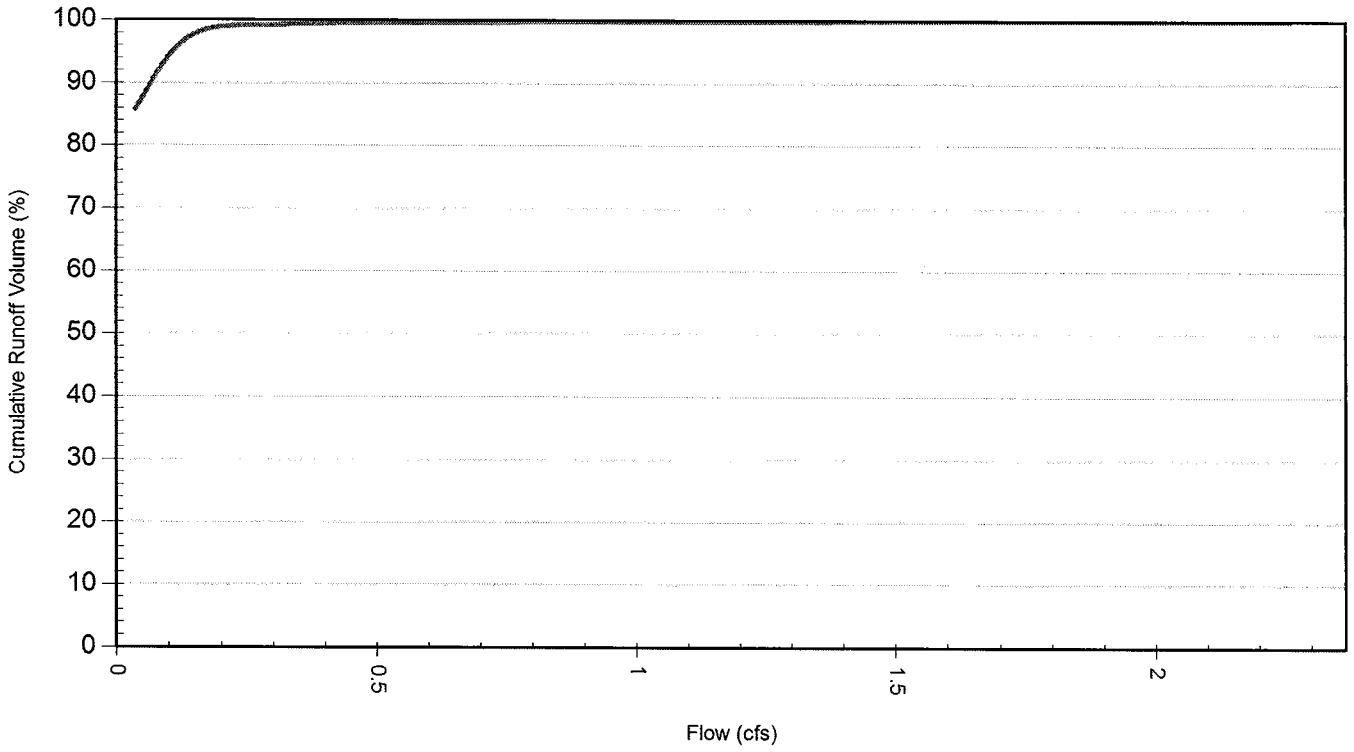
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (cfs)	Runoff Volume (ft³)	Volume Over (ft³)	Cumulative Runoff Volume (%)
0.035	200278	33088	85.8
0.141	227516	5853	97.5
0.318	231776	1593	99.3
0.565	232455	914	99.6
0.883	232841	528	99.8
1.271	233144	225	99.9
1.730	233369	0	100.0
2.260	233369	0	100.0

