ALLEN & MAJOR
ASSOCIATES, INC.

October 27, 2017

Andrew R. Port
Director of Planning & Development
City of Newburyport
60 Pleasant Street
Newburyport, MA 01950

RE: A&M Project # 1873-03
MVRTA Newburyport
Intermodal Parking Facility
Peer Review Response Letter

Dear Mr. Port,

Please accept Allen & Major Associates, Inc. (A&M) responses to Christiansen & Sergi, Inc.'s (CSI) comment letter dated October 16, 2017 regarding the proposed Intermodal Parking Facility. To facilitate the review, the CSI comments are reproduced below along with the A&M response in bold.

Plan

<u>CSI Comment:</u> The sewer connection on Titcomb Street crosses the water main. The invert elevation of the proposed sewer 20.35. Water mains generally are buried five feet below the street level. If that is the case on Titcomb Street the top of the water main is at approximately elevation 20.25. The sewer pipe will be just above the water pipe. As noted on the plan an 18" vertical separation is required between the sewer and the water with the sewer being lower than the water. In this case it appears the sewer will be over the water and if a concrete encasement is to be used around the sewer pipe it should be 6 inched thick and separated from the water main by at least six inches of stone to avoid a point load on the water pipe. This would raise the proposed sewer at least one foot. If the water line is higher than 20.25 it could present additional problems. The elevation of the water line should be determined by a test pit before construction begins. The DPS can determine if the connection can be made or an alternative should be sought. A connection to the sewer in Merrimack Street can be made without the complication of interference with the water main.

<u>A&M Response:</u> A note has been added to Sheet C-1 (Site Preparation Plan) and Sheet C-5 (Utilities Plan) regarding the need for an exploratory test pit at the location of the water and sewer crossing. A detail has been added to Sheet C-12 (Details) showing the requirements of the concrete encasement at the location of the water and sewer crossing. At the August 3, 2017 technical review meeting, the City of Newburyport Sewer Department stated that a sewer connection to the Merrimack Street sewer would not be allowed due to the age and depth of the line.

<u>CSI Comment:</u> The Drainage Report refers to a Stormceptor unit in the ground floor of the parking garage. It does not show on the Overall Grading and Drainage Plan sheet C-08 and its connection to the drainage system is not shown. The design engineer should provide on the plans the location of the Stormceptor, the size of the unit, the piping to connect to it and the piping to connect the discharge to the stormwater system.

<u>A&M Response</u>: The Stormceptor unit is within the building and is shown on the Plumbing drawings. See Sheet P-100 (Lower Level Plumbing Plan) and P-001 (Plumbing Legend, Schedules, Notes, & Part Plan). The plumbing drawings provide the location of the Stormceptor, the size of the unit, and the piping to bring it 10' past the exterior of the building. Copies of the Plumbing drawings have been included at the rear of the Civil Site Plan for reference.

<u>CSI Comment</u>: It has been my experience that floor drains from garages need to be directed to MDC traps and the outfall from the MDC trap discharged to the sewer system. MDC traps are not shown on the plans. The engineers should check with the plumbing inspector about the need for MDC traps.

<u>A&M Response</u>: The floor drains within the garage for all levels except the roof level are connected to a gas/oil interceptor prior to discharge to the sanitary sewer system. The floor drain locations and the gas/oil interceptor are shown on the Plumbing drawings. See Sheet P-100 (Lower Level Plumbing Plan) and P-001 (Plumbing Legend, Schedules, Notes, & Part Plan). Copies of the Plumbing drawings have been included at the rear of the Civil Site Plan for reference.

Drainage Report

<u>CSI Comment:</u> In his letter of August 15, 2017 to Andrew Port, Brian Jones stated that a Stormceptor will be installed in the facility to provide for removal of suspended solids from roof level parking. As noted above the Stormceptor is not shown on the plan.

<u>A&M Response</u>: The Stormceptor unit is within the building and is shown on the Plumbing drawings. See Sheet P-100 (Lower Level Plumbing Plan) and P-001 (Plumbing Legend, Schedules, Notes, & Part Plan). Copies of the Plumbing drawings have been included at the rear of the Civil Site Plan for reference.

<u>CSI Comment:</u> The removal efficiency of Stornceptors has come into question in recent years. The 80% removal stated by Mr. Jones was a accepted removal rate for years however in recent years States are only recognizing lower removal rates. New Jersey will only credit 50% removal rates to a Stormceptor. I have seen data that shows that 75% is attainable. Massachusetts had a STEP program that engineers could rely on for determination of removal efficiencies. That program has been discontinued and the Commonwealth will no longer comment on removal efficiencies. The STEP program will only provide reports on efficiency provided by manufactures and other governmental agencies without comment. The engineer should provide data to substantiate the 80% removal claim.

<u>A&M Response</u>: The Stormceptor shown on the Plumbing drawings is an approved product under the Massachusetts Board of State Examiners of Plumbers and Gasfitters for the intended use within the building. The Stormceptor sizing report providing documentation of the TSS removal has been added to the end of the drainage summary as an attachment.

<u>CSI Comment:</u> The stormwater flow to the east is tied into a piping system. It is possible that the existing drains cannot handle the increased flow. It is also possible that the increased flow will cause problems downstream. This is compounded by the fact that the existing drainage system in the area does not capture the water as efficiently as the proposed design and thus the change would introduce more water to the drainage system.

DPS should be made aware of this increased flow and determine if the additional flow will exacerbate any dwn stream drainage problems.

<u>A&M Response</u>: Per October 25, 2017 e-mail from City of Newburyport, the increase in rate of runoff to the east is acceptable.

<u>CSI Comment:</u> On drawing WS-2 the Remaining Land Of New England Development is shown as undeveloped yet the drainage calculations show is as being developed. This should be clarified.

***A&M Response*: Once the existing building and pavement has been removed, the remaining land of New England Development will be compacted subgrade covered with crushed stone (See Sheet C-07 "Landscape Plan" and Sheet C-08 "Landscape Notes & Details", Detail 5). The HydroCAD model has been revised to indicate that this area is "gravel" with a CN of 96.**

CSI Comment: The drainage areas outlined in the drainage plans do not take into account offsite drainage that enters the property under existing as well as proposed conditions. The downspouts from 85-87 Merrimac Street flow onto the property as well as flows from 92 Pleasant Street and the property of Market Street Trust which lie to the south. The flows from these properties will be intercepted by proposed area drains 1,2,3 and 4. The drainage area in the study should be expanded to include these additional areas.

***A&M Response*: The roof area and downspouts from 85-87 Merrimac Street (Pure Bliss) have been included to the watershed area. Only half of the roof area from this building enters the site. There are gutters and downspouts on both sides of the building. Regarding 92 Pleasant Street, based on a site inspection, we suggest that only a portion of this site flows onto the project area. There is a grass berm and solid wooden fence partially embedded along the rear lot line. We do agree that a portion of the Market Street Trust site flows onto the project area. The Watershed Maps and HydroCAD model have been revised to include this changes.**

CSI Comment: The time of concentration for both the existing and proposed conditions was assumed to be 5 minutes. The volume of water generated by a storm from a piece of property is determined by the type of ground cover. The rate at which the water leaves a site is determined by the time of concentration. The shorter the time of concentration the greater the peak rate of flow the longer time of concentration leads to a more gradual flow rate. More accurate times of concentration should be calculated using the tools available in the HydroCAD program and the peak rates of flow recalculated with the new drainage areas.

***A&M Response*: The time of concentration for both the existing and proposed conditions has been revised as requested. The travel paths have been added to the Watershed Maps (Sheets WS-1 and WS-2)**

Should you have any questions or require additional information, please feel free to call our office.

Very Truly Yours,
ALLEN & MAJOR ASSOCIATES, INC.

Brian D. Jones, PE
Senior Project Manager

Attachments:
1. NBPT parking garage Drainage Summary, Revision 1, dated October 27, 2017
2. NBPT parking garage Civil Site Plan, Revised per Peer Review, dated October 27, 2017

ALLEN & MAJOR
ASSOCIATES, INC.

October 27, 2017

Andrew R. Port
Director of Planning & Development
City of Newburyport
60 Pleasant Street
Newburyport, MA 01950

RE: A&M Project # 1873-03
MVRTA Newburyport –
Intermodal Parking Facility
Drainage Summary – Revision 1

Dear Mr. Port,

On behalf of our client, Desman Design Management, Allen & Major Associates, Inc. (A&M) is pleased to submit this revised stormwater summary to address the site improvements proposed at #63-83 Merrimac Street and #90 Pleasant Street. The intent of this summary is to illustrate the proposed stormwater runoff to the municipal drainage system.

The project includes the demolition of the existing structures and the construction of a multi-level parking facility and off-site improvements. The off-site improvements include the construction of new sidewalks and landscaped islands along the frontage of the project. The proposed design will remove approximately 6,000 square feet of impervious area through the installation of these new landscaped islands.

Storm water quality treatment for the roof level of the parking garage is achieved using a proprietary separator (Stormceptor 450i), which will provide TSS removal prior to discharge from the garage. The Stormceptor is located within the ground floor level. The stormwater quality within Titcomb Street will be improved over the existing conditions by taking one of the existing flow-through catch basins "off-line" and installing a drain manhole. All of the proposed catch basins within Merrimac Street and Titcomb Street will have deep sumps and hooded outlets.

The overall drainage area is the same in the existing and proposed conditions (see attached watershed plans WS-1 & WS-2). There is a shift in watershed areas due to the proposed construction of the garage. A portion of Watershed 1 is redirected towards the Titcomb Street drainage system. The result is a decrease in stormwater runoff towards the northwest (towards Route 1) and an increase in runoff towards the northeast (Titcomb Street). Overall, there is a decrease in runoff from the project area due to the added landscaping and green space. The small increase in runoff to the Titcomb Street drainage system has been reviewed by City Staff and determined to be acceptable.

The methodology in determining the runoff characteristics is NRCS; TR-20, Type III rainfalls (2, 10, 25, and 100 year events). All pertinent calculations represented in the following tables were developed utilizing HydroCAD Stormwater modeling software. The tables on the following page summarize the resulting values of the stormwater runoff model.

Design Storm	Flow to Study Point 1 Merrimac Street		
	Existing	**Proposed**	**Change**
	cfs	**cfs**	**cfs**
2yr	1.38	0.46	-0.92
10yr	2.15	0.73	-1.42
25yr	2.76	0.94	-1.82
100yr	4.02	1.38	-2.64

Design Storm	Flow to Study Point 2 Merrimac & Titcomb Street		
	Existing	**Proposed**	**Change**
	cfs	**cfs**	**cfs**
2yr	2.30	2.96	+0.66
10yr	3.59	4.70	+1.11
25yr	4.61	6.09	+1.48
100yr	6.71	8.93	+2.22

Should you have any questions or require additional information, please feel free to call our office.

Very Truly Yours,
ALLEN & MAJOR ASSOCIATES, INC.