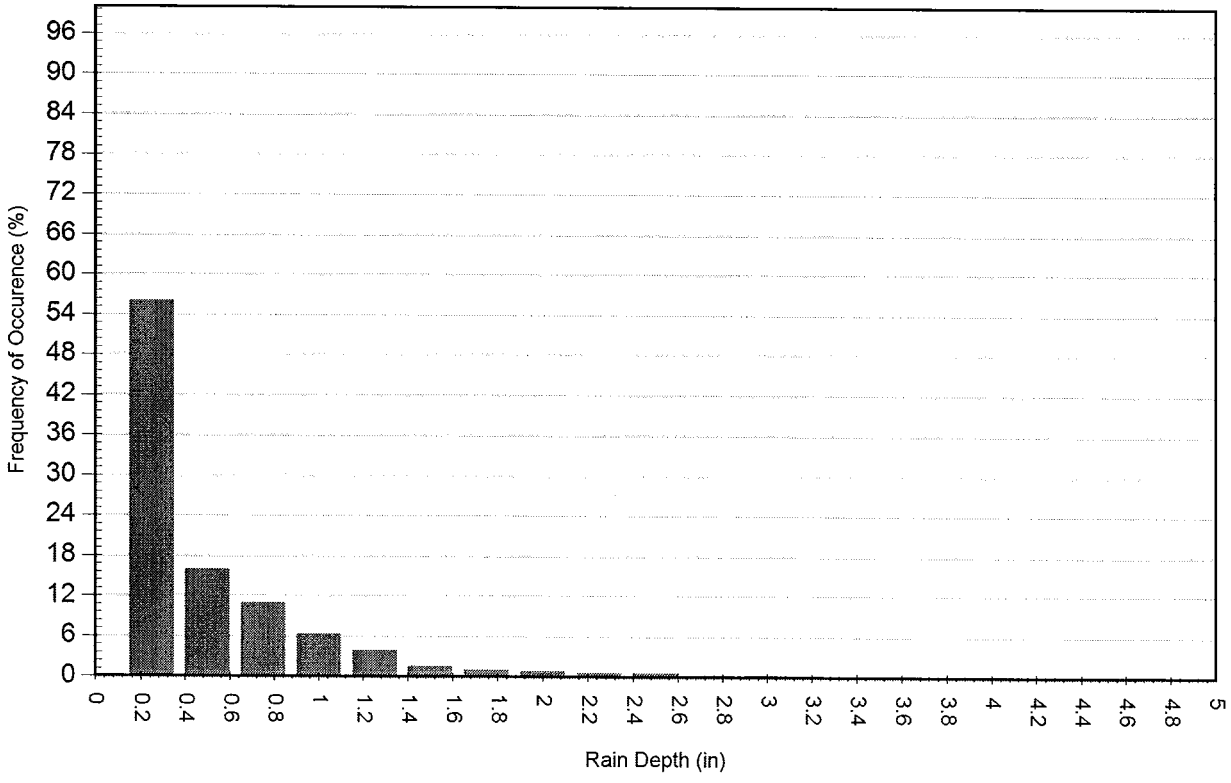
Cumulative Runoff Volume by Runoff Rate

For area: 0.32(ac), imperviousness: 39.0%, rainfall station: HYANNIS



Rainfall Event Analysis				
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	711	56.1	71	13.4
0.50	204	16.1	74	14.0
0.75	141	11.1	88	16.5
1.00	81	6.4	72	13.5
1.25	51	4.0	57	10.7
1.50	20	1.6	28	5.2
1.75	14	1.1	23	4.3
2.00	12	0.9	22	4.2
2.25	7	0.6	15	2.8
2.50	7	0.6	17	3.2
2.75	4	0.3	11	2.0
3.00	4	0.3	12	2.2
3.25	3	0.2	9	1.8
3.50	2	0.2	7	1.3
3.75	2	0.2	7	1.3
4.00	3	0.2	12	2.2
4.25	2	0.2	8	1.6
4.50	0	0.0	0	0.0
4.75	0	0.0	0	0.0

Frequency of Occurence by Rainfall Depths



For Stormceptor Specifications and Drawings Please Visit:
https://www.conteches.com/technical-guides/search?filter=1WBC0O5EYX

Manufacturer's O&M Manual

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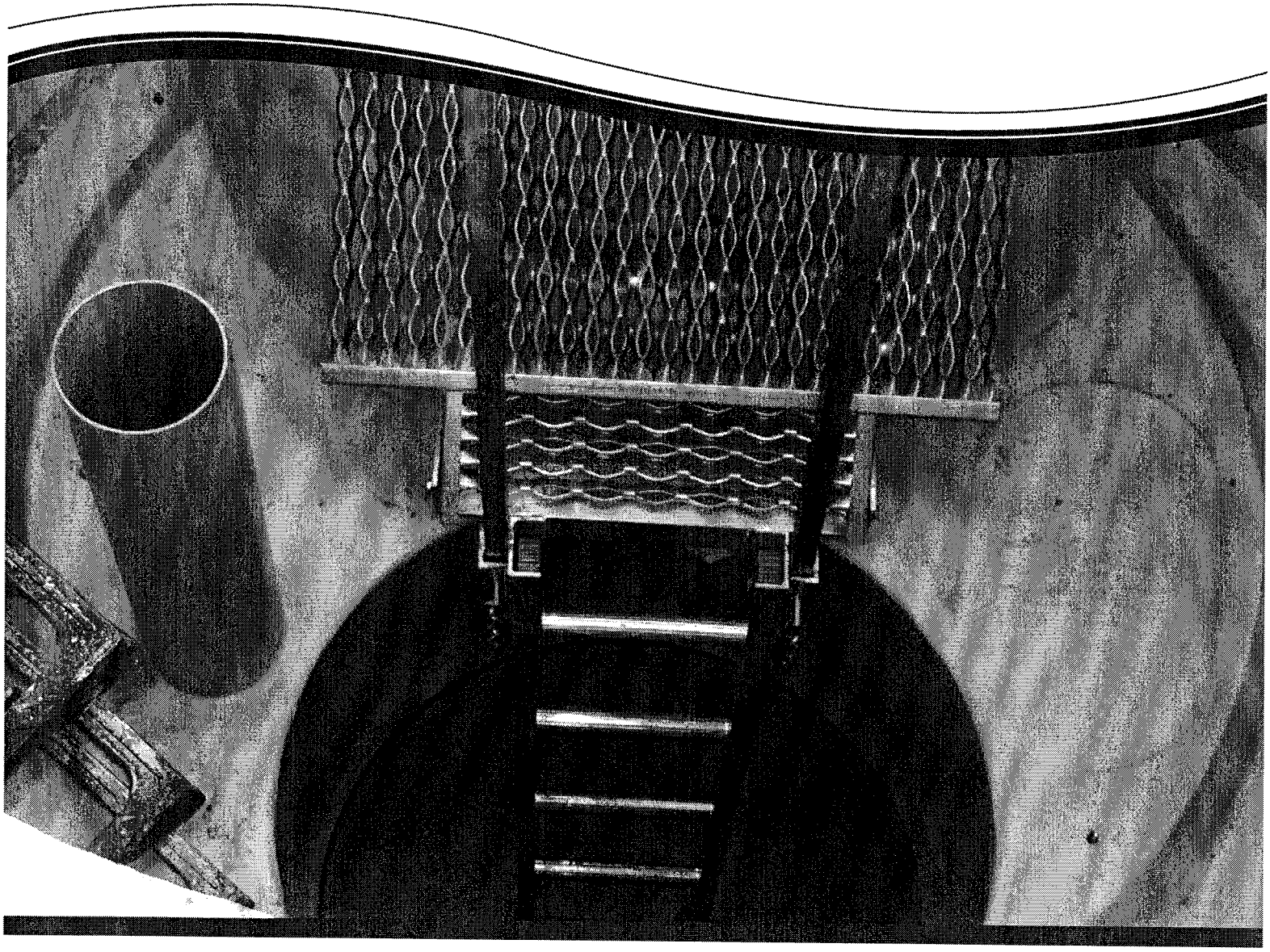
Stormceptor® STC
Operation and Maintenance Guide



Stormceptor® STC

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)

Stormceptor® STC

OPERATION AND MAINTENANCE GUIDE
Table of Content

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12. Maintenance 19

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.

$$v_{SC} = \frac{H}{6_H} = \frac{Q}{A_S}$$

Where:

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

H = tank depth, ft (m)

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

Q = volumetric flow rate, ft3/s (m3/s)

A_S = surface area, ft^2 (m^2)

(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 ft³ (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.