Brian D. Jones, PE
Senior Project Manager

Attachments:
Extreme Precipitation Tables
NRCS Soil Report
Pre-Development Hydro CAD Report, revised 10-27-17
Post-Development Hydro CAD Report, revised 10-27-17
Existing Watershed Map (WS-1), revised 10-27-17
Proposed Watershed Map (WS-2), revised 10-27-17
Operations and Maintenance Plan
Stormceptor Sizing Report, revised 10-27-17

Extreme Precipitation Tables

Northeast Regional Climate Center

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

Smoothing	Yes
State	Massachusetts
Location	
Longitude	70.874 degrees West
Latitude	42.812 degrees North
Elevation	0 feet
Date/Time	Tue, 25 Apr 2017 15:28:12 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.27	0.41	0.51	0.67	0.83	1.06	**1yr**	0.72	0.99	1.23	1.59	2.06	2.70	2.99	**1yr**	2.39	2.88	3.31	4.01	4.69	**1yr**
2yr	0.33	0.51	0.63	0.83	1.04	1.33	**2yr**	0.90	1.21	1.54	1.97	2.52	3.23	3.61	**2yr**	2.86	3.47	3.98	4.73	5.39	**2yr**
5yr	0.39	0.60	0.76	1.01	1.29	1.66	**5yr**	1.12	1.52	1.95	2.50	3.20	4.13	4.63	**5yr**	3.65	4.45	5.12	6.04	6.80	**5yr**
10yr	0.43	0.68	0.86	1.17	1.52	1.97	**10yr**	1.31	1.80	2.32	3.00	3.86	4.96	5.60	**10yr**	4.39	5.39	6.21	7.28	8.11	**10yr**
25yr	0.51	0.81	1.03	1.42	1.89	2.47	**25yr**	1.63	2.26	2.93	3.80	4.92	6.34	7.21	**25yr**	5.61	6.93	8.00	9.32	10.24	**25yr**
50yr	0.58	0.92	1.18	1.65	2.22	2.94	**50yr**	1.92	2.68	3.50	4.56	5.91	7.63	8.72	**50yr**	6.76	8.39	9.69	11.23	12.22	**50yr**
100yr	0.65	1.05	1.36	1.92	2.62	3.51	**100yr**	2.26	3.19	4.19	5.48	7.12	9.20	10.56	**100yr**	8.14	10.16	11.75	13.55	14.58	**100yr**
200yr	0.74	1.21	1.57	2.24	3.09	4.17	**200yr**	2.67	3.79	5.00	6.57	8.56	11.09	12.79	**200yr**	9.81	12.30	14.25	16.35	17.42	**200yr**
500yr	0.88	1.45	1.90	2.75	3.85	5.25	**500yr**	3.32	4.77	6.32	8.36	10.93	14.21	16.48	**500yr**	12.57	15.84	18.39	20.97	22.04	**500yr**

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.24	0.36	0.44	0.60	0.73	0.87	**1yr**	0.63	0.86	0.99	1.32	1.65	2.52	2.62	**1yr**	2.23	2.52	2.98	3.57	4.28	**1yr**
2yr	0.32	0.49	0.61	0.82	1.01	1.21	**2yr**	0.88	1.19	1.39	1.83	2.34	3.18	3.54	**2yr**	2.81	3.41	3.90	4.63	5.31	**2yr**
5yr	0.37	0.56	0.70	0.96	1.22	1.45	**5yr**	1.05	1.42	1.64	2.12	2.73	3.86	4.33	**5yr**	3.42	4.17	4.80	5.67	6.40	**5yr**
10yr	0.41	0.62	0.77	1.08	1.40	1.67	**10yr**	1.21	1.63	1.85	2.39	3.06	4.48	5.04	**10yr**	3.96	4.85	5.61	6.55	7.34	**10yr**
25yr	0.47	0.71	0.89	1.27	1.67	2.00	**25yr**	1.44	1.95	2.16	2.76	3.55	5.41	6.15	**25yr**	4.79	5.92	6.86	7.90	8.79	**25yr**
50yr	0.52	0.79	0.99	1.42	1.91	2.30	**50yr**	1.65	2.25	2.43	3.08	3.96	6.24	7.14	**50yr**	5.52	6.87	7.98	9.11	10.05	**50yr**
100yr	0.59	0.89	1.11	1.60	2.20	2.63	**100yr**	1.90	2.58	2.73	3.44	4.42	7.17	8.27	**100yr**	6.35	7.96	9.29	10.46	11.46	**100yr**
200yr	0.66	0.99	1.25	1.81	2.53	3.03	**200yr**	2.18	2.96	3.06	3.82	4.91	8.24	9.61	**200yr**	7.29	9.24	10.80	12.00	13.06	**200yr**
500yr	0.77	1.15	1.48	2.15	3.06	3.65	**500yr**	2.64	3.57	3.57	4.38	5.66	9.83	11.67	**500yr**	8.70	11.22	13.17	14.28	15.53	**500yr**

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.45	0.55	0.74	0.91	1.09	**1yr**	0.78	1.06	1.31	1.71	2.17	2.89	3.18	**1yr**	2.55	3.06	3.55	4.36	4.99	**1yr**
2yr	0.34	0.53	0.65	0.88	1.09	1.30	**2yr**	0.94	1.27	1.50	1.97	2.51	3.31	3.69	**2yr**	2.93	3.55	4.09	4.90	5.56	**2yr**
5yr	0.42	0.64	0.80	1.09	1.39	1.68	**5yr**	1.20	1.64	1.93	2.54	3.25	4.41	4.94	**5yr**	3.90	4.75	5.48	6.45	7.24	**5yr**
10yr	0.49	0.76	0.94	1.32	1.70	2.06	**10yr**	1.47	2.02	2.35	3.11	3.94	5.50	6.18	**10yr**	4.86	5.94	6.89	8.05	8.90	**10yr**
25yr	0.62	0.95	1.18	1.68	2.21	2.70	**25yr**	1.91	2.64	3.06	4.07	5.11	7.38	8.33	**25yr**	6.53	8.01	9.30	10.79	11.73	**25yr**
50yr	0.74	1.12	1.39	2.00	2.70	3.31	**50yr**	2.33	3.24	3.73	4.99	6.25	9.25	10.44	**50yr**	8.18	10.04	11.72	13.51	14.44	**50yr**
100yr	0.88	1.33	1.66	2.40	3.29	4.06	**100yr**	2.84	3.97	4.56	6.13	7.64	11.62	13.09	**100yr**	10.28	12.59	14.74	16.97	17.79	**100yr**
200yr	1.04	1.57	1.99	2.88	4.01	4.99	**200yr**	3.46	4.88	5.59	7.53	9.33	14.62	16.45	**200yr**	12.94	15.82	18.60	21.30	21.92	**200yr**
500yr	1.32	1.96	2.52	3.66	5.21	6.53	**500yr**	4.50	6.38	7.31	9.93	12.20	19.87	22.25	**500yr**	17.58	21.39	25.22	28.77	29.00	**500yr**

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

Essex County, Massachusetts, Northern Part

April 25, 2017

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

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.

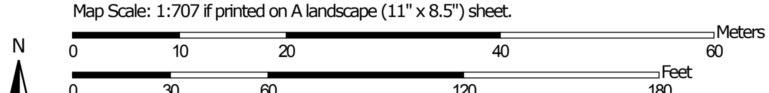
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in 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.

Soil Map

Map Scale: 1:707 if printed on A landscape (11" x 8.5") sheet.



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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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: Essex County, Massachusetts, Northern Part
Survey Area Data: Version 12, Sep 14, 2016

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

Date(s) aerial images were photographed: Mar 30, 2011—Apr 8, 2011

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

Map Unit Legend

Essex County, Massachusetts, Northern Part (MA605)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
602	Urban land	1.3	100.0%
Totals for Area of Interest		**1.3**	**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.

Essex County, Massachusetts, Northern Part

602—Urban land

Map Unit Setting

National map unit symbol: vjx3
Frost-free period: 125 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Excavated and filled land

Minor Components

Udorthents

Percent of map unit: 10 percent
Hydric soil rating: No

Charlton

Percent of map unit: 2 percent
Hydric soil rating: No

Hinckley

Percent of map unit: 2 percent
Hydric soil rating: No

Merrimac

Percent of map unit: 2 percent
Hydric soil rating: No

Paxton

Percent of map unit: 2 percent
Hydric soil rating: No

Windsor

Percent of map unit: 2 percent
Hydric soil rating: No

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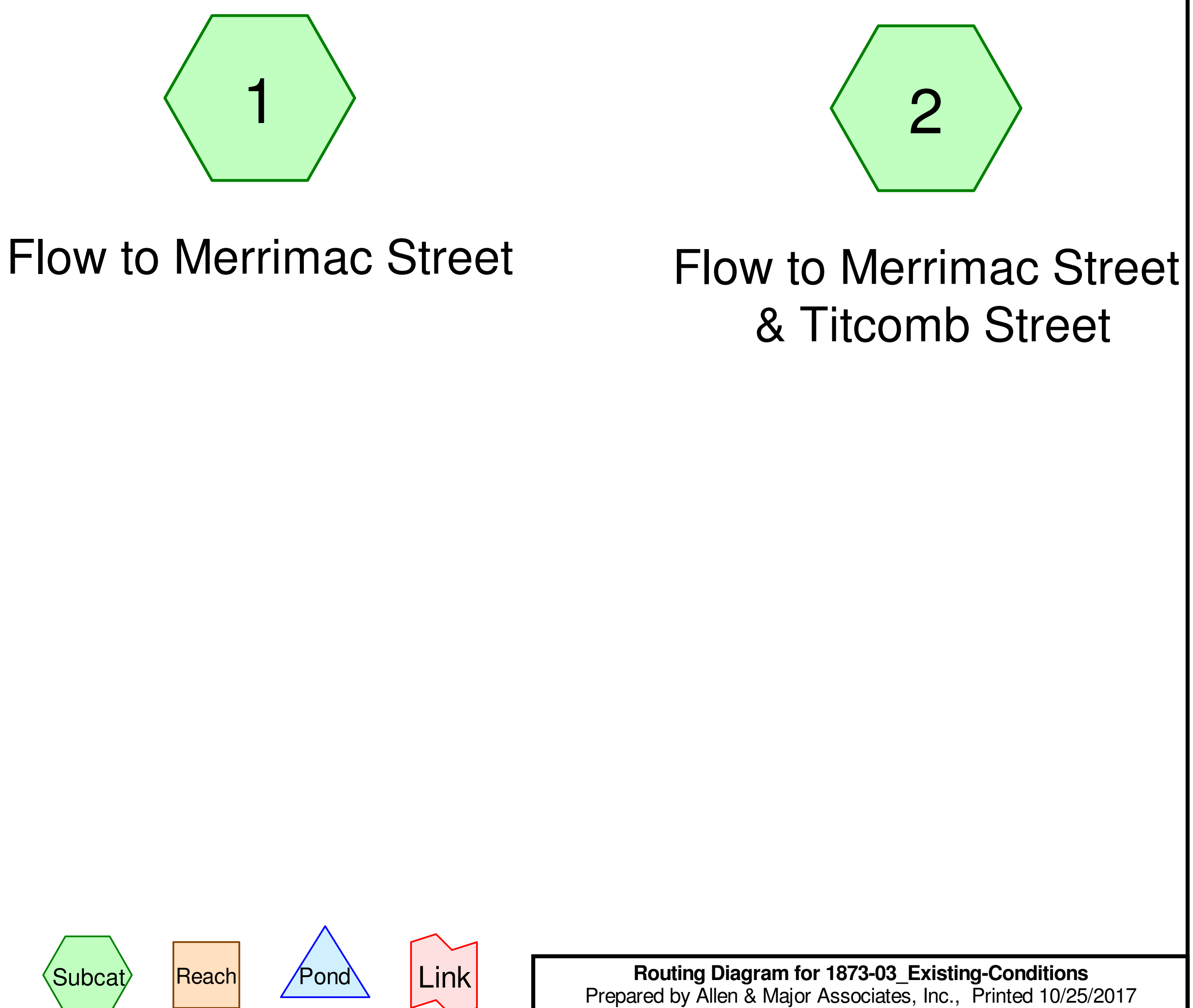


Routing Diagram for 1873-03_Existing-Conditions
Prepared by Allen & Major Associates, Inc., Printed 10/25/2017

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.025	68	>75% Grass cover, Good, HSG B/C (1, 2)
0.116	96	Gravel surface, HSG B/C (1)
0.959	98	Pavement (1, 2)
0.295	98	Rooftop (1, 2)
1.395	**97**	**TOTAL AREA**

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=21,755 sf 75.29% Impervious Runoff Depth>2.51"
Flow Length=253' Tc=1.7 min CN=97 Runoff=1.38 cfs 0.104 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=39,031 sf 98.01% Impervious Runoff Depth>2.50"
Flow Length=319' Tc=5.3 min CN=97 Runoff=2.30 cfs 0.187 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.291 af Average Runoff Depth = 2.50"
10.12% Pervious = 0.141 ac 89.88% Impervious = 1.254 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 1.38 cfs @ 15.03 hrs, Volume= 0.104 af, Depth> 2.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 2-Year (NRCC) Rainfall=3.23"

	Area (sf)	CN	Description
*	326	68	>75% Grass cover, Good, HSG B/C
*	5,049	96	Gravel surface, HSG B/C
*	1,914	98	Rooftop
*	14,466	98	Pavement
	21,755	97	Weighted Average
	5,375		24.71% Pervious Area
	16,380		75.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0200	1.14		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 3.23"
0.6	115	0.0450	3.42		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.5	100	0.0280	3.40		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
1.7	253	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 2.30 cfs @ 15.08 hrs, Volume= 0.187 af, Depth> 2.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 2-Year (NRCC) Rainfall=3.23"

	Area (sf)	CN	Description
*	777	68	>75% Grass cover, Good, HSG B/C
*	10,943	98	Rooftop
*	27,311	98	Pavement
	39,031	97	Weighted Average
	777		1.99% Pervious Area
	38,254		98.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.0500	0.21		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.5	132	0.0450	4.31		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
1.2	142	0.0100	2.03		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
5.3	319	Total			

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=21,755 sf 75.29% Impervious Runoff Depth>4.00"
Flow Length=253' Tc=1.7 min CN=97 Runoff=2.15 cfs 0.166 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=39,031 sf 98.01% Impervious Runoff Depth>3.99"
Flow Length=319' Tc=5.3 min CN=97 Runoff=3.59 cfs 0.298 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.464 af Average Runoff Depth = 3.99"
10.12% Pervious = 0.141 ac 89.88% Impervious = 1.254 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 2.15 cfs @ 15.03 hrs, Volume= 0.166 af, Depth> 4.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 10-Year (NRCC) Rainfall=4.96"

	Area (sf)	CN	Description
*	326	68	>75% Grass cover, Good, HSG B/C
*	5,049	96	Gravel surface, HSG B/C
*	1,914	98	Rooftop
*	14,466	98	Pavement
	21,755	97	Weighted Average
	5,375		24.71% Pervious Area
	16,380		75.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0200	1.14		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 3.23"
0.6	115	0.0450	3.42		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.5	100	0.0280	3.40		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
1.7	253	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 3.59 cfs @ 15.08 hrs, Volume= 0.298 af, Depth> 3.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 10-Year (NRCC) Rainfall=4.96"

	Area (sf)	CN	Description
*	777	68	>75% Grass cover, Good, HSG B/C
*	10,943	98	Rooftop
*	27,311	98	Pavement
	39,031	97	Weighted Average
	777		1.99% Pervious Area
	38,254		98.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.0500	0.21		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.5	132	0.0450	4.31		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
1.2	142	0.0100	2.03		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
5.3	319	Total			

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=21,755 sf 75.29% Impervious Runoff Depth>5.18"
Flow Length=253' Tc=1.7 min CN=97 Runoff=2.76 cfs 0.216 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=39,031 sf 98.01% Impervious Runoff Depth>5.17"
Flow Length=319' Tc=5.3 min CN=97 Runoff=4.61 cfs 0.386 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.602 af Average Runoff Depth = 5.18"
10.12% Pervious = 0.141 ac 89.88% Impervious = 1.254 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 2.76 cfs @ 15.03 hrs, Volume= 0.216 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 25-Year (NRCC) Rainfall=6.34"

	Area (sf)	CN	Description
*	326	68	>75% Grass cover, Good, HSG B/C
*	5,049	96	Gravel surface, HSG B/C
*	1,914	98	Rooftop
*	14,466	98	Pavement
	21,755	97	Weighted Average
	5,375		24.71% Pervious Area
	16,380		75.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0200	1.14		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 3.23"
0.6	115	0.0450	3.42		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.5	100	0.0280	3.40		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
1.7	253	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 4.61 cfs @ 15.08 hrs, Volume= 0.386 af, Depth> 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 25-Year (NRCC) Rainfall=6.34"

	Area (sf)	CN	Description
*	777	68	>75% Grass cover, Good, HSG B/C
*	10,943	98	Rooftop
*	27,311	98	Pavement
	39,031	97	Weighted Average
	777		1.99% Pervious Area
	38,254		98.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.0500	0.21		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.5	132	0.0450	4.31		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
1.2	142	0.0100	2.03		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
5.3	319	Total			

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=21,755 sf 75.29% Impervious Runoff Depth>7.62"
Flow Length=253' Tc=1.7 min CN=97 Runoff=4.02 cfs 0.317 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=39,031 sf 98.01% Impervious Runoff Depth>7.61"
Flow Length=319' Tc=5.3 min CN=97 Runoff=6.71 cfs 0.569 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.886 af Average Runoff Depth = 7.62"
10.12% Pervious = 0.141 ac 89.88% Impervious = 1.254 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 4.02 cfs @ 15.03 hrs, Volume= 0.317 af, Depth> 7.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 100-Year (NRCC) Rainfall=9.20"

	Area (sf)	CN	Description
*	326	68	>75% Grass cover, Good, HSG B/C
*	5,049	96	Gravel surface, HSG B/C
*	1,914	98	Rooftop
*	14,466	98	Pavement
	21,755	97	Weighted Average
	5,375		24.71% Pervious Area
	16,380		75.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.6	38	0.0200	1.14		**Sheet Flow, A to B** Smooth surfaces n= 0.011 P2= 3.23"
0.6	115	0.0450	3.42		**Shallow Concentrated Flow, B to C** Unpaved Kv= 16.1 fps
0.5	100	0.0280	3.40		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
1.7	253	Total			

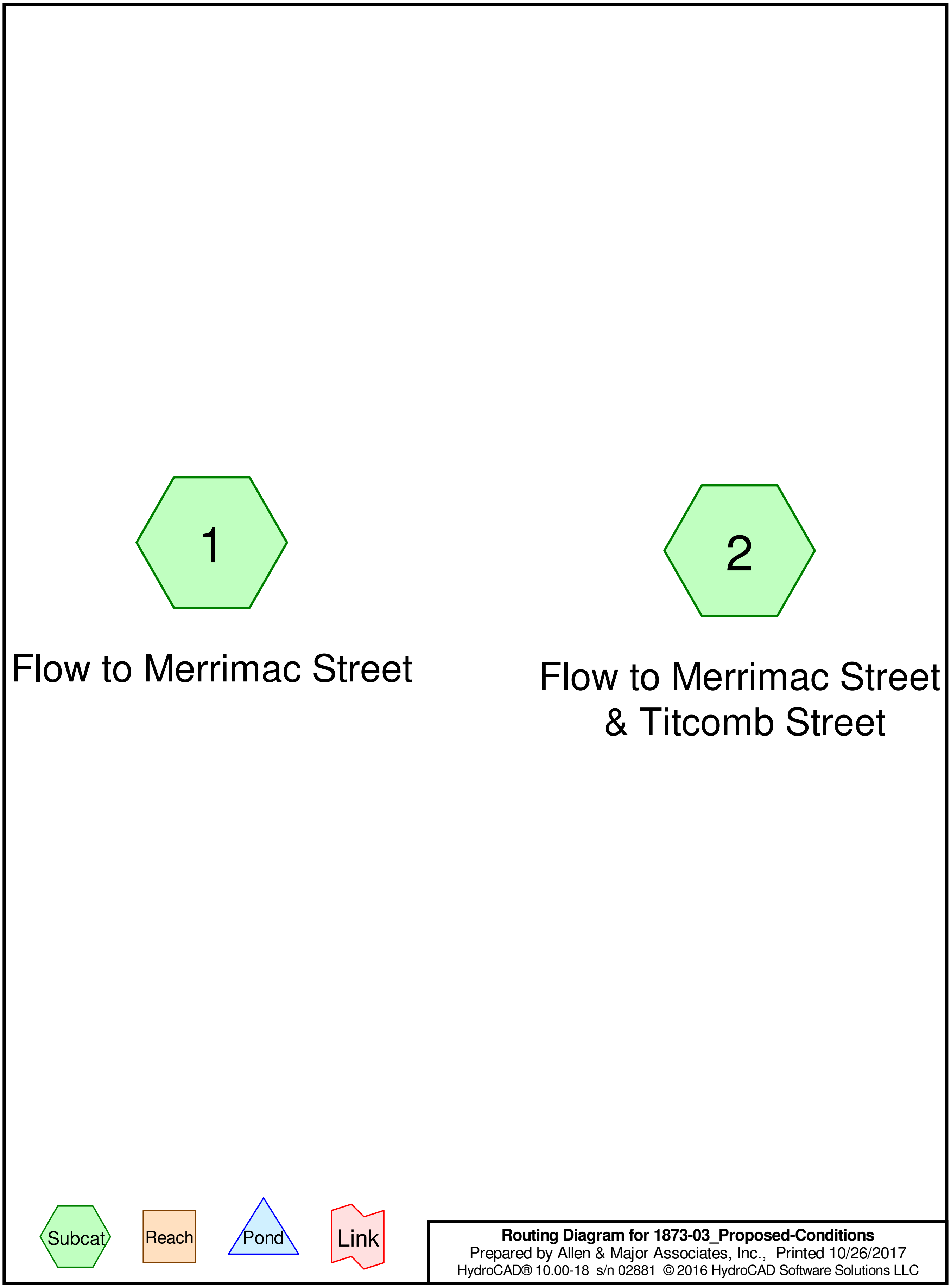
Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 6.71 cfs @ 15.08 hrs, Volume= 0.569 af, Depth> 7.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 100-Year (NRCC) Rainfall=9.20"

	Area (sf)	CN	Description
*	777	68	>75% Grass cover, Good, HSG B/C
*	10,943	98	Rooftop
*	27,311	98	Pavement
	39,031	97	Weighted Average
	777		1.99% Pervious Area
	38,254		98.01% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.6	45	0.0500	0.21		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.5	132	0.0450	4.31		**Shallow Concentrated Flow, B to C** Paved Kv= 20.3 fps
1.2	142	0.0100	2.03		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
5.3	319	Total			



Routing Diagram for 1873-03_Proposed-Conditions
Prepared by Allen & Major Associates, Inc., Printed 10/26/2017
HydroCAD® 10.00-18 s/n 02881 © 2016 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.545	98	Garage Roof Level (2)
0.170	96	Gravel surface, HSG B/C (2)
0.150	68	Landscape Area, HSG B/C (1, 2)
0.530	98	Pavement (1, 2)
1.395	**95**	**TOTAL AREA**

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=8,147 sf 88.67% Impervious Runoff Depth>2.31"
Flow Length=135' Tc=5.9 min CN=95 Runoff=0.46 cfs 0.036 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=52,639 sf 75.30% Impervious Runoff Depth>2.31"
Flow Length=267' Tc=5.7 min CN=95 Runoff=2.96 cfs 0.232 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.268 af Average Runoff Depth = 2.31"
22.91% Pervious = 0.320 ac 77.09% Impervious = 1.076 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 0.46 cfs @ 15.09 hrs, Volume= 0.036 af, Depth> 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 2-Year (NRCC) Rainfall=3.23"

	Area (sf)	CN	Description
*	923	68	Landscape Area, HSG B/C
*	7,224	98	Pavement
	8,147	95	Weighted Average
	923		11.33% Pervious Area
	7,224		88.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	35	0.0100	0.10		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.3	100	0.0200	6.33	39.56	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 50.0 & 0.0 '/' Top.W=25.00' n= 0.013
5.9	135	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 2.96 cfs @ 15.08 hrs, Volume= 0.232 af, Depth> 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 2-Year (NRCC) Rainfall=3.23"