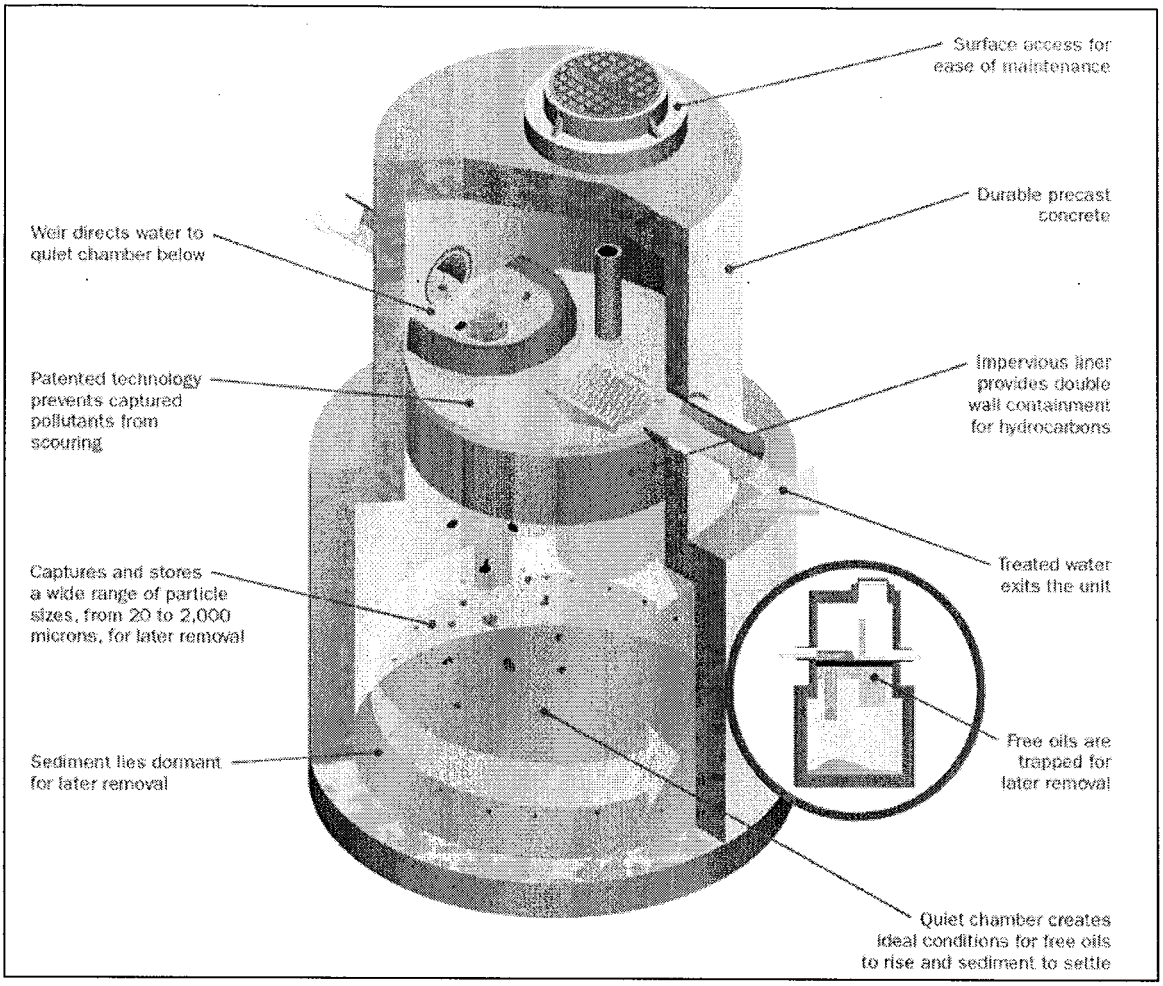


Figure 1. Inline Stormceptor

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.

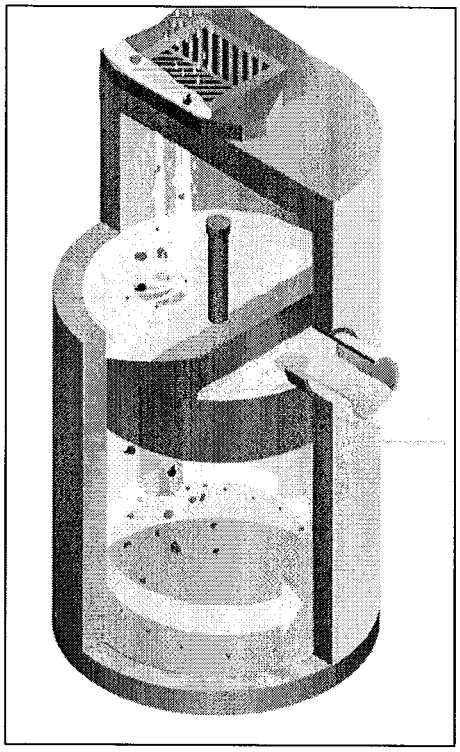


Figure 2. Inlet Stormceptor

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.