	Area (sf)	CN	Description
*	5,609	68	Landscape Area, HSG B/C
*	7,395	96	Gravel surface, HSG B/C
*	23,761	98	Garage Roof Level
*	15,874	98	Pavement
	52,639	95	Weighted Average
	13,004		24.70% Pervious Area
	39,635		75.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.4	45	0.0200	2.12		**Shallow Concentrated Flow, B to C** Grassed Waterway Kv= 15.0 fps
0.1	8	0.0150	2.49		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.3	140	0.0350	8.37	52.34	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
0.1	24	0.0200	7.44	9.14	**Pipe Channel, 15" HDPE** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.7	267	Total			

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=8,147 sf 88.67% Impervious Runoff Depth>3.80"
Flow Length=135' Tc=5.9 min CN=95 Runoff=0.73 cfs 0.059 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=52,639 sf 75.30% Impervious Runoff Depth>3.80"
Flow Length=267' Tc=5.7 min CN=95 Runoff=4.70 cfs 0.382 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.442 af Average Runoff Depth = 3.80"
22.91% Pervious = 0.320 ac 77.09% Impervious = 1.076 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 0.73 cfs @ 15.09 hrs, Volume= 0.059 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 10-Year (NRCC) Rainfall=4.96"

	Area (sf)	CN	Description
*	923	68	Landscape Area, HSG B/C
*	7,224	98	Pavement
	8,147	95	Weighted Average
	923		11.33% Pervious Area
	7,224		88.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	35	0.0100	0.10		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.3	100	0.0200	6.33	39.56	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 50.0 & 0.0 '/' Top.W=25.00' n= 0.013
5.9	135	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 4.70 cfs @ 15.08 hrs, Volume= 0.382 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 10-Year (NRCC) Rainfall=4.96"

	Area (sf)	CN	Description
*	5,609	68	Landscape Area, HSG B/C
*	7,395	96	Gravel surface, HSG B/C
*	23,761	98	Garage Roof Level
*	15,874	98	Pavement
	52,639	95	Weighted Average
	13,004		24.70% Pervious Area
	39,635		75.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.4	45	0.0200	2.12		**Shallow Concentrated Flow, B to C** Grassed Waterway Kv= 15.0 fps
0.1	8	0.0150	2.49		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.3	140	0.0350	8.37	52.34	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
0.1	24	0.0200	7.44	9.14	**Pipe Channel, 15" HDPE** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.7	267	Total			

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=8,147 sf 88.67% Impervious Runoff Depth>4.99"
Flow Length=135' Tc=5.9 min CN=95 Runoff=0.94 cfs 0.078 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=52,639 sf 75.30% Impervious Runoff Depth>4.99"
Flow Length=267' Tc=5.7 min CN=95 Runoff=6.09 cfs 0.502 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.580 af Average Runoff Depth = 4.99"
22.91% Pervious = 0.320 ac 77.09% Impervious = 1.076 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 0.94 cfs @ 15.09 hrs, Volume= 0.078 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 25-Year (NRCC) Rainfall=6.34"

	Area (sf)	CN	Description
*	923	68	Landscape Area, HSG B/C
*	7,224	98	Pavement
	8,147	95	Weighted Average
	923		11.33% Pervious Area
	7,224		88.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	35	0.0100	0.10		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.3	100	0.0200	6.33	39.56	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 50.0 & 0.0 '/' Top.W=25.00' n= 0.013
5.9	135	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 6.09 cfs @ 15.08 hrs, Volume= 0.502 af, Depth> 4.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 25-Year (NRCC) Rainfall=6.34"

	Area (sf)	CN	Description
*	5,609	68	Landscape Area, HSG B/C
*	7,395	96	Gravel surface, HSG B/C
*	23,761	98	Garage Roof Level
*	15,874	98	Pavement
	52,639	95	Weighted Average
	13,004		24.70% Pervious Area
	39,635		75.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.4	45	0.0200	2.12		**Shallow Concentrated Flow, B to C** Grassed Waterway Kv= 15.0 fps
0.1	8	0.0150	2.49		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.3	140	0.0350	8.37	52.34	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
0.1	24	0.0200	7.44	9.14	**Pipe Channel, 15" HDPE** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.7	267	Total			

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

Subcatchment 1: Flow to Merrimac Street Runoff Area=8,147 sf 88.67% Impervious Runoff Depth>7.44"
Flow Length=135' Tc=5.9 min CN=95 Runoff=1.38 cfs 0.116 af

Subcatchment 2: Flow to Merrimac Street & Titcomb Street Runoff Area=52,639 sf 75.30% Impervious Runoff Depth>7.44"
Flow Length=267' Tc=5.7 min CN=95 Runoff=8.93 cfs 0.749 af

Total Runoff Area = 1.395 ac Runoff Volume = 0.865 af Average Runoff Depth = 7.44"
22.91% Pervious = 0.320 ac 77.09% Impervious = 1.076 ac

Summary for Subcatchment 1: Flow to Merrimac Street

Runoff = 1.38 cfs @ 15.09 hrs, Volume= 0.116 af, Depth> 7.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 100-Year (NRCC) Rainfall=9.20"

	Area (sf)	CN	Description
*	923	68	Landscape Area, HSG B/C
*	7,224	98	Pavement
	8,147	95	Weighted Average
	923		11.33% Pervious Area
	7,224		88.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.6	35	0.0100	0.10		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.3	100	0.0200	6.33	39.56	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 50.0 & 0.0 '/' Top.W=25.00' n= 0.013
5.9	135	Total			

Summary for Subcatchment 2: Flow to Merrimac Street & Titcomb Street

Runoff = 8.93 cfs @ 15.08 hrs, Volume= 0.749 af, Depth> 7.44"

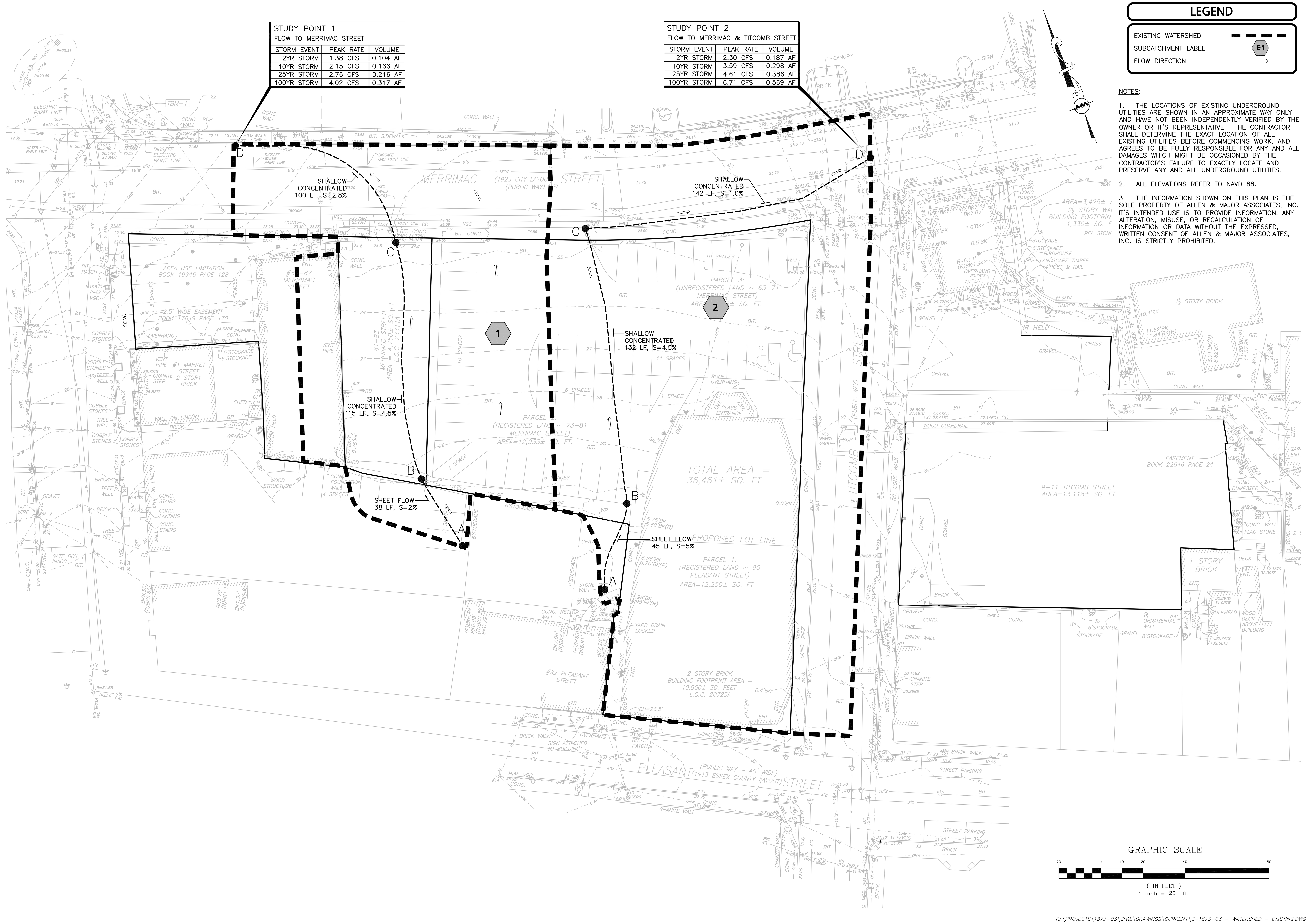
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 30.00 hrs 100-Year (NRCC) Rainfall=9.20"

	Area (sf)	CN	Description
*	5,609	68	Landscape Area, HSG B/C
*	7,395	96	Gravel surface, HSG B/C
*	23,761	98	Garage Roof Level
*	15,874	98	Pavement
	52,639	95	Weighted Average
	13,004		24.70% Pervious Area
	39,635		75.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	50	0.0300	0.17		**Sheet Flow, A to B** Grass: Short n= 0.150 P2= 3.23"
0.4	45	0.0200	2.12		**Shallow Concentrated Flow, B to C** Grassed Waterway Kv= 15.0 fps
0.1	8	0.0150	2.49		**Shallow Concentrated Flow, C to D** Paved Kv= 20.3 fps
0.3	140	0.0350	8.37	52.34	**Trap/Vee/Rect Channel Flow, Gutter Flow** Bot.W=0.00' D=0.50' Z= 0.0 & 50.0 '/' Top.W=25.00' n= 0.013
0.1	24	0.0200	7.44	9.14	**Pipe Channel, 15" HDPE** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.013
5.7	267	Total			

STUDY POINT 1		
FLOW TO MERRIMAC STREET		
STORM EVENT	PEAK RATE	VOLUME
2YR STORM	1.38 CFS	0.104 AF
10YR STORM	2.15 CFS	0.166 AF
25YR STORM	2.76 CFS	0.216 AF
100YR STORM	4.02 CFS	0.317 AF

STUDY POINT 2		
FLOW TO MERRIMAC & TITCOMB STREET		
STORM EVENT	PEAK RATE	VOLUME
2YR STORM	2.30 CFS	0.187 AF
10YR STORM	3.59 CFS	0.298 AF
25YR STORM	4.61 CFS	0.386 AF
100YR STORM	6.71 CFS	0.569 AF



LEGEND

EXISTING WATERSHED

SUBCATCHMENT LABEL

FLOW DIRECTION

NOTES:

1. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR IT'S REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

2. ALL ELEVATIONS REFER TO NAVD 88.

3. THE INFORMATION SHOWN ON THIS PLAN IS THE SOLE PROPERTY OF ALLEN & MAJOR ASSOCIATES, INC. IT'S INTENDED USE IS TO PROVIDE INFORMATION. ANY ALTERATION, MISUSE, OR RECALCULATION OF INFORMATION OR DATA WITHOUT THE EXPRESSED, WRITTEN CONSENT OF ALLEN & MAJOR ASSOCIATES, INC. IS STRICTLY PROHIBITED.

GRAPHIC SCALE

(IN FEET)
1 inch = 20 ft.

R:\PROJECTS\1873-03\CIVIL\DRAWINGS\CURRENT\C-1873-03 - WATERSHED - EXISTING.DWG

DESMAN Design Management

ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering • land surveying
environmental consulting • landscape architecture
www.allenmajor.com

MVRTA NEWBURYPORT INTERMODAL PARKING FACILITY

NEWBURYPORT, MA

100% CONSTRUCTION DOCUMENTS - BID SET

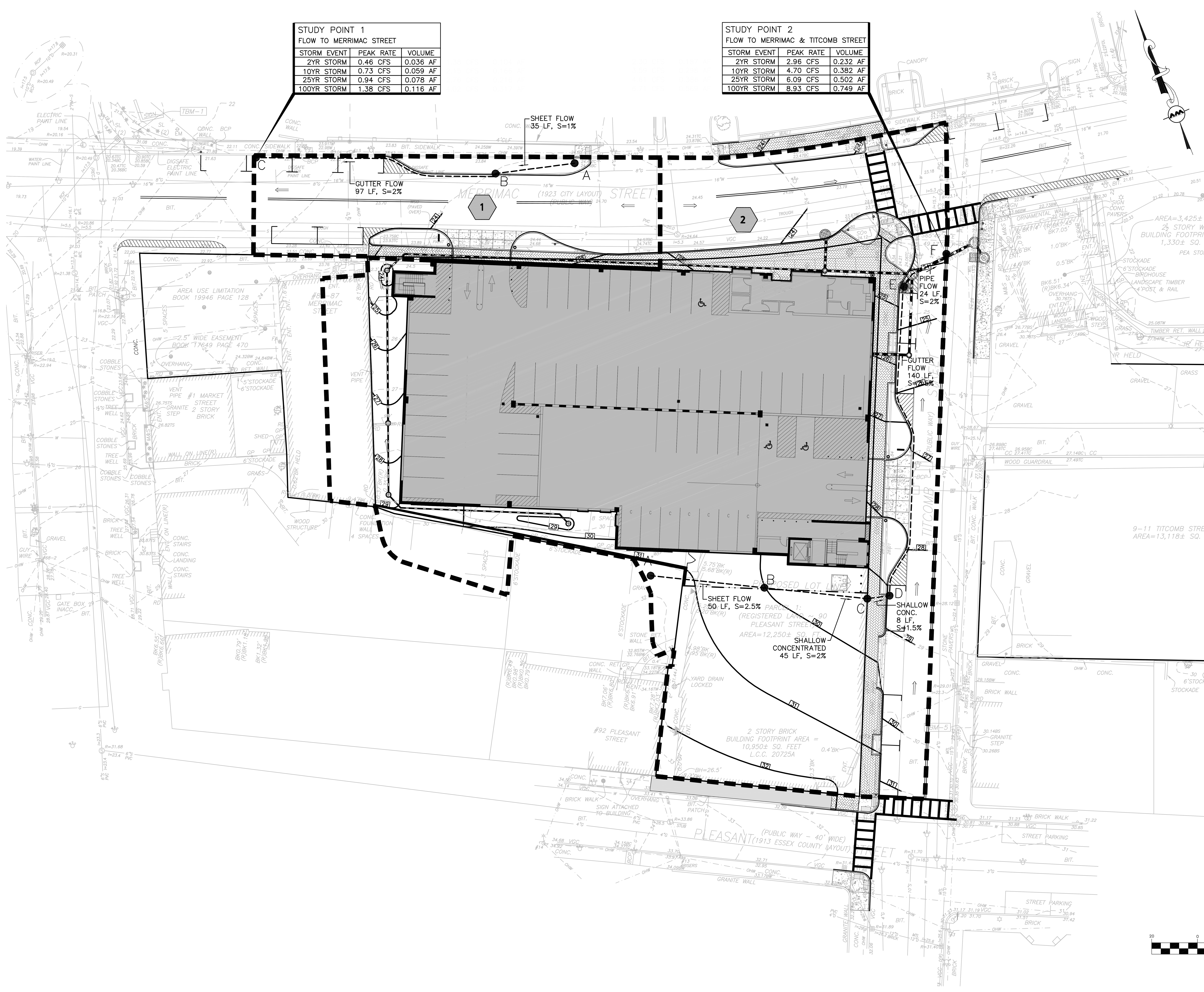
ISSUE		
1	PEER REVIEW	10-27-17
NO.	DESCRIPTION	DATE

DRAWING TITLE:
EXISTING WATERSHED PLAN

DRAWING NO:
WS-1

SCALE: 1"=20'
DATE: 10/09/2017
PROJECT NO: 1873-01 (A&M)

DES.	DRWN.	CHK'D.
BDJ	BDJ	BDJ



STUDY POINT 1
FLOW TO MERRIMAC STREET

STORM EVENT	PEAK RATE	VOLUME
2YR STORM	0.46 CFS	0.036 AF
10YR STORM	0.73 CFS	0.059 AF
25YR STORM	0.94 CFS	0.078 AF
100YR STORM	1.38 CFS	0.116 AF

STUDY POINT 2
FLOW TO MERRIMAC & TITCOMB STREET

STORM EVENT	PEAK RATE	VOLUME
2YR STORM	2.96 CFS	0.232 AF
10YR STORM	4.70 CFS	0.382 AF
25YR STORM	6.09 CFS	0.502 AF
100YR STORM	8.93 CFS	0.749 AF

LEGEND

- PROPOSED WATERSHED
- SUBCATCHMENT LABEL
- FLOW DIRECTION

NOTES:

1. THE LOCATIONS OF EXISTING UNDERGROUND UTILITIES ARE SHOWN IN AN APPROXIMATE WAY ONLY AND HAVE NOT BEEN INDEPENDENTLY VERIFIED BY THE OWNER OR IT'S REPRESENTATIVE. THE CONTRACTOR SHALL DETERMINE THE EXACT LOCATION OF ALL EXISTING UTILITIES BEFORE COMMENCING WORK, AND AGREES TO BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE CONTRACTOR'S FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES.

2. ALL ELEVATIONS REFER TO NAVD 88.

3. THE INFORMATION SHOWN ON THIS PLAN IS THE SOLE PROPERTY OF ALLEN & MAJOR ASSOCIATES, INC. IT'S INTENDED USE IS TO PROVIDE INFORMATION. ANY ALTERATION, MISUSE, OR RECALCULATION OF INFORMATION OR DATA WITHOUT THE EXPRESSED, WRITTEN CONSENT OF ALLEN & MAJOR ASSOCIATES, INC. IS STRICTLY PROHIBITED.

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MVRTA NEWBURYPORT INTERMODAL PARKING FACILITY

NEWBURYPORT, MA

100% CONSTRUCTION DOCUMENTS - BID SET

ISSUE

NO.	DESCRIPTION	DATE
1	PEER REVIEW	10-27-17

DRAWING TITLE:
PROPOSED WATERSHED PLAN

DRAWING NO:
WS-2

SCALE: 1"=20'
DATE: 10/09/2017
PROJECT NO: 1873-01 (A&M)

DES.	DRWN.	CHK'D.
BDJ	BDJ	BDJ

MVRTA Newburyport

Intermodal Parking Facility

Newburyport, MA 01950

ALLEN & MAJOR
ASSOCIATES, INC.

Operation & Maintenance Plan

INTRODUCTION
In accordance with the standards set forth by the Stormwater Management Policy issued by the Department of Environmental Protection (DEP), Allen & Major Associates, Inc. has prepared the following Operation and Maintenance Plan for the redevelopment of #63 through 83 Merrimac Street and #90 Pleasant Street, Newburyport, Massachusetts.

The plan is broken down into three major sections. The first section describes construction-related erosion and sedimentation controls (Construction Period). The second section describes the long term pollution prevention measures (Long Term Pollution Prevention Plan). The third section is a post-construction operation and maintenance plan designed to address the long-term maintenance needs of the stormwater management system (Long Term Maintenance Plan).

NOTIFICATION PROCEDURES FOR CHANGE OF RESPONSIBILITY FOR O&M
The Stormwater Management System (SMS) for this project is operated by the City of Newburyport. The operator shall be responsible for the long-term operation and maintenance of this SMS as outlined in this Operation and Maintenance (O&M) Plan. Should ownership of the SMS change, the owner will continue to be responsible until the succeeding owner has assumed such responsibility.

CONTACT INFORMATION

Stormwater Management System Operator:	City of Newburyport 60 Pleasant Street Newburyport, MA 01950 Phone: (978) 465-4413

Emergency Contact Information:

- o Allen & Major Associates, Inc. (Site Civil Engineer) Phone (603) 627-5500
- o Newburyport Department of Public Services Phone (978) 465-4464
- o Newburyport Fire Department (non-emergency line) Phone (978) 465-4427

CONSTRUCTION PERIOD

1. Install the erosion control measures as shown on the "Site Preparation Plan".

2. All erosion control measures shall be maintained, repaired or replaced as required or at the direction of the owner's engineer, the City Engineer, or the City Conservation Agent.

3. Sediment accumulation up-gradient of the erosion control barrier greater than 6" in depth shall be removed and disposed of in accordance with all applicable regulations.

4. If it appears that sediment is exiting the site, immediate action shall be taken to stop the sediment from exiting the site. Silt sacks shall then be installed in all off-site catch basins adjacent to the site and the on-site erosion and sediment control measures shall be modified to prevent any future sediment from exiting the site.

LONG TERM POLLUTION PREVENTION PLAN

Standard #4 from the MA DEP Stormwater Management Handbook requires that a Long Term Pollution Prevention Plan (LTPPP) be prepared and incorporated as part of the Operation and Maintenance of the Stormwater Management System. The purpose of the LTPPP is to identify potential sources of pollution that may affect the quality of stormwater discharges, and to describe the implementation of practices to reduce the pollutants in stormwater discharges. The following items describe the source control and proper procedures for the LTPPP.

- **SPILL PREVENTION AND RESPONSE**

  Sources of potential spill hazards include vehicle fluids, liquid fuels, pesticides, paints, solvents, and liquid cleaning products. The majority of the spill hazards would likely occur within the building and would not enter the stormwater drainage system. However, there are spill hazards from vehicle fluids or liquid fuels located outside of the buildings. These exterior spill hazards have the potential to enter the stormwater drainage system and are to be addressed as follows:

  1. Spill Hazards of pesticides, paints, and solvents shall be remediated using the Manufacturers' recommended spill cleanup protocol.
  2. Vehicle fluids and liquid fuel spill shall be remediated according to the local and state regulations governing fuel spills.
  3. The owner shall have the following equipment and materials on hand to address a spill clean-up: brooms, dust pans, mops, rags, gloves, absorptive material, sand, sawdust, plastic and metal trash containers.
  4. All spills shall be cleaned up immediately after discovery
  5. Spills of toxic or hazardous material shall be reported, regardless of size, to the Massachusetts Department of Environmental Protection at 888-304-1133.
  6. Should a spill occur, the pollution prevention plan will be adjusted to include measures to prevent another spill of a similar nature. A description of the spill, along with the causes and cleanup measures will be included in the updated pollution prevention plan.

- **MANAGEMENT OF DEICING CHEMICALS AND SNOW**

  Snow will be stored on site, to the extent practicable. The owner's maintenance staff (or its designee) will be responsible for the clearing of the sidewalks and building entrances. The owner may be required to use a de-icing agent such as potassium chloride to maintain a safe walking surface. The de-icing agent for the walkways and building entrances will be kept within the storage rooms located within the building. De-icing agents will not be stored outside. The owner's maintenance staff will limit the application of sand and salt.

LONG TERM MAINTENANCE PLAN – FACILITIES DESCRIPTION

The following is a description of the stormwater management system for the project site.

- **STORMWATER COLLECTION SYSTEM**

  The stormwater runoff from the garage roof level is collected using internally and discharged to a proprietary separator (Stormceptor) within the ground level of the garage. The stormwater discharge connects to the existing municipal drainage system in Titcomb Street.