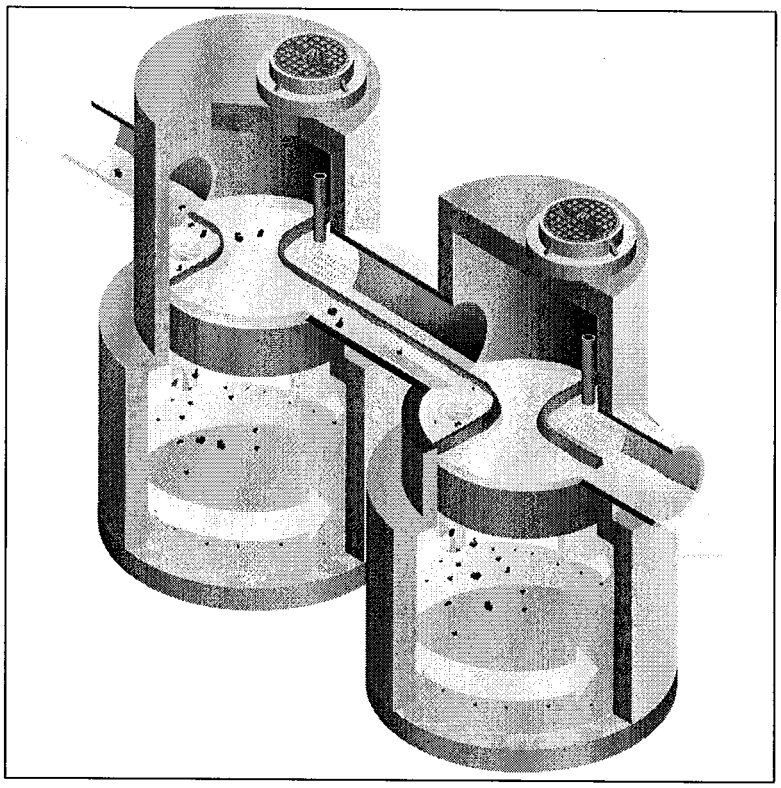


Figure 3. Series System

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 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.