- **SITE MAINTENANCE**

  A maintenance staff employee shall inspect the site for garbage and other debris on a daily basis. All debris shall be disposed of immediately and in accordance with applicable regulations.

SUPPLEMENTAL INFORMATION (See following pages)

OPERATION & MAINTENANCE SCHEDULE & CHECKLIST
STORMCEPTOR® INSPECTION AND MAINTENANCE GUIDE

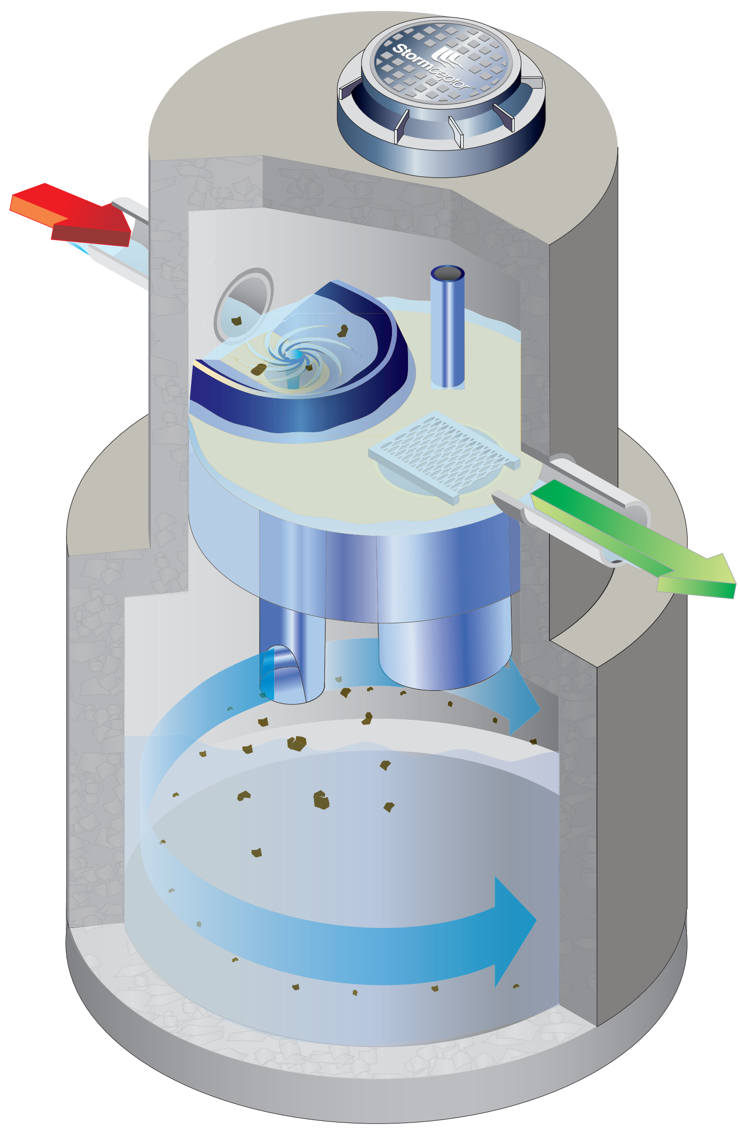
MVRTA NEWBURYPORT INTERMODAL PARKING FACILITY, NEWBURYPORT, MA

OPERATION & MAINTENANCE SCHEDULE & CHECKLIST

Note all cleanouts, anomalies, degradation, and corrections.

Structure or Task	**Maintenance Activity**	**Maintenance Cost/Unit**	**Schedule**	**Estimated Annual Maintenance Cost**	**Inspection Performed By**	
					Date:	By:
Deep sump catch basins	Remove sediment using a vacuum truck before sediment depth is 24".	$250/cleaning for three new catch basins	Annually.	$750		
Proprietary Separator (Stormceptor)	Remove sediment using a vacuum truck before sediment depth is 24". Refer to attached manufacturer's information regarding maintenance procedures.	$250/cleaning for one WQ-BMP	Annually.	$250		
Pavement	Perform vacuum sweeping. Maintain information that confirms the sweeping schedule and that all vacuum sweeps have been disposed in accordance with state and local requirements.	$1500/sweeping for all pavements	Inspect /sweep twice per year (Early spring & late fall)	$3000		

Rinker MATERIALS™



Stormceptor® Owner's Manual

Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942
Canadian Patent No. 2,175,277
Canadian Patent No. 2,180,305
Canadian Patent No. 2,180,338
Canadian Patent No. 2,206,338
Canadian Patent No. 2,327,768
U.S. Patent No. 5,753,115
U.S. Patent No. 5,849,181
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 707,133
Australia Patent No. 729,096
Australia Patent No. 779,401
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Japan Patent No. 9-11476
Korean Patent No. 0519212
New Zealand Patent No. 314,646
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Other Patents Pending

Table of Contents

Congratulations!

Your selection of a Stormceptor® means that you have chosen the most recognized and efficient stormwater oil/sediment separator available for protecting the environment. Stormceptor is a pollution control device often referred to as a “Hydrodynamic Separator (HDS)” or an “Oil Grit Separator (OGS)”, engineered to remove and retain pollutants from stormwater runoff to protect our lakes, rivers and streams from the harmful effects of non-point source pollution.

1 – Stormceptor Overview

Stormceptor is a patented stormwater quality structure most often utilized as a treatment component of the underground storm drain network for stormwater pollution prevention. Stormceptor is designed to remove sediment, total suspended solids (TSS), other pollutants attached to sediment, hydrocarbons and free oil from stormwater runoff. Collectively the Stormceptor provides spill protection and prevents non-point source pollution from entering downstream waterways.

Key benefits of Stormceptor include:

- Removes sediment, suspended solids, debris, nutrients, heavy metals, and hydrocarbons (oil and grease) from runoff and snowmelt.
- Will not scour or re-suspend trapped pollutants.
- Provides sediment and oil storage.
- Provides spill control for accidents, commercial and industrial developments.
- Easy to inspect and maintain (vacuum truck).
- “STORMCEPTOR” is *clearly* marked on the access cover (excluding inlet designs).
- Relatively small footprint.
- 3rd Party tested and independently verified.
- Dedicated team of experts available to provide support.

Model Types:

- STC (Standard)
- EOS (Extended Oil Storage)
- OSR (Oil and Sand Removal)
- MAX (Custom designed unit, specific to site)

Configuration Types:

- Inlet unit (accommodates inlet flow entry, and multi-pipe entry)
- In-Line (accommodates multi-pipe entry)
- Submerged Unit (accommodates the site’s tailwater conditions)
- Series Unit (combines treatment in two systems)

Please Maintain Your Stormceptor

To ensure long-term environmental protection through continued performance as originally designed for your site, **Stormceptor must be maintained**, as any stormwater treatment practice does. The need for maintenance is determined through inspection of the Stormceptor. Procedures for inspection are provided within this document. Maintenance of the Stormceptor is performed from the surface via vacuum truck.

If you require information about Stormceptor, or assistance in finding resources to facilitate inspections or maintenance of your Stormceptor please call your local Rinker Materials Representative or the Stormceptor Information Line at (800) 909-7763.

2 – Stormceptor Operation & Components

Stormceptor is a flexibly designed underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention using patented flow separation technology.

Stormceptor creates a non-turbulent treatment environment below the insert platform within the system. The insert diverts water into the lower chamber, allowing free oils and debris to rise, and sediment to settle under relatively low velocity conditions. These pollutants are trapped and stored below the insert and protected from large runoff events for later removal during the maintenance procedure.

With thousands of units operating worldwide, Stormceptor delivers reliable protection every day, in every storm. The patented Stormceptor design prohibits the scour and release of captured pollutants, ensuring superior water quality treatment and protection during even the most extreme storm events. Stormceptor's proven performance is backed by the longest record of lab and field verification in the industry.

Stormceptor Schematic and Component Functions

Below are schematics of two common Stormceptor configurations with key components identified and their functions briefly described.

Figure 1.

Inline Stormceptor

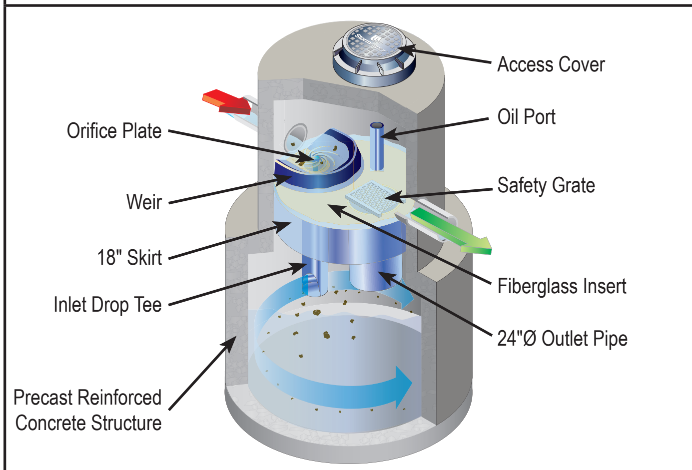
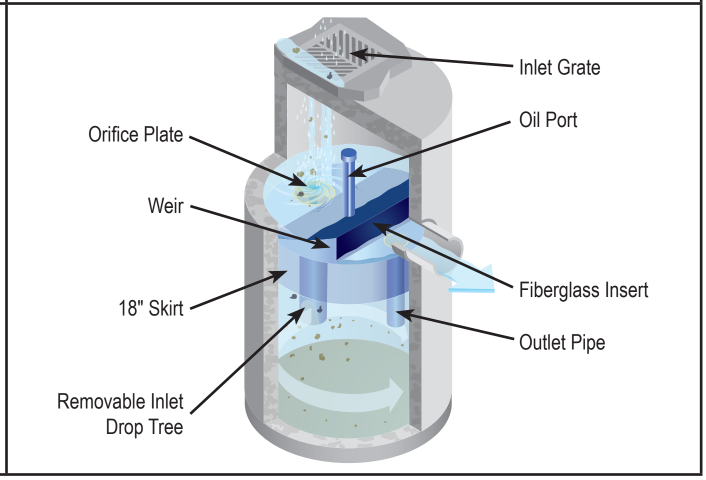


Figure 2.

Inlet Stormceptor



- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower chamber
- **Orifice plate** – prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower chamber
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vacuum line access port for sediment removal
- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

3 – Stormceptor Identification

Stormceptor is available in both precast concrete and fiberglass vessels, with precast concrete often being the dominant material of construction.

In the Stormceptor, a patented, engineered fiberglass insert separates the structure into an upper chamber and lower chamber. The lower chamber will remain full of water, as this is where the pollutants are sequestered for later removal. Multiple Stormceptor model (STC, OSR, EOS and MAX) configurations exist, each to be inspected and maintained in a similar fashion.

Each unit is easily identifiable as a Stormceptor by the trade name "Stormceptor" embossed on each access cover at the surface. To determine the location of "inlet" Stormceptor units with horizontal catch basin inlet, look down into the grate as the Stormceptor insert will be visible. The name "Stormceptor" is not embossed on inlet models due to the variability of inlet grates used/ approved across North America.

Once the location of the Stormceptor is determined, the model number may be identified by comparing the measured depth from the fiberglass insert level at the outlet pipe's invert (water level) to the bottom of the tank using **Table 1**.

In addition, starting in 1996 a metal serial number tag containing the model number has been affixed to the inside of the unit, on the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the unit using depth measurements, please contact your local Rinker Materials Representative for assistance.

Sizes/Models

Typical general dimensions and capacities of the standard precast STC, EOS & OSR Stormceptor models are provided in **Tables 1 and 2**. Typical rim to invert measurements are provided later in this document. The total depth for cleaning will be the sum of the depth from outlet pipe invert (generally the water level) to rim (grade) and the depth from outlet pipe invert to the precast bottom of the unit. Note that depths and capacities may vary slightly between regions.

Table 1. Stormceptor Dimensions – Insert to Base of Structure

STC Model	Insert to Base (in.)
450	60
900	55
1200	71
1800	105
2400	94
3600	134
4800	128
6000	150
7200	134
11000*	128
13000*	150
16000*	134

EOS Model	Insert to Base (in.)
4-175	60
9-365	55
12-590	71
18-1000	105
24-1400	94
36-1700	134
48-2000	128
60-2500	150
72-3400	134
110-5000*	128
130-6000*	150
160-7800*	134

OSR Model	Insert to Base (in.)
65	60
140	55
250	94
390	128
560	134
780*	128
1125*	134

Notes:

1. *Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 2. Storage Capacities

STC Model	Hydrocarbon Storage Capacity gal	Sediment Capacity ft^3	EOS Model	Hydrocarbon Storage Capacity gal	OSR Model	Hydrocarbon Storage Capacity gal	Sediment Capacity ft^3
450	86	46	**4-175**	175	**065**	115	46
900	251	89	**9-365**	365	**140**	233	58
1200	251	127	**12-590**	591			
1800	251	207	**18-1000**	1198			
2400	840	205	**24-1400**	1457	**250**	792	156
3600	840	373	**36-1700**	1773			
4800	909	543	**48-2000**	2005	**390**	1233	465
6000	909	687	**60-2500**	2514			
7200	1059	839	**72-3400**	3418	**560**	1384	690
11000*	2797	1089	**110-5000***	5023	**780***	2430	930
13000*	2797	1374	**130-6000***	6041			
16000*	3055	1677	**160-7800***	7850	**1125***	2689	1378

Notes:

1. *Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

4 – Stormceptor Inspection & Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and is required to insure proper functioning of the Stormceptor. Both inspection and maintenance of the Stormceptor is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, which is approximately 15% of the unit's total storage capacity (see **Table 3**). The frequency should be adjusted based on historical inspection results due to variable site pollutant loading.
- Sediment removal is easier when removed on a regular basis at or prior to the recommended maintenance sediment depths, as sediment build-up can compact making removal more difficult.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

What conditions can compromise Stormceptor performance?

- If construction sediment and debris is not removed prior to activating the Stormceptor unit, maintenance frequency may be reduced.
- If the system is not maintained regularly and fills with sediment and debris beyond the capacity as indicated in **Table 2**, pollutant removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur for the Stormceptor and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor is to be inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins. For typical inspection and maintenance activities, no specific supplemental training is required for the Stormceptor. Information provided within this Manual (provided to the site owner) contains sufficient guidance to maintain the system properly.

In unusual circumstances, such as if a damaged component needs replacement or some other condition requires manned entry into the vessel, confined space entry procedures must be followed. Only professional maintenance service providers trained in these procedures should enter the vessel. Service provider companies typically have personnel who are trained and certified in confined space entry procedures according to local, state, and federal standards.

What equipment is typically required for inspection?

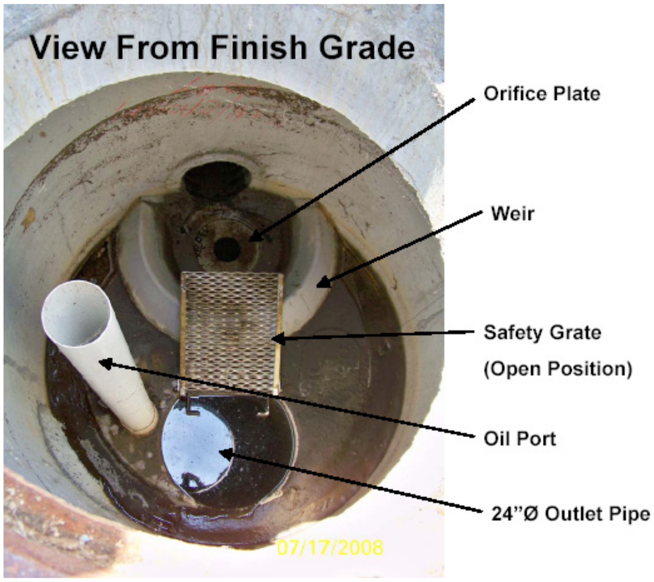
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

Recommended Stormceptor Inspection Procedure:

- Stormceptor is to be inspected from grade through a standard surface manhole access cover.
- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick.
- Oil depth is measured through the oil inspection port, either a 4-inch or 6-inch diameter port.
- Sediment depth can be measured through the oil inspection port or the 24-inch diameter outlet riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

Figure 3.

Figure 4.



What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, hoist and safety harness for specially trained personnel if confined space entry is required

Recommended Stormceptor Maintenance Procedure

Maintenance of Stormceptor is performed using a vacuum truck.

No entry into the unit is required for maintenance. ***DO NOT ENTER THE STORMCEPTOR CHAMBER*** unless you have the proper personal safety equipment, have been trained and are qualified to enter a confined space, as identified by local Occupational Safety and Health Regulations (e.g. 29 CFR 1910.146). Without the proper equipment, training and permit, entry into confined spaces can result in serious bodily harm and potentially death. Consult local and/or state regulations to determine the requirements for confined space entry. Be aware, and take precaution that the Stormceptor fiberglass insert may be slippery. In addition, be aware that some units do not have a safety grate to cover the outlet riser pipe that leads to the submerged, lower chamber.

- Ideally maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is to be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
    - For 6-ft diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch outlet riser pipe (See Fig. 5).
    - For 4-ft diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch drop tee hole (See Fig. 6).

Figure 5.

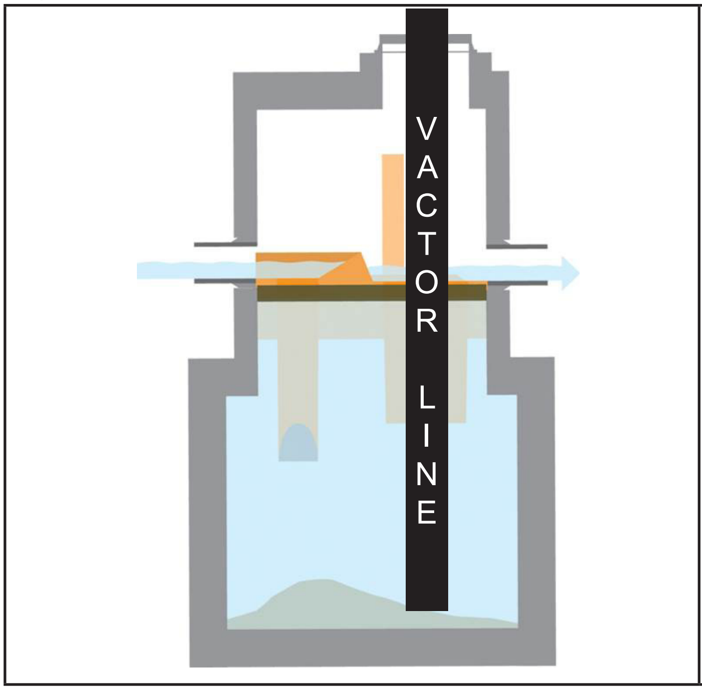
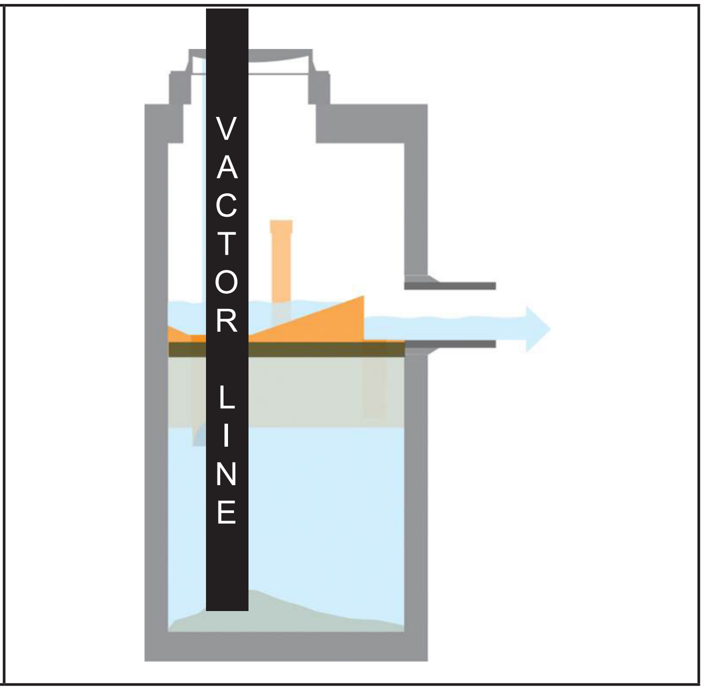


Figure 6.



- Using the vacuum hose, decant the water from the lower chamber into a separate containment tank or to the sanitary sewer, if permitted by the local regulating authority.
- Remove the sediment sludge from the bottom of the unit using the vacuum hose. For large Stormceptor units, a flexible hose is often connected to the primary vacuum line for ease of movement in the lower chamber.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using safe and proper confined space entry procedures.

Figure 7.

Figure 8.

A maintenance worker stationed at the above ground surface uses a vacuum hose to evacuate water, sediment, and debris from the system.

What is required for proper disposal?

The requirements for the disposal of material removed from Stormceptor units are similar to that of any other stormwater treatment Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. This could be site and pollutant dependent. In some cases, approval from the disposal facility operator/agency may be required.

What about oil spills?

Stormceptor is often implemented in areas where there is high potential for oil, fuel or other hydrocarbon or chemical spills. Stormceptor units should be cleaned immediately after a spill occurs by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required in the event of a spill.

What if I see an oil rainbow or sheen at the Stormceptor outlet?

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 hydrocarbon rainbow or sheen can be seen at very small oil concentrations (< 10 ppm). Stormceptor is effective at removing 95% of free oil, and the appearance of a sheen at the outlet with high influent oil concentrations does not mean that 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 or dissolved oil conditions.

What factors affect the costs involved with inspection/maintenance?

The Vacuum Service Industry for stormwater drainage and sewer systems is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean Stormceptor units will vary. Inspection and maintenance costs are most often based on unit size, the number of units on a site, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

What factors predict maintenance frequency?

Maintenance frequency will vary with the amount of pollution on your site (number of hydrocarbon spills, amount of sediment, site activity and use, etc.). It is recommended that the frequency of maintenance be increased or reduced based on local conditions. If the sediment load is high from an unstable site or sediment loads transported from upstream catchments, maintenance may be required semi-annually. Conversely once a site has stabilized, maintenance may be required less frequently (for example: two to seven year, site and situation dependent). Maintenance should be performed immediately after an oil spill or once the sediment depth in Stormceptor reaches the value specified in **Table 3** based on the unit size.

Table 3. Recommended Sediment Depths Indicating Maintenance

STC Model	Maintenance Sediment depth (in)	EOS Model	Maintenance Sediment depth (in)	Oil Storage Depth (in)	OSR Model	Maintenance Sediment depth (in)
450	8	**4-175**	9	24	**065**	8
900	8	**9-365**	9	24	**140**	8
1200	10	**12-590**	11	39		
1800	15					
2400	12	**24-1400**	14	68	**250**	12
3600	17	**36-1700**	19	79		
4800	15	**48-2000**	16	68	**390**	17
6000	18	**60-2500**	20	79		
7200	15	**72-3400**	17	79	**560**	17
11000*	17	**110-5000***	16	68	**780***	17
13000*	20	**130-6000***	20	79		
16000*	17	**160-7800***	17	79	**1125***	17

Note:

1. *The values above are for typical standard units.*

   **Per structure.*

Replacement parts

Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. Therefore, inspection and maintenance activities are generally focused on pollutant removal. However, if replacements parts are necessary, they may be purchased by contacting your local Rinker Materials Representative or the Stormceptor Information Line at (800) 909-7763.

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor's long and effective service life.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: ______________________________

Allowable Sediment Depth: ______________________________

Serial Number: ______________________________

Installation Date: ______________________________

Location Description of Unit: ______________________________

Other Comments: ______________________________

Contact Information

Questions regarding the Stormceptor can be addressed by contacting your Local Rinker Materials representative, the Stormceptor Information Line at (800) 909-7763 or visit our website www.rinkerstormceptor.com.