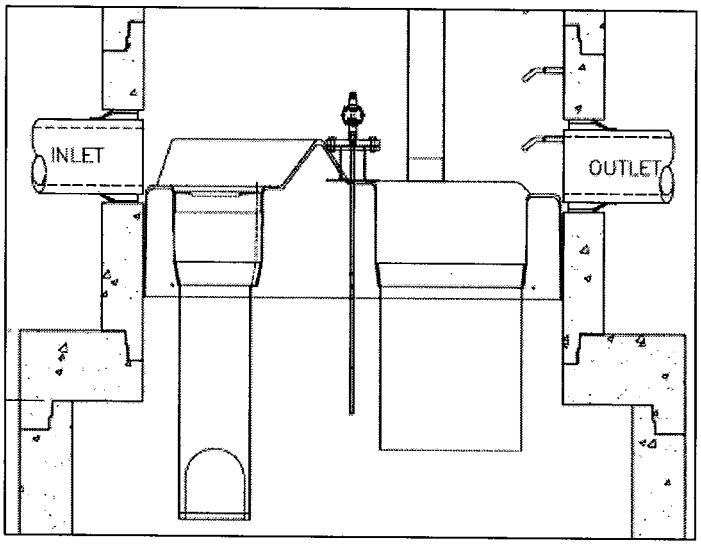


Figure 4. Oil level alarm

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

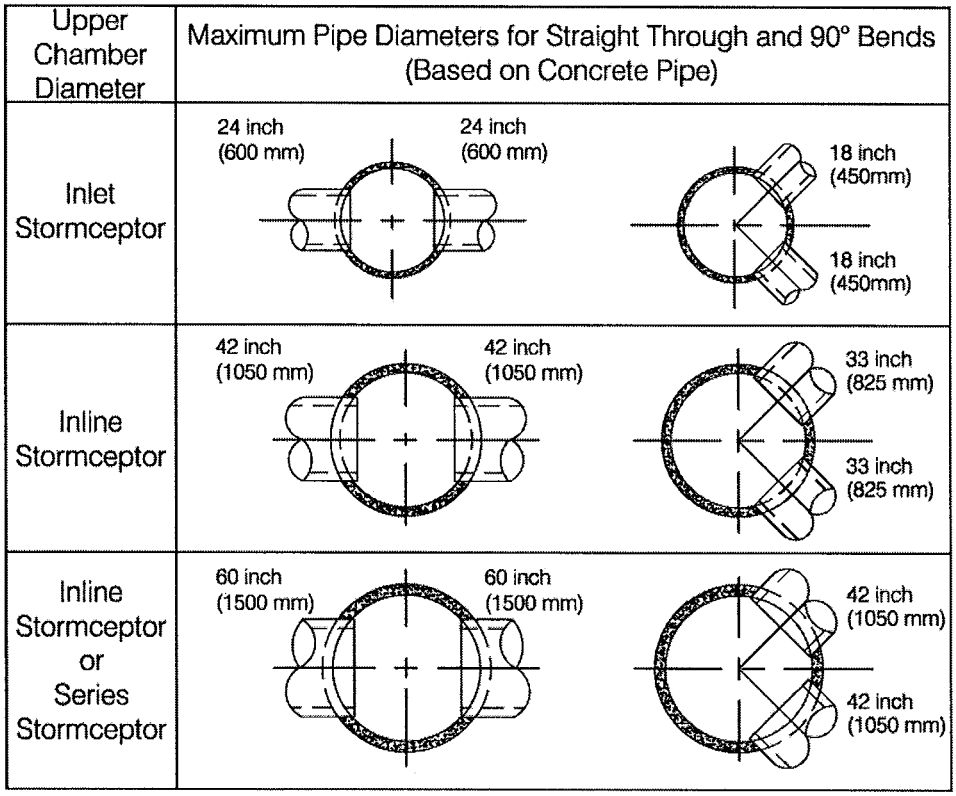


Figure 5. Maximum pipe diameters for straight through and bend applications

*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.

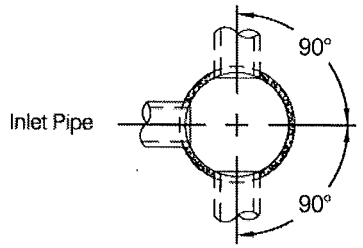
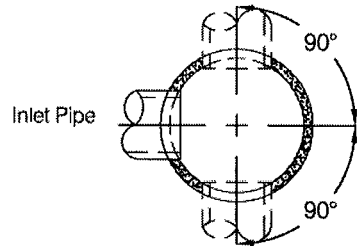
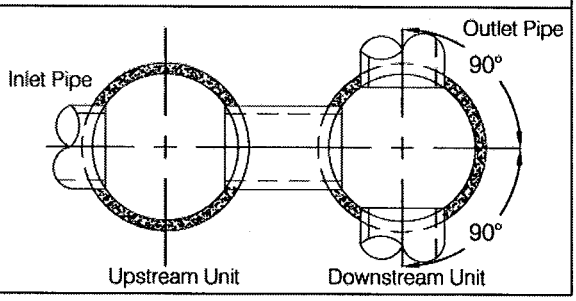
Stormceptor System	Maximum Bend Configurations
Inlet Stormceptor	
Inline Stormceptor	
Series Stormceptor	

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*1.3v2/2g).

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

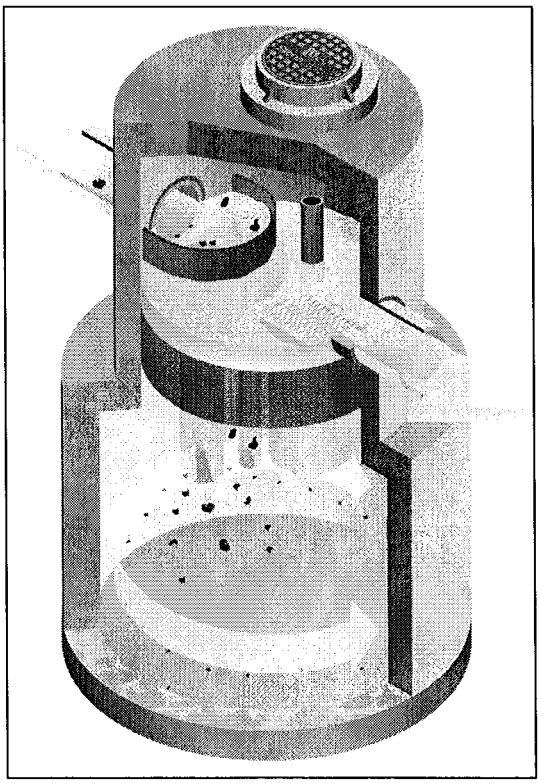


Figure 7. Submerged Stormceptor

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.

Site-specific design support is available from our engineers.

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