UNITED STATES

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Email	info@imbriumsystems.com

www.imbriumsystems.com
www.stormceptor.com

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Stormceptor®

Rinker MATERIALS™

Detailed Stormceptor Sizing Report – NBPT Parking Garage roof level

Project Information & Location			
Project Name	NBPT Parking Garage	**Project Number**	1873-03
City	Newburyport	**State/ Province**	Massachusetts
Country	United States of America	**Date**	10/24/2017
Designer Information		**EOR Information (optional)**	
Name	Brian Jones	**Name**	
Company	Allen & Major Associates, Inc.	**Company**	
Phone #	603-627-5500	**Phone #**	
Email	bjones@allenmajor.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	NBPT Parking Garage roof level
Recommended Stormceptor Model	STC 450i
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	84
PSD	Fine Distribution
Rainfall Station	BOSTON WSFO AP

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	84
STC 900	90
STC 1200	90
STC 1800	90
STC 2400	92
STC 3600	93
STC 4800	94
STC 6000	95
STC 7200	96
STC 11000	97
STC 13000	97
STC 16000	98
StormceptorMAX	Custom

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**	10040
Rainfall Station Name	BOSTON WSFO AP	**Total Rainfall (in)**	2457.1
Station ID #	0770	**Average Annual Rainfall (in)**	42.4
Coordinates	42°21'38"N, 71°0'38"W	**Total Evaporation (in)**	230.2
Elevation (ft)	20	**Total Infiltration (in)**	48.1
Years of Rainfall Data	58	**Total Rainfall that is Runoff (in)**	2178.8

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.

Stormceptor®

Rinker MATERIALS™

Drainage Area	
Total Area (acres)	0.54
Imperviousness %	98.0

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)	

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)	21.60
Stormceptor Outlet Invert Elev (ft)	21.50
Stormceptor Rim Elev (ft)	24.50
Normal Water Level Elevation (ft)	21.50
Pipe Diameter (in)	12
Pipe Material	CIP - cast iron
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.

Fine Distribution

Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	NBPT Parking Garage roof level

Site Details

Drainage Area	
Total Area (acres)	0.54
Imperviousness %	98.0

Surface Characteristics	
Width (ft)	307.00
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

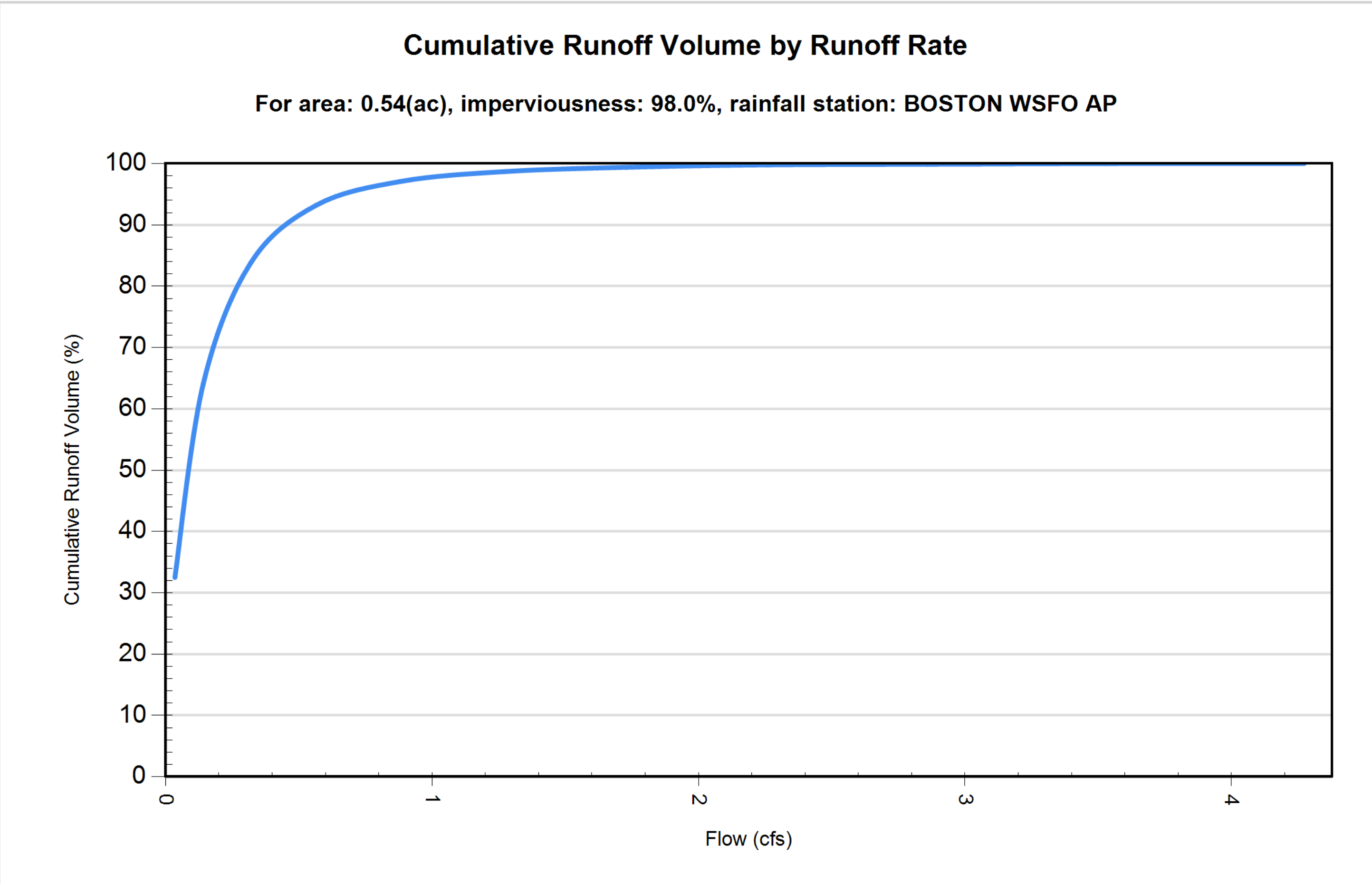
Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	

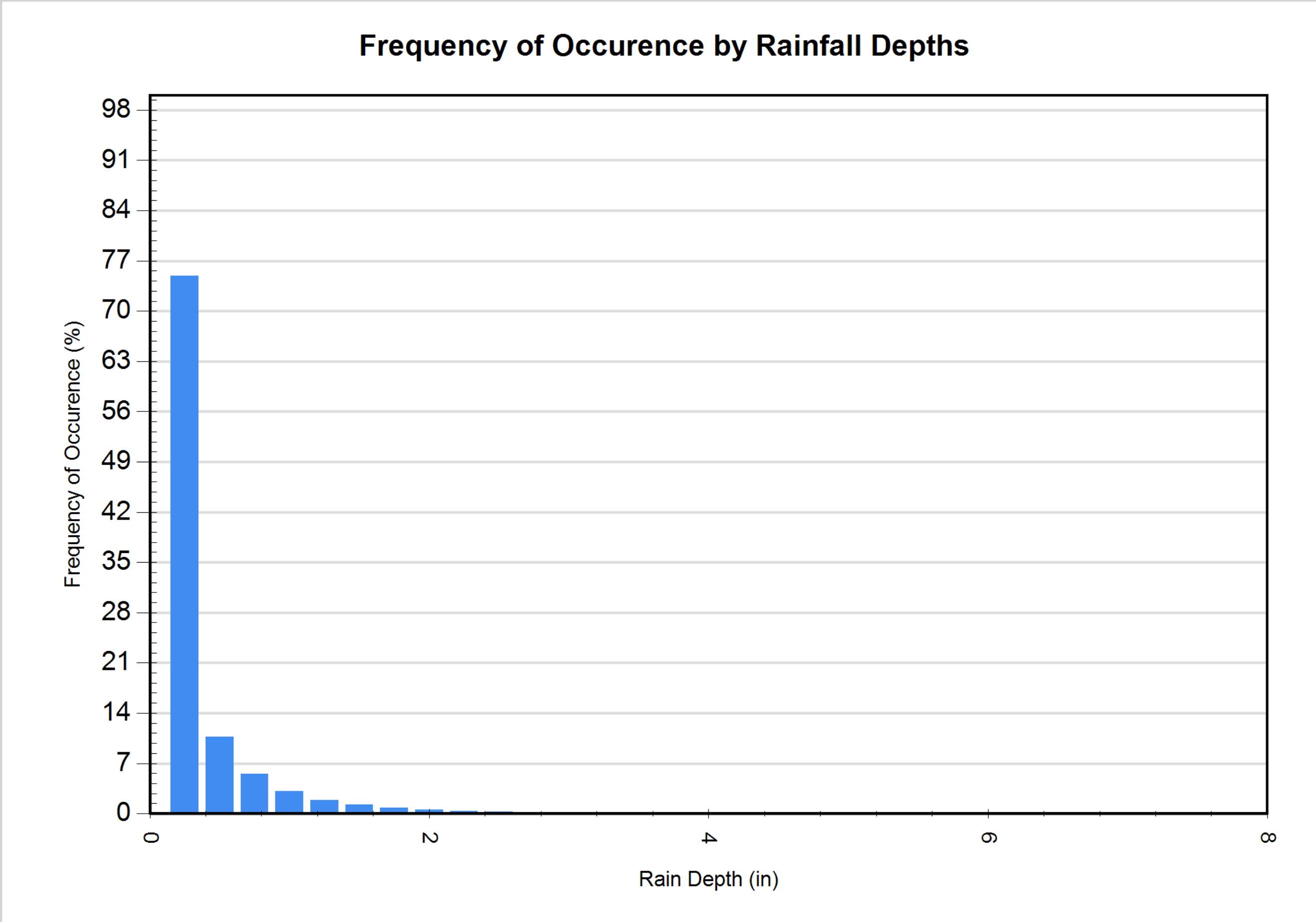
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	
Exponential Buildup Power	
Exponential Washoff Exponent	

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	1439034	2988715	32.5
0.141	2833593	1593552	64.0
0.318	3704758	722449	83.7
0.565	4124107	302628	93.2
0.883	4297362	129374	97.1
1.271	4369113	57567	98.7
1.730	4400365	26304	99.4
2.260	4416550	10107	99.8
2.860	4422620	4037	99.9
3.531	4425877	777	100.0
4.273	4426545	109	100.0



Rainfall Event Analysis				
Rainfall Depth (in)	No. of Events	Percentage of Total Events (%)	Total Volume (in)	Percentage of Annual Volume (%)
0.25	7519	74.9	454	18.5
0.50	1075	10.7	395	16.1
0.75	548	5.5	340	13.9
1.00	315	3.1	274	11.2
1.25	192	1.9	216	8.8
1.50	127	1.3	176	7.2
1.75	84	0.8	136	5.5
2.00	52	0.5	97	3.9
2.25	38	0.4	81	3.3
2.50	28	0.3	67	2.7
2.75	14	0.1	37	1.5
3.00	15	0.1	43	1.7
3.25	4	0.0	12	0.5
3.50	5	0.0	17	0.7
3.75	4	0.0	15	0.6
4.00	2	0.0	8	0.3
4.25	5	0.0	21	0.8
4.50	1	0.0	4	0.2
4.75	1	0.0	5	0.2
5.00	4	0.0	20	0.8
5.25	1	0.0	5	0.2
5.50	0	0.0	0	0.0
5.75	3	0.0	17	0.7
6.00	0	0.0	0	0.0
6.25	2	0.0	12	0.5
6.50	0	0.0	0	0.0
6.75	0	0.0	0	0.0
7.00	0	0.0	0	0.0
7.25	1	0.0	7	0.3
7.50	0	0.0	0	0.0
7.75	0	0.0	0	0.0



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